Interventions for Tobacco Cessation in Adults, Including Pregnant Persons: An Evidence Update for the U.S. Preventive Services Task Force

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Structured Abstract

**Objective:** We undertook this systematic review to support the U.S. Preventive Services Task Force in updating its 2015 recommendation on tobacco cessation interventions for adults, including pregnant women. Our review addressed the effectiveness and safety of pharmacotherapy, behavioral interventions, and electronic cigarettes for tobacco cessation.

**Data Sources:** We conducted an overview of reviews for evidence related to pharmacotherapy and behavioral interventions among the general adult population and for behavioral interventions among pregnant women. We searched the following databases and organizations’ websites to identify existing reviews through April 2018: PubMed, PsycInfo, the Database of Abstracts of Reviews of Effects, the Cochrane Database of Systematic Reviews, the Centre for Reviews and Dissemination Health Technology Assessment, the Agency of Healthcare Research and Quality, the Canadian Agency for Drugs and Technologies in Health, Center for Disease Control and Prevention’s Guide to Community Preventive Services, the Health and Medicine Division of the National Academies of Sciences, Engineering, and Medicine (formerly the Institute of Medicine), the National Health Service Health Technology Assessment Programme, and the Surgeon General. We conducted a search for primary evidence related to the effectiveness and safety of electronic cigarettes (through April 2019) and pharmacotherapy among pregnant women (through April 2019) and did not rely on existing systematic reviews for this evidence. We conducted ongoing surveillance for relevant literature through January 23, 2020.

**Study Selection:** For the overview of reviews, we included reviews with or without meta-analysis that were published in the English language that systematically reported the effects of tobacco cessation interventions on health, cessation, or adverse outcomes. We excluded nonsystematic meta-analyses and narrative reviews. For primary evidence related to the effectiveness and safety of electronic cigarettes among adults and pharmacotherapy among pregnant women, we included randomized controlled trials and large observational studies that reported health or cessation outcomes at 6 months or more followup or adverse events at any time point. For all evidence, we conducted critical appraisal of all provisionally included reviews and excluded reviews rated as having “critically low” credibility according to AMSTAR-2 criteria and individual studies rated as “poor” quality according to study design-specific risk-of-bias criteria. Data were abstracted by one reviewer and confirmed by another.

**Data Analysis:** We grouped reviews based on population and intervention and identified one or more reviews within each population and intervention subgroup that represented the most current and applicable evidence to serve as the basis for the main findings (“primary” reviews) and discussed complementary and discordant findings from other included reviews as necessary. We did not reanalyze any of the individual study evidence but presented pooled analyses and existing point estimates from included reviews. We narratively synthesized the primary evidence for electronic cigarettes among adults and pregnant women and medications for smoking cessation among pregnant women and where appropriate, conducted random-effects meta-analyses to pool study results.

**Results:** We included 67 systematic reviews, 33 of which served as the basis for the primary findings. While this review was broadly scoped to include abstinence of all tobacco products, the
primary outcome in all cases was abstinence from combustible cigarette smoking. Among adults, combined pharmacotherapy and behavioral interventions significantly increased smoking abstinence by 83 percent versus usual care or minimal support control groups not using medication (risk ratio [RR] 1.83 [95% confidence interval [CI], 1.68 to 1.98]). Furthermore, all seven FDA-approved medications for smoking cessation were found to be effective in increasing smoking quit rates compared with placebo or nondrug arms at 6 or more months followup. The pooled RR for abstinence for nicotine replacement therapy (NRT, all forms) was 1.55 (95% CI, 1.49 to 1.61), for bupropion, 1.62 (95% CI, 1.49 to 1.76), and for varenicline, 2.24 (95% CI, 2.06 to 2.43). Combined NRT versus a single form of NRT showed a statistically significantly greater cessation effect (RR 1.25 [95% CI, 1.15 to 1.36]). Pooled analysis of trials directly comparing NRT and bupropion did not suggest a difference between the two types of pharmacotherapy; however, varenicline has been shown to be superior to both NRT and bupropion in achieving abstinence at 6 months or greater, although there are fewer trials testing these differences. Although less evidence is available, certain medications such as nortriptyline and cytisine used for tobacco cessation have shown potential benefits. None of the drugs were associated with serious adverse events, including major cardiovascular adverse events or neuropsychiatric events.

Compared with various controls, behavioral interventions such as in-person advice and support from clinicians including physician advice, nurse advice, individual counseling with a cessation specialist, and group behavioral interventions telephone counseling, mobile phone-based interventions, interactive and tailored internet-based interventions, and the use of incentives had modest but significantly increased relative smoking cessation at 6 or more months (15% to 88% range in relative effects). For example, the pooled RR of physician advice versus no advice was 1.76 (95% CI, 1.58 to 1.96) for smoking cessation at 6 or more months’ followup. There was a lack of clear benefit of motivational interviewing, decision aids, print-based, nontailored self-help materials, real-time video counseling, biofeedback (feedback on smoking exposure, smoking-related disease, or smoking-related harms), exercise, acupuncture, hypnotherapy, and system change interventions compared with controls; however, there was substantially less evidence related to each of these interventions. While some reviews found evidence of potential effect modification by specific intervention, population, or study design characteristics, there was no one factor that consistently predicted greater treatment effects, and nearly every subgroup analysis was found to be statistically significant. Few reviews on behavioral interventions captured information on potential harms, and none suggested serious adverse events that arose.

We identified four trials that addressed the effectiveness and harms of the use of electronic cigarettes among adults. No trials testing the effects of electronic cigarettes for smoking cessation among pregnant women were identified. Results were mixed on smoking cessation effectiveness at 6 to 12 months among smokers intending to quit when compared with placebo devices or nicotine replacement. Four additional trials also reported on potential short-term harms of electronic cigarette use for cessation; none suggested relatively higher rates of serious adverse events.

Among pregnant women, smoking cessation during late pregnancy was greater among women receiving any type of behavioral intervention, with evidence most clear for counseling versus controls (RR 1.31 [95% CI, 1.16 to 1.47]). Behavioral interventions were also associated with an
increase in mean birthweight of babies as well as a decreased risk of low birth weight. We identified no new trials of pharmacotherapy among pregnant women, including no trials testing the effects of bupropion or varenicline in this population. For NRT, rates of validated cessation among women allocated to NRT (5.4% to 28.2%) compared with placebo (5.0% to 25.4%) were not statistically different (pooled RR 1.17 [95% CI, 0.78 to 1.76]). Benefits of NRT on infant health outcomes were seen in a few trials, but that evidence was limited. There was no clear evidence of harms from behavioral interventions or associated with NRT use during pregnancy, but harms also could not be ruled out given sparse reporting, low statistical power for evaluating rare harms, and limitations of observational study comparisons.

**Limitations:** The comprehensiveness of our overview of reviews is limited by the recency and quality of the source reviews; with exceptions, we did not describe or cite individual trials because of the large volume of trials represented in the reviews. Furthermore, there are a limited number of trials testing the benefits and harms of electronic cigarettes among adults as well as the use of medications to assist pregnant women stop smoking. Such sparsity in research hampers our ability to make any robust conclusions about their effectiveness and potential harms.

**Conclusions:** There is strong evidence that a range of pharmacological and behavioral interventions, both individually and in combination, are effective in increasing smoking cessation in adults. Moreover, behavioral interventions can help pregnant women stop smoking. Data on the effectiveness and safety of electronic cigarettes for smoking cessation among adults are limited as are data on the use of tobacco cessation pharmacotherapies among pregnant women. Future research should focus on direct comparisons between different combinations and classes of drugs, the effectiveness of remotely delivered behavioral interventions, and the efficacy and safety of electronic cigarettes.
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Chapter 1. Introduction

Purpose

The Agency for Healthcare Research and Quality (AHRQ) has requested an updated evidence report on tobacco cessation interventions for adults and pregnant women. This report will be used by the United States Preventive Services Task Force (USPSTF) to update its 2015 recommendation on behavioral and pharmacotherapy interventions for tobacco smoking cessation in adults, including pregnant women.¹

Condition Definition

Tobacco is a plant grown for its leaves, which are dried and fermented before being put in tobacco products. Tobacco contains nicotine, an ingredient that can lead to addiction, as well as many other harmful chemicals within the tobacco itself or created by burning it. Tobacco can be consumed in many configurations: in cigarettes, pipes, cigars, cigarillos, little cigars, bidis (tobacco wrapped in tendu or temburni leaves), kreteks (clove cigarettes), and smokeless formats (including chew, snuff including snus, and dissolvable tobacco as strips, sticks, or lozenges), and through a hookah or waterpipe. In addition, effective August 2016, the United States Food and Drug Administration (FDA) extended its regulatory authority to include electronic nicotine delivery systems (ENDS) (e.g., electronic cigarettes [e-cigarettes], e-hookah, e-cigars, vape pens, advanced refillable personal vaporizers, and electronic pipes) as regulated tobacco products under the rationale that the majority of e-cigarettes contain nicotine, which is defined by the Tobacco Control Act as a tobacco-derived product.² One recent study found that 99 percent of e-cigarettes sold in the United States in 2015 contained nicotine.³ In this review, given the regulatory environment in the U.S. regarding e-cigarettes, the use of e-cigarettes is included as both a tobacco product (for which we sought evidence related to quitting e-cigarette use) and as a potential cessation aid (for which we sought evidence related to using e-cigarettes to quit combustible smoking).

Electronic nicotine delivery systems are a diverse group of products that produce a heated aerosol that users inhale from a mouthpiece. Electronic cigarettes (i.e., e-cigarettes or e-cigs) range in design but share certain components: a battery, heating coil, atomizer (transforms e-liquid to an aerosol), cartridge containing the e-liquid, and a mouthpiece. Users draw on the mouthpiece, activate the heating element, and inhale the aerosol. The liquid solution (i.e., e-liquid, juice) contains propylene glycol and/or glycerol (glycerin), with various levels of nicotine (including no nicotine).⁴ Other components of the solution include water, ethanol, and various additives including flavorings that vary among brands in presence and amount.⁴ Early generation devices closely resembled cigarettes and were disposable or partly disposable; second-generation devices (i.e., vape pens) are rechargeable (most have a USB charger) and have customizable looks and tip.⁵ Later designs reflect a diverse set of products that may be square or rectangular and bear little resemblance to cigarettes. Many can be customized by the user and are referred to as modified vape devices (mods).⁵ Box-style mods allow greater customization (e.g., wattage, temperature control) and are generally larger and more powerful than the previous two e-
cigarette types. The more recent generation of e-cigarettes, including JUUL, Suorin and NJOY Ace, retail brands of e-cigarettes shaped like USB drives, are smaller and simpler than mods and are not refillable but use a pod that clicks onto the device to deliver the e-fluid (often referred to as pod mods). These devices typically have higher nicotine concentrations and utilize nicotine salts, which allows for higher levels of nicotine to be more palatably inhaled than free-base nicotine and can increase the rate of nicotine delivery as compared with earlier generations of e-cigarettes.\textsuperscript{6, 7} Sales of JUULs increased markedly from 2015 to 2017, and JUUL is now the largest retail brand of e-cigarettes in the United States, accounting for more than half of the market share in tracked retail channels.\textsuperscript{8, 9} Because e-cigarettes are developed by a variety of manufacturers, the contents vary widely and in some cases are not consistent with product labeling.\textsuperscript{4, 10-12}

Tobacco dependence refers to a psychologic state typified by tolerance and withdrawal where the body is dependent on nicotine for normal function. According to the Diagnostic and Statistical Manual of Mental Disorders (fifth edition, DSM-5), a tobacco use disorder is diagnosed when an individual uses tobacco for more than a year and a minimum of two features that relate to nicotine tolerance, withdrawal symptoms, and social and behavioral factors related to use (e.g., failure to attend to responsibilities and obligations due to tobacco use, continue use despite adverse social or interpersonal consequences).\textsuperscript{13}

**Prevalence and Burden**

Tobacco smoking is the leading preventable cause of disease, disability, and death in the United States. According to a 2014 Surgeon General’s Report, cigarette smoking and exposure to tobacco smoke resulted in more than 480,000 premature deaths annually in the United States.\textsuperscript{14} Combustible cigarette smoking causes various forms of cancer, cardiovascular disease, respiratory disease, and reproductive disorders. Fifty years after the 1964 Surgeon General’s report was published, research continues to identify diseases caused by cigarette smoking, including diabetes mellitus, rheumatoid arthritis, colorectal cancer, erectile dysfunction, tuberculosis, and congenital defects.\textsuperscript{14} In addition to causing multiple diseases, cigarette smoking can cause inflammation and impair immune function.\textsuperscript{14} Smoking during pregnancy is known to be causally related to higher risks of miscarriage, stillbirth, preterm birth, fetal growth restriction, placental abruption, certain congenital anomalies, and impaired lung function in childhood and beyond.\textsuperscript{14-17}

There has been progress over the past several decades in reducing the use of tobacco products by U.S. adults. In 2018, an estimated 19.7 percent (49.1 million) of adults in the United States currently used any tobacco product.\textsuperscript{18} The most commonly used tobacco product was combustible cigarettes (34.2 million; 13.7%). This is the lowest prevalence measured since 1965, when National Health Interview Survey data collection began, and represents a 67 percent decline in cigarette smoking among U.S. adults in those 52 years; however no significant change in cigarette smoking prevalence occurred during 2017 to 2018.\textsuperscript{18, 19} Estimates regarding current use of other tobacco products among adults in 2018 were: cigars, 3.9 percent (9.6 million); e-cigarettes, 3.2 percent (8.1 million); smokeless tobacco, 2.4 percent (5.9 million); and pipes, 1.0 percent (2.6 million). During 2017 to 2018, the prevalence of e-cigarette use increased from 2.8
percent to 3.2 percent \((p=0.029)\) and the prevalence of smokeless tobacco increased from 2.1 to 2.4 percent \((p=0.047)\). In 2017, 3.7 percent of U.S. adults (9.0 million; 19% of tobacco product users) used two or more tobacco products; the most prevalent combinations were cigarettes and e-cigarettes (30.1%), followed by cigarettes and cigars (29.2%). Among current tobacco product users, the proportion who were daily users was 75.0 percent for cigarettes, 58.2 percent for smokeless tobacco, 40.5 percent for e-cigarettes, 12.4 percent for cigars, and 10.6 percent for pipes.

Despite a reduction in tobacco product use in U.S. adults, during 2017-2018, the prevalence of current use of any tobacco product increased by 38 percent among high school students (from 19.6% to 27.1%) and by 29 percent among middle school students (from 5.6% to 7.2%). The increase in tobacco use seen in this time period was driven by the considerable rise in e-cigarette use. Data from the 2011–2018 National Youth Tobacco Survey (NYTS), found that among high school students, current e-cigarette use increased from 1.5 percent in 2011 to 20.8 percent in 2018; with a 78 percent increase just between 2017 (11.7%) to 2018 (20.8%). Similarly, for young adults ages 18 to 24 years, a significant increase in self-reported e-cigarette use was seen between 2017 (5.2%) and 2018 (7.6%) \((\text{difference}, 2.4\% [95\% \text{ CI}, 0.4\% to 4.4\%])\) whereas there was no change among adults aged 25 to 44 years and a nonsignificant decrease in those aged 45 to 64 and 65 and older.

Among adults, persistent disparities in tobacco use exist by age, sex, race/ethnicity, sexual orientation, education, income level, insurance and disability status, psychological status, and region. In 2018, prevalence of tobacco product use was higher among those ages 25 to 44 years (23.8%), 45 to 64 years (21.3%), and 18 to 24 years (17.1%) than among those age ≥65 years (11.9%), and higher among males (25.8%) than females (14.1%). By race and ethnicity, tobacco use prevalence was highest among American Indian/Alaska Natives (32.3%), followed by multiracial adults (25.4%), whites (21.9%), and blacks (19.3%), Hispanics (13.8%), and Asians (10.0%). Prevalence of tobacco use was also higher among adults who were lesbian, gay, or bisexual (29.2%) than among heterosexual adults (19.5%). Prevalence also varied by education and income levels: It was higher among adults who had a GED (41.4%) than among those who had completed any other levels of education (ranging from 25.9% in those without a diploma (0-12 year of education) to 8.2% in those with a graduate degree), and higher among those who had an annual household income of <$35,000 (26.2%) than among those with higher incomes (ranging from 14.3% in those with annual household incomes ≥$100,000 to 21.0% in those with annual household incomes between $35,000 and $74,000). In 2018, there was higher prevalence of tobacco product use among those insured by Medicaid (27.8%) or had other public insurance (23.0%) than among people covered by private health insurance (17.2%) or Medicare only (12.6%). Prevalence was also higher in those who had a disability/limitation (24.30%) than among those who did not (19.3%), as well as those who had serious psychological distress (36.7%), compared with those who did not (19.1%). Additionally, by U.S. region, the Midwest (23.6%) and South (21.4%) had higher prevalence of tobacco product use than the West (15.3%) or Northeast (17.5%).

According to 2016 Behavioral Risk Factor Surveillance System data, e-cigarette use among adults was highest among men (5.9%), young adults ages 18 to 24 (9.2%), respondents identifying as multiracial (9.3%) or American Indian and Alaska Native (7.4%), and those
identifying as lesbian/gay (7%), bisexual (9%) or transgender (8.7%). In addition, respondents with chronic illnesses (cardiovascular disease, diabetes, cancer, asthma, chronic obstructive pulmonary disease, and chronic kidney disease) were more likely to be e-cigarette users than individuals without such conditions. Respondents with depression were particularly more likely to be e-cigarette users as compared with respondents who were not depressed (9.1% vs. 3.9%).

Among pregnant U.S. women who gave birth in 2016, 7.2 percent reported smoking cigarettes while pregnant. The prevalence of smoking during pregnancy was highest among women ages 20 to 24 years (10.7%), followed by women ages 15 to 19 (8.5%) and 25 to 29 years (8.2%). Additionally, prevalence of smoking during pregnancy was highest for women with a high school diploma or GED (12.2%), followed by women with less than a high school diploma (11.7%) and women with some college or an Associate degree (7.9%) while prevalence was lowest among women with a master’s degree of higher (0.4%). Similar to trends in the general adult population, Non-Hispanic American Indian or Alaska Native women had the highest prevalence of smoking during pregnancy (16.7%), followed by white women (10.5%), black (6.0%), Native Hawaiian or other Pacific Islander (4.5%), Hispanic women (1.8%) and Asian women (0.6%). Additionally, from 2014 to 2017, 3.6 percent of pregnant women ages 18 to 44 years reported current use of e-cigarettes, a proportion that was not statistically significantly different among non-pregnant women in the same age group (3.3%).

**Etiology and Natural History**

Initiation of smoking typically begins in early adolescence at an average age of 15 years. Data suggest that smoking prevalence in adolescents increases over time, peaks during young adulthood, and then declines as individuals age. This trajectory may vary, however, given differences in age at initiation of smoking, time to progress to daily smoking, and dependence symptoms. About one-third of individuals who have ever tried smoking become daily smokers. Nicotine dependence generally follows daily smoking, although dependence can develop years after the initiation of daily smoking. Among adolescents, symptoms of dependence have been reported at even low levels of cigarette consumption (e.g., two cigarettes once a week).

Tobacco dependence is a chronic condition and the majority of users make multiple quit attempts before achieving lasting success. According to the NHIS, approximately two-thirds of all people who smoked cigarettes in 2015 (68%) reported they were interested in quitting smoking, and 55.4 percent of these smokers had made a quit attempt during the previous year, although less than one-third had used evidence-based cessation treatments and less than one in 10 were successful in quitting in the previous year. One study estimated that 22 percent of smokers relapsed within 3 months; however, long-term follow-up is recommended because successful quitters remain at risk of relapse for several years after smoking cessation.

Research shows that the appearance of withdrawal symptoms early in the quit-attempt period is negatively associated with the ability to remain abstinent and avoid relapse. On average, a second lapse (i.e., one instance of smoking, even a puff) occurs with 24 hours of the first lapse, and lapse to relapse (i.e., return to one’s baseline level of smoking) occurs 3 to 5 weeks after the cessation attempt. Factors associated with relapse include higher severity of nicotine
dependence, daily smoking onset at younger age, higher number of prior quit attempts, being female, presence of psychiatric symptoms (mainly anxiety and depression symptoms), and higher body mass index. The rate of relapse is inversely related to the duration of continuous abstinence (i.e., the risk of relapse decreases with longer abstinence). For example, one study found the relapse rate among those who achieved up to 11 months of abstinence was consistently above 50 percent, dropping to 36 percent after 2 years of abstinence and 25 percent after 5 years of abstinence, then stabilizing at around 10 percent after 30 years of abstinence.

**Tobacco Cessation Interventions**

Various pharmacological and behavioral methods are available to assist adults quit tobacco use. Behavioral interventions and pharmacotherapy are believed to have complementary modes of action and independently improve the chances of maintaining long-term abstinence.

**Pharmacotherapy Tobacco Cessation Interventions**

Seven FDA-approved over-the-counter (OTC) and prescription medications for treating tobacco dependence are available. These include three OTC nicotine replacement therapy (NRT) products (transdermal nicotine patches, nicotine lozenges, and nicotine gum), two prescription-only nicotine replacement products (nicotine inhaler and nasal spray [Nicotrol®]), and prescription-only bupropion hydrochloride sustained release (Zyban® and generic form; referred to as bupropion hereafter) and varenicline tartrate (Chantix®), neither of which contains nicotine. Although Wellbutrin SR® is not indicated for smoking cessation treatment, it contains the same active ingredient as Zyban®. Other medications are used clinically to treat tobacco dependence, including clonidine (antihypertensive) and nortriptyline (antidepressant), but these are not FDA-approved for smoking cessation. Cytisine, a partial agonist of nicotine acetylcholine receptors, is available both with and without a prescription in eastern and central Europe and is widely available internationally (including in the United States) through online vendors although not FDA-approved.

**Behavioral Tobacco Cessation Interventions**

Specific behavioral interventions include self-help materials (e.g., written materials, videos, audiotapes, computer), phone-based interventions, quit lines, brief provider-delivered interventions (e.g., advice from a physician or nurse), intensive counseling delivered on an individual basis or in a group setting, mobile phone and text-messaging interventions, biomedical risk assessment, and combinations of these approaches. Behavioral interventions generally aim to teach individuals to recognize high-risk situations and develop coping strategies to deal with them. Complementary and alternative therapies, such as acupuncture, acupressure, laser therapy, electrostimulation, hypnotherapy, and the consumption of herbals (e.g., St. John’s wort), have also been used as tobacco cessation aids alone or as adjuncts to other treatments.
Electronic Cigarettes

The rapid increase in the advertising, sales, and use of e-cigarettes among youth has evoked a vigorous debate in the tobacco control community about the public health impact of e-cigarettes, how best to regulate them, and their role in tobacco cessation.\textsuperscript{5, 36} Because e-cigarettes may offer both nicotine replacement and behavioral and sensory aspects similar to conventional cigarettes without the inhalation of tobacco smoke, they have the potential to serve as a tobacco cessation or harm reduction tool when used by smokers.\textsuperscript{37-39} Conversely, when taken up by nonsmokers (generally adolescents and young adults), e-cigarettes may serve as a pathway to nicotine addiction and tobacco smoking.\textsuperscript{14} In addition, significant questions remain regarding the effectiveness of e-cigarettes for tobacco cessation as well as their impact on individual and population health, including the potential for progression to conventional tobacco use among nontobacco users, long-term dual use among current smokers, relapse among former smokers, and the inclusion of harmful or potentially harmful ingredients.\textsuperscript{14, 31, 40-43} E-cigarettes intended for therapeutic purposes (i.e., for cessation use) are subject to FDA regulations. Companies that wish to make such claims must apply to the FDA’s Center for Drug Evaluation and Research.\textsuperscript{44, 45} Currently, no e-cigarettes are approved for therapeutic use as smoking cessation devices.

Current Clinical Practice in the United States

In 2015, 68.0 percent of adult smokers wanted to stop smoking, 55.4 percent made a past-year quit attempt, 7.4 percent recently quit smoking, 57.2 percent had been advised by a health professional to quit, and 31.2 percent used cessation counseling and/or medication when trying to quit.\textsuperscript{28} Among smokers who made quit attempts, 6.8 percent reported using counseling, 29.0 percent reported using medication, and 4.7 percent reported using both. Among those who used counseling, 4.1 percent used a telephone quit line, 2.8 percent used one-on-one counseling, and 2.4 percent used a stop-smoking clinic, class, or support group. Among smokers who used a medication to quit, 16.6 percent reported using a nicotine patch, 12.5 percent used nicotine gum or lozenges, 7.9 percent used varenicline, 2.7 percent used bupropion, and 2.4 percent used a nicotine spray or inhaler.\textsuperscript{28} The rates of counseling and treatment vary modestly depending on patients’ age, race/ethnicity, gender, insurance status, health status, physician status, and physician specialty.\textsuperscript{46, 47} Smokers aged 45–64 years (65.7%) and ≥65 years (65.7%) reported a higher prevalence of receiving advice to quit than did smokers aged 18–24 years (44.4%) and 25–44 years (49.8%).\textsuperscript{47} Lower prevalence of receiving advice to quit were reported by Asian (34.2%), American Indian/Alaska Native (38.1%), and Hispanic (42.2%) smokers than by white smokers (60.2%); and by uninsured smokers (44.1%) than by smokers with any type of insurance (range = 56.8%–69.2%). Smokers reporting a disability/limitation or serious psychological distress reported a higher prevalence of receiving advice to quit than did smokers without these conditions (71.8% and 70.2%, respectively, vs 53.6% and 55.7%).\textsuperscript{28 47, 48} One survey found that patients were more likely to receive counseling from their primary care physician (26.9%) than from other health care providers (15.5%), and internal medicine and cardiovascular disease physicians were more likely to provide tobacco cessation counseling (32.5% and 35.4%, respectively) than family or
obstetrics/gynecology physicians (23.5 and 19.7%). Psychiatrists ordered tobacco cessation prescriptions more than any other specialty (17.7%).

A few physician surveys and qualitative studies suggests that physician screening for e-cigarette use is limited, but report that some physicians recommend the use of e-cigarettes as cessation devices. When surveyed in 2013, two-thirds of a sample of 787 North Carolina physicians indicated that e-cigarettes were a helpful aid for smoking cessation, 13 percent incorrectly believed that e-cigarettes were approved by the FDA for smoking cessation, and 35 percent recommended them to their patients. Conversely, a survey of Kansas family physicians published in 2017 found that 82 percent would not recommend e-cigarettes for smoking cessation. A national survey of primary care physicians, pulmonologists, surgeons, and anesthesiologists conducted in 2015 found that approximately 54.5 percent agreed with a statement that e-cigarettes could help patients quit smoking, and 37.9 percent have at some point recommended electronic cigarettes to their patients that smoke.

Screening for e-cigarette use varies by practice and risk demographics. A 2012 survey of members of the American College of Obstetricians and Gynecologists (ACOG) found that 53 percent of respondents reported screening pregnant women for chewing tobacco, snuff/snus, e-cigarettes, and dissolvables all or some of the time. One study of patient-reported screening prevalence from the 2013–2014 National Survey on Drug Use and Health showed that patients with anxiety, depression, and substance abuse disorders were more likely to be screened for noncigarette tobacco product use (88.6%, 79.6%, and 79.4%, respectively) than respondents with no reported mental health conditions (77.8%).

Recommendations of Others

The 2015 USPSTF recommendation and 2008 Public Health Service (PHS) Guideline (the basis of the 2008 USPSTF recommendation) are endorsed by or are generally consistent with the recommendations of other national and international organizations, including those from the American College of Physicians and American Medical Association, American Family Physicians, and the American Dental Association. The 2020 Surgeon General’s report on Smoking Cessation similarly concluded that smoking cessation medications approved by the FDA and behavioral counseling are cost-effective cessation strategies and increase the likelihood of successfully quitting smoking, particularly when used in combination. In addition, the Community Preventive Services Task Force recommends worksite-based incentives and competitions when these efforts are combined with other individual support interventions, increasing the unit price of tobacco products, mass-reach health communication interventions, quit line interventions, and smoke-free policies to encourage tobacco cessation among adults.

The World Health Organization released recommendations for the prevention of tobacco use during pregnancy in 2013 that were based on an overview of reviews and a panel of experts’ ratings of the quality of the evidence. The panel made a strong recommendation for advice and psychosocial interventions for pregnant women who were smokers. It recommended against the use of bupropion or varenicline for smoking cessation, based on very low-quality evidence, but could not make a recommendation for or against NRT use during pregnancy. Accordingly, a
strong recommendation for further research on pharmacotherapy for smoking cessation during pregnancy was made. ACOG recommendations for smoking cessation during pregnancy are also consistent with the 2015 USPSTF recommendations and the 2008 PHS Guideline.

Several national and professional organizations have issued recent recommendations regarding screening for and use of e-cigarettes among adults. Many recommend that e-cigarette use should be part of tobacco screening questions and that those who smoke or vape should be advised to quit all nicotine products and be provided with tobacco cessation interventions. Recommendations regarding the use of e-cigarettes as an aid for quitting use of other tobacco products (namely combustible cigarettes) are mixed: the 2020 Surgeon General’s report on Smoking Cessation concluded that there is presently inadequate evidence to conclude that e-cigarettes, in general, increase smoking cessation. A recent 2019 American College of Preventive Medicine guideline states that clinicians should advise patients that e-cigarettes are not considered evidence-based smoking cessation therapy; but that a shared-decision making approach may be necessary if patients have failed or refused other therapies and are more willing to try e-cigarettes to cut down or quit smoking. ACOG recommends against the use of e-cigarette products by pregnant and postpartum individuals, children and adolescents, and adults who currently do not use tobacco products. The American Cancer Society (2019) does not recommend the use of e-cigarettes as a cessation method and the American Heart Association concluded in its 2014 position paper that there was not enough evidence for clinicians to counsel their patients to use e-cigarettes as a primary cessation aid. Key policy recommendations by organizations including the AMA, Surgeon General, and the American Association for Cancer Research and the American Society of Clinical Oncology have also been published in support of Federal, State, and local regulation of e-cigarettes, most specifically policies aimed at restricting the sale, distributions, marketing, and advertising of e-cigarettes to youth as well as smoke-free policies that include e-cigarettes.

**Previous USPSTF Recommendation**

In 2015, the USPSTF issued four recommendation statements (Table 1). Two “A” grade recommendations were given for behavioral and pharmacotherapy interventions for adults and for behavioral interventions for pregnant women, whereas two “I” statements were issued for pharmacotherapy interventions for pregnant women and the use of e-cigarettes for tobacco cessation among adults and pregnant women. The 2015 recommendation updated and was consistent with the 2009 and 2003 recommendations. In both years, the USPSTF recommended that clinicians ask all adults about tobacco use and provide interventions for smoking cessation for those who use tobacco products (A recommendation). It also recommended that clinicians ask all pregnant women about tobacco use and provide augmented, pregnancy-tailored counseling for those who smoke (A recommendation). The original USPSTF recommendation (2003) and reaffirmation (2009) were based on the 2000 and 2008 updates of the Public Health Service (PHS) Clinical Practice Guideline “Treating Tobacco Use and Dependence.”
Chapter 2. Methods

Scope and Purpose

This is an update of our 2015 review.\textsuperscript{72,73} Consistent with that review, we relied primarily on an overview of reviews method for this update. In general, an overview of reviews focuses on a broad condition or problem for which there are two or more potential interventions. The overview of reviews approach was the most appropriate approach for our update because of the large number of tobacco cessation trials and the availability of multiple systematic reviews on the subject. To conduct this overview of reviews, we: 1) searched for reviews; 2) selected reviews; 3) assessed the credibility of the reviews; 4) determined the use of reviews; 5) abstracted review details and findings; and 6) synthesized findings across reviews. A typical Analytic Framework, Key Questions (KQs), and inclusion/exclusion criteria are outlined as they relate to the objectives of the overview of reviews. We did not search for original research (with the exceptions noted below), replicate quality rating or data abstraction of original studies, or replicate review-specific meta-analyses.

Evidence for pregnant women was synthesized separately from evidence for the general adult population given the unique health risks of tobacco smoking for both women and children, physiological differences during pregnancy that can affect nicotine withdrawal symptoms, generally higher motivation to quit among pregnant than nonpregnant adults, and the potential different benefits and harms of various cessation treatments.

Given the 2015 USPSTF conclusions of insufficient evidence for 1) the benefits and harms of e-cigarettes for tobacco cessation and 2) the benefits and harms of pharmacologic tobacco cessation interventions among pregnant women, we decided \textit{a priori} to conduct a de novo systematic review (i.e., an original search and synthesis of primary evidence) related to these specific areas. In addition, before initiating our review, we established that we would consider a search for primary research for specific interventions and/or questions if no recent (2014-present) reviews were identified for the topic.

Key Questions and Analytic Framework

With input from the USPSTF, we developed an Analytic Framework (Figure 1) and three KQs, using the USPSTF’s methods to guide the literature search, data abstraction, and data synthesis.

1. Do tobacco cessation interventions improve mortality, morbidity, and other health outcomes in adults who currently use tobacco, including pregnant women?
2. Do tobacco cessation interventions increase tobacco abstinence in adults who currently use tobacco, including pregnant women?
3. What harms are associated with tobacco cessation interventions in adults, including pregnant women?
Data Sources and Searches

We searched the following databases for relevant systematic reviews through April 2019: PubMed, PsycINFO, the Database of Abstracts of Reviews of Effects, the Cochrane Database of Systematic Reviews (CDSR), and the Centre for Reviews and Dissemination Health Technology Assessment (Appendix A). In addition to these database searches, we searched the websites of the following organizations: AHRQ, the Canadian Agency for Drugs and Technologies in Health, CDC’s Guide to Community Preventive Services, Health and Medicine Division of the National Academies (formerly the Institute of Medicine), the NHS Health Technology Assessment Programme, and the U.S. Surgeon General. We restricted our searches to articles in the English language published since January 2014. We also examined the reference lists of all our included reviews to identify other reviews for inclusion. We supplemented our searches with suggestions from experts and reviews identified through news and table-of-contents alerts from sources such as ScienceDirect (Elsevier, Maryland Heights, MO) and Tobacco Control. We also searched for potentially relevant in-process or planned reviews as indicated by review protocols through AHRQ, CDSR, and the Centre for Reviews and Dissemination PROSPERO register.

In addition to the search for reviews, we conducted three separate searches for primary evidence.

The first search was a targeted literature search for studies evaluating the effectiveness and safety of bupropion among adults given that no recent systematic review had been published on this subject. In addition to carrying forward a 2014 review, we systematically searched an existing database maintained by the USPSTF Scientific Resource Center for developing the LitWatch newsletter. We searched the LitWatch database, maintained in EndNote® X9 (Thomson Reuters, New York, NY), to locate relevant evidence from 2012 through January 23, 2020. LitWatch is a regular audit of information sources to locate newly published research and/or guidelines that are relevant to topics in the USPSTF portfolio. A list of included articles and guidelines is compiled in a LitWatch newsletter every 2 months and distributed to the USPSTF Scientific Director, the USPSTF Topic Prioritization Workgroup, and AHRQ medical officers and related staff.

The second search focused on studies addressing the use of e-cigarettes for tobacco cessation. We conducted searches in the following databases: CDSR, Cochrane Central Register of Controlled Clinical Trials (CENTRAL), PsycInfo, PubMed, and Scopus, from January 2014 through April 2019 (Appendix A).

The third search centered on pharmacotherapy tobacco cessation interventions among pregnant women; we conducted searches in Medline, CENTRAL, PubMed, PsycInfo from January 2014 through April 2019 (Appendix A).

We conducted ongoing surveillance for relevant primary literature through January 23, 2020 and for Cochrane systematic reviews through February 28, 2020 and have updated the review with new evidence as it’s been published.

We also reviewed the reference lists of related systematic or narrative reviews to identify studies for potential inclusion and searched ClinicalTrials.gov for relevant ongoing trials that were listed...
as “recruiting,” “active, not recruiting,” “not yet recruiting,” “completed,” or “terminated” to identify any studies underway that might be of relevance for ongoing evaluation.

We imported the literature from these sources directly into EndNote® X9.

**Study Selection**

We developed criteria for inclusion and exclusion of systematic reviews based on our previous review (**Appendix A Table 1**). Generally, we included studies if they were systematic reviews, with or without meta-analysis, that: 1) examined the effectiveness of tobacco cessation interventions for adults and 2) were published in English from January 2014 to present. We included reviews focused on specific interventions (e.g., NRT, group counseling) and specific subpopulations (e.g., persons with serious mental illness). We considered reviews published by Cochrane as well as other non-Cochrane reviews. We excluded nonsystematic narrative reviews and other reviews of reviews. We excluded reviews that only or primarily evaluated interventions among children and adolescents and broader public health strategies. We included only the most recent version of updated reviews.

We outlined separate inclusion and exclusion criteria when considering primary evidence related to bupropion, e-cigarettes, and pharmacotherapy interventions among pregnant women. For primary evidence related to the benefits (KQ 1-KQ 2) and safety (KQ 3) of bupropion and e-cigarettes, we included randomized controlled trials (RCTs) in which smokers were randomized to bupropion or e-cigarettes or a control condition, such as a placebo/placebo device, a no-intervention condition, or another active tobacco cessation intervention (e.g., NRT, counseling). We included cohort studies with sample sizes of 1,000 participants or more. We included studies only if they reported a health outcome (KQ 1) or a measure of tobacco abstinence (KQ 2) at least 6 months after baseline assessment or adverse events (AEs) (KQ 3) at any point after treatment started. We excluded studies that only reported intermediate smoking outcomes (e.g., desire to smoke, withdrawal symptoms, quantity of cigarettes smoked). We required that studies take place in developed countries defined as “very high” on the 2015 Human Development Index (HDI) of the United Nations (http://hdr.undp.org/en/statistics).

For pharmacotherapy interventions among pregnant women, we used the criteria outlined in the review by Coleman and colleagues. Accordingly, we included RCTs that permitted assessment of the independent effects of any type of first-line pharmacotherapy on smoking cessation. Included trials also had to provide very similar (or identical) levels of behavioral support to participants in the treatment and control groups. In addition, and unique from the Coleman review, we included large cohort studies (n>1000) that compared pregnant women who were exposed versus not exposed to medications for smoking cessation. We excluded quasi-randomized, crossover, and within-participant designs, and required that studies take place in countries deemed “very high” on the Human Development Index.

Two reviewers independently screened the abstracts and titles of all records identified in the searches, using the inclusion and exclusion criteria as a guide for identifying eligible studies. Subsequently, two reviewers assessed the full text of potentially relevant systematic reviews and
primary studies using a standard form outlining the eligibility criteria. We resolved disagreements through discussion, although disagreements were minimal and easily resolved. All reviews were conducted in DistillerSR (Evidence Partners, Ottawa, Canada). We kept detailed records of all included and excluded studies (and reasons for exclusion) during full-text review.

Quality Assessment and Data Abstraction

We used the AMSTAR 2 (Assessment of Multiple Systematic Reviews) tool to rate the credibility of the systematic reviews under consideration for inclusion. The AMSTAR 2 tool contains 16 items that relate to the planning and conduct of the review (Appendix A Table 2). We rated our overall confidence in the results of each review according to published guidance: a rating of “high” reflects that the review had zero or one noncritical weakness; “moderate” indicates the review was judged to have more than one noncritical weakness; “low” means the review was judged to have one critical flaw with or without noncritical weaknesses or multiple noncritical weaknesses; and “critically low” signifies that more than one critical flaw was present. In line with USPSTF criteria for primary evidence, we excluded reviews rated as critically low because they would not provide an accurate and comprehensive summary of the available evidence. We included low credibility reviews but rarely relied on them for the main results. One reviewer completed the AMSTAR 2 tool for all provisionally included reviews, and for all reviews that were rated critically low a second reviewer provided an independent assessment with the same tool.

For individual studies, we used criteria developed by the USPSTF to assess the quality of included evidence (Appendix A Table 2). We examined potential risks of bias, including randomization and measurement procedures (including blinding and consistency between groups); comparability of the groups at baseline; overall and group-specific attrition; intervention fidelity; and the appropriateness of the statistical procedures, including methods for handling missing data. At least two independent reviewers assessed the quality of the primary evidence, and we resolved discrepancies through consultation with a third reviewer and discussion. We applied the typical USPSTF quality scores (i.e., good quality, fair quality, or poor quality) after reviewing the number and seriousness of the threats to validity. Those rated as poor quality contained a serious flaw or flaws that we felt likely biased or invalidated the results and were excluded from this review.

We abstracted data from each included review and primary study into detailed abstraction forms using DistillerSR. For all included evidence, one reviewer completed primary data abstraction, and a second reviewer checked all data for accuracy and completeness.

Data Synthesis and Analysis

Given the large number of reviews that met our eligibility criteria and the overlapping scope and evidence between many of them, we developed a method to identify one or more reviews within each population and intervention subgroup that represented the most current and applicable evidence. These reviews serve as the basis for the main findings (called primary reviews...
hereafter). **Box 1** describes the full set of criteria we applied to identify the primary reviews for each population and intervention. First, we categorized all included reviews according to the type of tobacco cessation intervention (i.e., distinct types of pharmacotherapy, behavioral, and/or combination interventions) and population (e.g., adults, pregnant women). Within each group, we listed the reviews in chronological order by the last search date (some reviews were listed more than once in the table if they addressed multiple populations or intervention types). Next, we compared the included studies within each review to evaluate comprehensiveness and noted concordance and discordance in the included primary literature. When we encountered highly discordant bodies of evidence, we sought an explanation for the difference by examining the inclusion and exclusion criteria. For example, if the most recent review for a given category did not appear to be the most comprehensive review in terms of the number of included studies, we examined to what extent the inclusion criteria (e.g., allowable study designs, outcomes of interest) may have influenced the discrepancy in included studies. We also looked at individual included studies as necessary to ensure that the potential primary reviews did not omit important studies. Finally, we reviewed the inclusion and exclusion criteria and data analysis procedures of each review to determine the most applicable evidence. We reviewed the remaining reviews for complementary or discordant findings. In general, the results across reviews within each population and intervention grouping were consistent with one another and thus, we do not elaborate on these consistencies within the results.

**Box 1. Criteria for Choosing Primary Systematic Reviews Compared with Other Reviews for the Same Population and Intervention Group**

1. The search strategy is more up to date.
2. The included studies apply inclusion/exclusion criteria that offer the most relevant and credible evidence (i.e., based on included study designs, populations, comparators, setting, followup >6 months, and outcomes).
3. There are more (or an equal number of) included studies of the ideal study design
4. Appropriately conducted pooled results are presented, with or without meta regression or subgroup analysis.
5. The quality of the review is better.

We summarized the characteristics of the primary evidence reviews in evidence tables but did not reanalyze individual study data. Instead, we reported the pooled analyses and existing point estimates presented in the included reviews. For reviews that included meta-analyses, we conducted comparisons of the pooled estimates of efficacy for each intervention versus comparator and took the definition of abstinence (continuous, point prevalence) and the length of followup into consideration. When extracting pooled estimates from the reviews, we considered the statistical validity of the available meta-analytic results. We also presented subgroup results related to the intensity or type of intervention, when available. We evaluated the appropriateness of meta-analytic procedures and used our technical judgment to interpret pooled analyses accounting for limitations or concerns from heterogeneity, statistical approaches, or other factors.

In anticipation of sparse reporting of health outcomes (KQ 1), we decided a priori to synthesize any data related to health outcomes qualitatively. The primary outcome for KQ 2 was smoking cessation at 6 months’ or longer followup using the strictest definition of abstinence available in
each review. We abstracted results at both 6 and 12 months’ followup if the reviews presented both. In most cases, the reviews reported the “longest followup” result and required at least 6 months’ followup. The preferred outcome in most reviews was continuous abstinence (i.e., completely abstinent from quit date to followup allowing for up to five cigarettes) or prolonged abstinence (i.e., typically allows a “grace period” following the quit date to allow for lapses) over point prevalence abstinence (i.e., abstinent at a particular point in time such as 7 or 30 days before followup and thus includes a mix of recent and continuous quitters). Biochemical verification of self-reported abstinence was not required in most reviews, but validated outcomes were used when reported. All included reviews used analyses based on intention-to-treat principles in which participants lost to followup who could not be classified definitively as nonsmokers were counted as smokers.

To evaluate health outcomes in pregnant women and neonates, we analyzed outcomes for all RCTs regardless of the control condition. Due to high statistical heterogeneity, we do not provide pooled effect estimates. Instead, we present descriptive forest plots comparing the NRT and control conditions for key reported perinatal health outcomes (preterm birth, low birthweight, stillbirth, birthweight) and narratively describe the results of the individual studies. The calculated relative risks are presented for most outcomes, but for low birthweight, the odds ratios were calculated for some trials and combined with study reported odds ratios to allow for comparisons of this outcome across all studies reporting the outcome. For some studies, data necessary for comparing health outcomes were not available in the primary studies. In such instances, we used data reported in a recent Cochrane review that directly contacted study authors for relevant data.

For computing a pooled estimate across the included trials for pharmacotherapy smoking cessation among pregnant women, we used the DerSimonian and Laird model for pooling relative risks (RR) and used a restricted maximum likelihood model with the Knapp-Hartung correction for small samples to estimate the 95% CI interval. We used Stata version 15.1 (StataCorp LP, College Station, TX) for all analyses. All significance testing was 2-sided, and results were considered statistically significant if the p-value was 0.05 or less.

Grading the Strength of the Body of Evidence

We graded the strength of the overall body of evidence for each KQ as follows. “High” indicates high confidence that the evidence reflects the true effect and that further research is very unlikely to change our confidence in the estimate of effects. “Moderate” indicates moderate confidence that the evidence reflects the true effect and that further research may change our confidence in the estimate of effect and may change the estimate. “Low” indicates low confidence that the evidence reflects the true effect and that further research is likely to change our confidence in the estimate of effect and is likely to change the estimate. A grade of “insufficient” indicates that evidence is either unavailable or does not permit estimate of an effect.

For our overview of reviews method, we adopted the strength of the overall body of evidence assigned within the primary systematic review. In most cases, these grades were based on the Grading of Recommendations Assessment, Development and Evaluation (GRADE) working
group definitions, which consider study limitations, consistency of effect, imprecision, indirectness and publication bias. Where strength of evidence grades were not available, including for our own primary evidence syntheses, we adapted the EPC approach – which generally aligns with GRADE methodology – to assign an overall strength of evidence grade based on consensus discussions involving at least two reviewers.80

**Expert Review and Public Comment**

A draft Research Plan was posted on the USPSTF Web site for public comment from March 14 through April 11, 2018. In response to public comment, the USPSTF made the following changes to the research plan. First, reviews focused on relapse prevention interventions are included. Second, the USPSTF clarified that the target condition includes use of any tobacco product, as regulated by the FDA, including cigarettes, roll-your-own tobacco, smokeless tobacco, cigars, pipe tobacco, dissolvables, smoking tobacco through a hookah or waterpipe, and e-cigarettes. Reviews limited to or including cessation of any of these tobacco products are included. Third, reviews limited to specific subpopulations of adults with high prevalence of tobacco use or at risk of tobacco use-related morbidity are included, as are results from credible subgroup analyses. Last, reviews of medications that are not approved as first-line tobacco cessation medications but are used off-label and are available in the United States are included. The USPSTF made other minor modifications and clarifications as appropriate, including clarifying that any intervention that takes place in primary care or that can feasibly be referred to from primary care are included. A final research plan was posted on the USPSTF Web site on July 26, 2018. We made no deviations from the final research plan in the conduct of this review.

**USPSTF Involvement**

We worked with four USPSTF members at key points throughout this review, particularly when determining the scope and methods and developing the Analytic Framework and KQs. The USPSTF members approved the final Analytic Framework, KQs, and inclusion and exclusion criteria after revisions reflecting the public comment period. AHRQ funded this review under a contract to support the work of the USPSTF. An AHRQ Medical Officer provided project oversight, reviewed the draft report, and assisted in the external review of the report.
Chapter 3. Results

This report addresses two populations of interest: the general adult population and pregnant women. Within each population, results are organized first by KQ and then by intervention-specific categories.

Evidence for Adults

Included Evidence

We identified 64 reviews that synthesized the benefits and/or harms of tobacco cessation interventions among adults, including those among an unselected population of adults and those limited to a specific subgroup of adults (Table 2).54, 81-143 Fifty-seven of these reviews were newly identified (published from 2014 to 2019) and seven reviews were carried forward from our previous systematic review. The remaining reviews included in our previous report were excluded because more recent and comprehensive reviews on each population or intervention have been published. Of the 209 full-text articles that were reviewed, the most common reasons for exclusion were study design (i.e., not a systematic review; k=41), absence of prespecified outcomes or cessation outcomes at 6 months or more (k=28), and critically low-quality rating (k=23) (Appendix B Figure 1).

We designated 32 of the 64 reviews as primary reviews on smoking cessation interventions for general adult populations (Table 2). As described in the methods section, we chose these primary reviews based on their comprehensiveness, appropriateness (in scope and applicability), and critical appraisal ratings. Table 3 lists the inclusion and exclusion criteria for each primary review. Table 4 lists the characteristics of the included evidence for each primary review and Table 5 presents the pooled results for tobacco cessation outcomes for all included interventions.

Eleven “ancillary” reviews had overlapping evidence with that synthesized in the primary reviews; results were consistent with the primary reviews in terms of statistical significance and effect magnitude and are not discussed further. An additional 21 reviews focused on specific subpopulations of adults (e.g., people with severe mental illness, smokeless tobacco users). Results of these subpopulation reviews were compared with results from general adult reviews; we only discussed findings of these subgroup reviews if they suggested substantive differences than that of the broader reviews. Seven of these reviews among specific subgroups presented results related to harms of medication use and are also included as main results. Characteristics of these additional reviews (ancillary and those limited to subpopulations) are provided in Appendix C.

Our review of the primary evidence on the use of e-cigarettes for tobacco cessation resulted in eight included trials (reported in 14 publications), four of which addressed tobacco cessation and all of which address potential harms (Appendix B, Figure 2).144-157 Two of these trials were included in our previous review, and six trials are new to this update.
Appendix D lists all included studies and Appendix E lists the excluded studies, with reasons for exclusion.

**Credibility/Quality Assessment**

We rated 29 of the reviews in adults as having high credibility, 26 as having moderate credibility, and the remaining 9 as having low credibility according to AMSTAR 2 criteria. Most of the main results (primary reviews) were based on reviews we rated as high or moderate credibility; only three reviews rated as low credibility were presented as main results given their unique foci (harms of varenicline, sex differences in the effectiveness of medications, and harms of varenicline use among smokeless tobacco users). Though they were rated as low credibility, the flaws noted in these reviews (e.g., lack of dual study selection, unclear ascertainment of funding of included studies, not accounting for risk-of-bias of studies in interpretation of the findings) are unlikely to invalidate the results we present from these reviews. We excluded 26 reviews as having very low credibility; these reviews had more than one critical flaw and thus, we felt could not be relied on to provide an accurate and comprehensive summary of the available evidence. Many of these critical flaws related to the search and selection of included studies (e.g., a partial search strategy, no dual selection of studies), a lack of a risk-of-bias assessment, very little information about the included studies, or an inappropriate data synthesis or analysis method. Of the 64 included reviews, 32 were Cochrane Collaboration reviews. These reviews are generally well-conducted, well-reported, and use similar robust methods for study selection and synthesis, strengthening our confidence in these findings.

We rated all eight trials of e-cigarettes as fair quality (Table 6). Major quality limitations of these trials included uncertain validity of randomization and allocation concealment procedures, differences in reasons for missing data across treatment groups, unclear blinding of outcome assessors, substantial crossover and relatively high loss to follow-up with unclear treatment of missing data.

**Key Question 1. Do Tobacco Cessation Interventions Improve Mortality, Morbidity, and Other Health Outcomes in Adults Who Currently Use Tobacco?**

**Combined Pharmacotherapy and Behavioral Interventions**

None of the included systematic reviews reported the effectiveness of combined pharmacotherapy and behavioral interventions on health outcomes, including mortality and tobacco-related morbidity.

**Pharmacotherapy Interventions**

None of the included systematic reviews that assessed pharmacotherapy interventions among a general adult population reported the effects of interventions on mortality, morbidity, or other health outcomes.
**Behavioral Interventions**

One systematic review\textsuperscript{126} reported the results from a single RCT\textsuperscript{158} that evaluated the effect of a behavioral tobacco cessation intervention on health outcomes. In this trial, males considered to be at high risk of cardiorespiratory disease (n=1,445) were randomized to an intensive stop-smoking intervention that included advice, written materials, and one followup visit on health outcomes or a no intervention control group. At 20-year followup, in the intervention compared with the control group, total mortality was 7 percent lower, fatal coronary disease was 13 percent lower and lung cancer (death plus registrations) was 11 percent lower.\textsuperscript{159} These differences were not statistically significant, reflecting low power and the diluting effects of incomplete compliance with the cessation advice in the intervention group, and a progressive reduction in smoking by men in the control group.\textsuperscript{159}

**E-Cigarettes**

We did not identify any primary evidence on the use of e-cigarettes as tobacco cessation interventions that reported results related to health outcomes.

**Key Question 2. Do Tobacco Cessation Interventions Increase Tobacco Abstinence in Adults Who Currently Use Tobacco?**

**Combined Pharmacotherapy and Behavioral Interventions**

*Primary Results*

Only one review, the moderate-credibility review by Stead (2016), assessed the effect of combining pharmacotherapy and behavioral support for smoking cessation among adults.\textsuperscript{128} The review included 53 trials (12 of which were new to this update) that enrolled 15 to 5887 participants. In a meta-analysis that combined 52 of the 53 trials, there was a statistically significant benefit of combined pharmacotherapy and behavioral interventions versus control on smoking cessation at 6 months’ followup or longer (risk ratio [RR] 1.83 [95% confidence interval [CI], 1.68 to 1.98]; I\textsuperscript{2}=36%; k=52; n=19,488) (Table 5).\textsuperscript{128} Average quit rates in these trials ranged from 2 to 50 percent (mean: 15.2%) among participants receiving pharmacotherapy and behavioral support versus 0 to 36 percent (mean: 8.6%) among participants randomized to a control group. The review found some evidence of asymmetry in a funnel plot, with an excess of smaller trials detecting larger effects, suggesting the possibility of publication or other bias; however, a sensitivity analysis removing the smaller trials did not have a marked effect on the pooled estimate.

Control participants were offered usual care, self-help materials or brief advice on quitting that was of lower intensity than that given to intervention participants. Studies limited to adolescents or pregnant women were excluded. About half of the studies were conducted in the United States. A high proportion of trials were conducted in health care settings (e.g., primary care clinics, dental clinics, Veterans Administration medical centers) and/or recruited people with specific health needs (e.g., general and psychiatric hospital inpatients, patients awaiting admission for surgery, mental health patients, those with mild airway obstruction or COPD). In
more than half of the trials (32/53, 60%), participants were required to be motivated to quit
smoking for inclusion or were classified as likely to be interested in quitting; the remaining trials
(21/53, 40%) did not select participants based on motivation to quit. The average age of
participants typically ranged from low 40s to mid-50s.

The included interventions typically offered or prescribed NRT; only seven trials offered
bupropion or nortriptyline, and no trials offered varenicline. There was a great deal of variation
in the intensity and format of behavioral support. The typical intervention involved multiple
contacts with a specialist cessation adviser or counselor, including face-to-face contact with
additional sessions often provided by phone. Most trials (28/53, 53%) offered between four and
eight sessions and a quarter (13/53, 25%) offered more than eight sessions. Total planned
intervention contact time typically ranged from 90 to 300 minutes. Specialized cessation
counselors or trained trial staff delivered most of the interventions. A primary care provider was
the main interventionist in only four included studies.

**Evidence of Effect Modification**

The review by Stead conducted planned subgroup analyses by setting, participant motivation to
quit, provider, intensity, and compliance with medication and behavioral support. They found
that the pooled effect of combined interventions was higher among 43 studies that were
conducted in or recruited participants from a health care setting, compared with eight trials that
recruited community volunteers. The results in both settings, however, showed significant
benefit (health care: RR 1.97 [95% CI, 1.79 to 2.18] vs. community: RR 1.53 [95% CI: 1.33 to
1.76]) (Chi² test for subgroup difference, p=0.00). There was no evidence that the relative effect
of the intervention differed according to participant readiness-to-quit (meta regression, p=0.09).
The subgroup of trials that included participants selected for motivation to change had a slightly
larger effect estimate than the subgroup not selected for motivation, although the confidence
intervals overlapped. Likewise, there was not an important difference in the effects of
interventions delivered by cessation counseling specialists versus those provided by a
nonspecialist health care provider, peer supporter, or lay health advisor (meta-regression,
p=0.37). There was no clear evidence that increasing number of sessions or duration of personal
contact had larger effects (bivariate meta regression, p=0.73). The subgroup of trials that offered
eight or more sessions had the largest estimate (RR 2.10 [95% CI, 1.65 to 2.68]), but the
confidence intervals overlapped for all four groups of interventions categorized by the number of
sessions that included personal contact (i.e., 0 sessions, 1-3 sessions, 4-8 sessions, more than 8
sessions). Finally, there was no evidence of effect modification according to treatment uptake
when comparing those with high (over 70% starting pharmacotherapy and receiving at least one
session of support), moderate (over 30% starting pharmacotherapy and over 50% receiving at
least one session of support), or low (less than 30% starting pharmacotherapy or less than 50%
receiving at least one session of support) compliance with the intervention (Chi² test for
subgroup difference, p=0.07).128
Pharmacotherapy Interventions

Nicotine Replacement Therapy

Primary results. The most recent high-credibility review, conducted by Hartmann-Boyce (2018), systematically searched for evidence through July 2017 that compared NRT with placebo or no NRT control groups among adult smokers. The review included 136 RCTs, 18 of which are new to this update, that ranged in size from fewer than 50 to over 8000 participants (median: 257). All six forms of NRT significantly increased the rate of cessation compared with placebo or no NRT, as did choice of NRT product (Table 5). Considering any form of NRT compared with placebo or no NRT, the pooled RR for abstinence was 1.55 (95% CI, 1.49 to 1.61; \( I^2 = 39\% \); \( k=133; n=64,640 \)) at the longest followup (6 months or more). Overall, 16.9 percent of participants who received some type of NRT achieved abstinence at 6 months or longer (range 1.7% to 60.0%), compared with 10.5 percent of control participants (range 0.5% to 46.0%).

The review included trials among men or women, including six trials among pregnant women who smoked and were motivated to quit, irrespective of the setting from which they were recruited or their initial level of nicotine dependence. In most studies, participants were an average age of 40 to 50 years and the average number of cigarettes smoked was over 20 per day. Most studies took place in North America (\( k=62 \)) and Europe (\( k=56 \)) and included members of the community who volunteered in response to media advertisements and were treated in clinical settings. Twenty-six trials were conducted in a primary care or similar setting, with smokers typically recruited in response to a specific invitation from their doctor. The remaining trials were conducted in antenatal clinics, specialized smoking-cessation clinics, hospitals (in- or outpatient), drug abuse or psychiatric treatment centers, schools, or in settings designed to resemble over the counter (OTC) use of NRT.

The primary analysis (i.e., the effectiveness of one or more types of NRT compared with a placebo or a control group receiving no NRT) consisted of 131 trials reporting 133 comparisons among 64,640 participants. In this group of studies, 56 trials evaluated nicotine gum, 51 trials evaluated transdermal nicotine patches, 8 evaluated an oral nicotine tablet or lozenge, 7 evaluated a choice of products being offered, 4 evaluated intranasal nicotine spray, 4 evaluated nicotine inhaler, 2 evaluated the provision of patch and inhaler, 1 evaluated oral spray, and 1 each evaluated the provision of a patch and lozenge, patch and inhaler, and patch, gum, and lozenge. Most of the 56 trials that compared nicotine gum to a control provided the 2 milligram (mg) dose, while the remaining trials provided 4 mg. The treatment periods were usually 2 to 3 months but ranged from 3 weeks to 12 months. Many of the trials included a variable period of dose tapering, but most encouraged participants to be gum-free by 6 to 12 months. Among the nicotine patch trials (\( k=51 \)), the typical maximum daily dose was 15 mg for a 16-hour patch or 21 mg for a 24-hour patch. Eight trials directly compared a higher-dose patch to a standard-dose patch. The minimum duration of therapy ranged from 3 weeks to 3 months. In the nicotine tablet or lozenge studies (\( k=8 \)), three trials used 2 mg sublingual tablets, one trial used a 1 mg lozenge, and two trials used 2 mg or 4 mg lozenges. All trials provided the same behavioral support in terms of advice, counseling, and number of followup visits to the active pharmacotherapy and control groups, but different trials provided different amounts of support.
Evidence of effect modification. Indirect comparisons of trials within the Hartmann-Boyce review based on various study-, population-, intervention-, and outcome-related characteristics showed that the relative rates of abstinence were similar across groups. For instance, there was no evidence that timing (12- vs. 6-months) or choice of outcome (continuous vs. point prevalence abstinence) produced different treatment effects among trials of nicotine gum or patch (there were too few trials to test these differences for other products). Likewise, there was no evidence of effect modification through indirect subgroup comparisons according to the intensity or type of behavioral support that was provided to the intervention and control groups. As expected, absolute quit rates among control groups varied according to the intensity of the behavioral support; for example, rates averaged 3.5 percent with low-intensity support, 9 percent with high-intensity individual support, and 11.7 percent with group-based support. In terms of setting, the pooled RRs according to subgroup were all similar, with overlap in the 95% confidence intervals. The pooled RR for trials of any form of NRT among community volunteers for whom care was provided in a medical setting was 1.62 (95% CI, 1.53 to 1.72; $I^2=25\%$; $k=6$; $n=24,957$), similar to that of trials conducted in smoking clinics (RR 1.70 [95% CI, 1.48 to 1.96; $I^2=0\%$; $k=12$; $n=3300$), in primary care settings (RR 1.50 [95% CI, 1.33 to 1.69]; $I^2=0\%$; $k=24$; $n=11,974$), in hospitals (RR 1.39 [95% CI, 1.24 to 1.55]; $I^2=15\%$; $k=13$; $n=7037$), and in settings similar to OTC (RR 1.40 [95% CI, 1.26 to 1.55]; $I^2=83\%$; $k=9$; $n=13,163$). Finally, there was no substantive change in the pooled effect estimate after a series of sensitivity analyses accounting for trial risk of bias (i.e., either excluding studies at high risk of bias or limiting the analysis to only those at low risk of bias) or study methods (i.e., removing studies with no biochemical verification or restricting to only placebo-controlled trials).

Comparative effectiveness of different doses, duration, and modes of NRT. A separate high-credibility review by Lindson (2019a) evaluated the effectiveness and safety of different forms, deliveries, doses, durations, and schedules of NRT for achieving smoking cessation. The review included trials among people of any age who smoked and were motivated to quit, irrespective of the setting from which they were recruited or of their initial level of nicotine dependence. Any form of NRT was included, with eligible comparisons being any other form, dose, duration, or schedule of NRT use. Studies were not eligible if one of the study arms received an additional intervention component that could not be separated from the NRT intervention, making it impossible to establish whether any effect found was as a result of the difference in NRT use or the additional component.

The review included 63 studies ($n=41,509$), 21 of which were new to this update. The median sample size was 400 participants but ranged from 45 to 3575 participants. Most trials were among adult cigarette smokers with an average age of approximately 45 years old; six trials targeted specific populations including adolescents (1 trial), older adults (1 trial), men only (1 trial), those who were alcohol dependent or who had a history of alcohol dependence (2 trials), and adults with PTSD (1 trial). Trials typically recruited people who smoked at least 15 cigarettes per day; in most, the average number smoked was greater than or equal to 20 cigarettes per day. Just about half of the studies (31/63, 49%) recruited participants directly from the community, typically in response to media advertisements, with the remaining trials mostly recruiting from referrals from clinicians or health care clinics including smoking cessation clinics or quit lines, substance abuse clinics, or primary care clinics.
Fourteen studies compared the use of combination NRT (a fast-acting form plus a patch) with a single form of NRT and found that combination NRT resulted in higher long-term (6 months or longer) quit rates (RR 1.25 [95% CI, 1.15 to 1.36]; $I^2=4\%$; $k=14$; $n=11,356$) (Table 5). There was no evidence of subgroup differences when comparing combination therapy versus patch alone or a fast-acting form of NRT alone (Chi² test for subgroup difference, $p=0.61$). There was no evidence from direct comparisons that a higher dose patch of 42/44 mg or 21/25 mg patch was more effective than a lower dose patch of 21/22 mg patch or 14/15 mg. Five trials compared 4 mg to 2 mg gum use; overall, there was a statistically significant greater effect of the higher dose of gum on cessation; however, sensitivity analyses revealed that was only true among trials that were among high dependency smokers, with no evidence of an effect in low dependency smokers. Evidence from eight trials suggested that using either a form of fast-acting NRT or a patch resulted in similar quit rates at 6 months or more (RR 0.90 [95% CI, 0.77 to 1.05]; $I^2=0\%$; $k=8$; $n=3319$). Nine trials compared the use of NRT or no NRT prior to the set quit date (i.e., “preloading” by using NRT while still smoking prior to an official quit date). The pooled effect found a positive statistically significant effect of NRT preloading on abstinence at 6 months or longer (RR, 1.25 [95% CI, 1.08 to 1.44]; $I^2=0\%$; $k=9$; $n=4395$). No comparisons based on duration of combination therapy or patch therapy showed a statistically significant difference on smoking abstinence. Except for the comparison of combination versus single form NRT, these comparisons and findings are based on a relatively small number of trials and should be interpreted cautiously.

**Bupropion**

**Primary results.** The high-credibility Hughes (2014) review included the most comprehensive evidence synthesis on the effectiveness of bupropion versus placebo or no pharmacotherapy. The review included 66 studies that evaluated the effects of bupropion on smoking cessation and provided an analysis of 44 trials that evaluated smoking cessation after 6 months or more in those taking bupropion versus those taking a placebo or no pharmacotherapy. The pooled RR was 1.62 (95% CI, 1.49 to 1.76; $k=44$; $n=13,728$) with little evidence of heterogeneity ($I^2=18\%$) (Table 5). Within this analysis, most studies were based on continuous abstinence measures that were biochemically validated, and 93 percent (41/44) of the trials were placebo controlled. Quit rates ranged from 4 to 43 percent (mean, 19.7%) among those receiving bupropion and from 0 to 33 percent (mean, 11.5%) among those in the control groups. There was no statistically significant difference among trials that reported cessation outcomes at 6- versus 12 months’ followup (Chi² test for subgroup difference, $p=0.53$). Almost all included studies (43 of 44) randomized intervention participants to the recommended dose of bupropion at 300 mg daily (150 mg twice per day). Treatment duration ranged from 7 to 26 weeks. Two studies compared the effectiveness of 300 mg versus 150 mg daily doses and found no differences in quit rates at 12 months.

The Hughes review assessed the effects of antidepressant medications, including bupropion, on smoking cessation rates at followup at least 6 months following initiation of treatment. Evidence related to other antidepressant medications, such as nortriptyline or citalopram, from the Hughes review is discussed below under “Other Medications.” For smoking cessation outcomes, the review required RCTs to compare bupropion with placebo or another nonbupropion control or compare different dosages of bupropion. The authors excluded trials in
which all participants received the same bupropion treatment but different behavioral support. Most trials (77%) were conducted in North America. Twenty-nine (44%) of the trials recruited special populations, such as individuals with comorbid health conditions (e.g., chronic obstructive pulmonary disease, schizophrenia, cardiovascular disease), adolescents, specific racial and ethnic groups (African American, Maori), or those who had previously failed to quit smoking using bupropion or NRT. Most trials excluded participants with current depression but not those with a history of depression.

**Newer primary evidence.** Given the time elapsed since the review by Hughes, we supplemented this review with a targeted search for primary published literature (see Methods section) from 2013 to present and identified two additional trials (in four articles)\(^{160-163}\) whose results we have incorporated alongside those of the Hughes review and those related to comparative effectiveness of pharmacotherapy. The EAGLES trial, published in 2016, is the largest placebo-controlled efficacy and safety trial to date of pharmacotherapy for smoking cessation.\(^{160}\) In this trial, 8144 smokers who were motivated to quit were randomized to varenicline (1 mg twice per day), bupropion (150 mg twice a day), a nicotine patch (21 mg per day with taper), or a placebo patch and pill for 12 weeks, with 12 weeks of no treatment followup. Smoking cessation counseling (10 minutes or less) was given to each group at each clinic visit over the course of the trial. The trial included 140 centers in 16 countries, although more than half of the data comes from the United States. Randomization and analyses were stratified into a psychiatric cohort (those with mood disorders, anxiety disorders, psychotic disorders, or borderline personality disorder) and a nonpsychiatric cohort. The relative effect of bupropion versus placebo was consistent with the larger evidence base synthesized in the Hughes review. Overall, bupropion was superior to placebo in achieving continuous abstinence between weeks 9 and 24 (quit date was set at 8 weeks) compared with placebo, with an OR of 1.89 ([95% CI, 1.56 to 2.29]; p<0.0001; n=4069). The absolute quit rates within this trial (bupropion 16.2% and placebo 9.4%) were also similar to the average quit rates reported in the trials pooled in the Hughes review (bupropion 19.7% and placebo 11.5%). There was no evidence of an interaction effect according to the psychiatric or nonpsychiatric cohort (p=0.6237), although the absolute rates of quitting were higher in the nonpsychiatric bupropion (18.8%) and placebo (10.5%) groups (OR, 2.00 [95% CI, 1.54 to 2.59]) compared with the psychiatric bupropion (13.7%) and placebo (8.3%) groups (OR, 1.77 [95% CI, 1.33 to 2.36]).

Evidence from the EAGLES trial on the comparison of NRT versus placebo and varenicline versus placebo is incorporated in each of those respective reviews (NRT\(^{98}\) and varenicline\(^{87}\)) and therefore is not discussed further here. Secondary comparative effectiveness results are presented below under “Comparative Effectiveness” section.

**Evidence of effect modification.** In the review by Hughes, the effects of bupropion were found to be similar regardless of treatment or recruitment setting (i.e., community volunteers and individuals recruited from health care settings) in *post hoc* indirect comparisons. Similarly, no difference in cessation effects was evident when comparing bupropion trials that included intensive *group-based* behavioral interventions to those that provided intensive *individual-level* behavioral interventions for both the intervention and control groups. None of the three studies that used factorial designs to compare the effects of bupropion with varying levels of behavioral support found evidence that the efficacy of bupropion varied between lower and higher levels of
behavioral support or by type of counseling approach provided (i.e., individual-based cognitive behavioral therapy vs. group therapy). Furthermore, the effects of the bupropion were similar when limited to 6-month cessation (RR 1.69 [95% CI, 1.45 to 1.97]) and 12-month cessation (RR 1.59 [95% CI, 1.44 to 1.76]). There was no examination of effect modification by other population, intervention, or study characteristics, including whether effectiveness differed among persons with or without mental illness.

Varenicline

**Primary results.** A 2016 moderate-credibility review by Cahill included 39 RCTs among adult smokers that evaluated the efficacy or safety of varenicline. The review found that varenicline at standard doses more than doubled the chances of quitting compared with placebo. The pooled RR for validated continuous abstinence at 6 or more months’ followup was 2.24 (95% CI, 2.06 to 2.43; \( I^2 = 60\% \); k=27; n=12,625) (Table 5). Quit rates ranged from 5.3 to 46.8 percent (mean, 25.6%) among those receiving varenicline and from 0 to 28.2 percent (mean, 11.1%) among those in the control groups.

Just over half of the studies were conducted in the United States or were multisite and included settings in the United States or Canada. The trials were conducted in smoking cessation clinics, hospitals, and universities and other research centers. None of the included studies took place in or involved primary care staff. Participants in most trials were adult smokers who were willing to make a quit attempt. Several trials were conducted in clinical subgroups, including among hospital inpatients and disease-specific subgroups (i.e., people with CVD, asthma, substance use disorder, depression, and bipolar/schizoaffective disorder).

Most of the trials used the standard 12-week regimen of varenicline, routinely titrating the first week up to the recommended daily dose of 1 mg twice a day. Three trials compared different dosage arms of varenicline against a placebo arm. Most trials compared varenicline with an identical placebo regimen; trials comparing varenicline with other pharmacotherapies are discussed below (“Comparative Effectiveness”). All trials provided brief counseling for quit support to both treatment and control groups. As a condition of inclusion, all the trials reported cessation at least 6 months from the start of the intervention. All the trials except one used biochemical verification of abstinence.

**Evidence of effect modification.** There was no evidence of differences in the effects of varenicline according to different study, drug, and population characteristics in the review by Cahill. A separate review by McKee (2016) found that varenicline versus placebo had a larger statistically significant effect size for women than men for continuous abstinence at both 3 and 6 months’ followup (sex x medication interaction, p<0.05). For example, at 6 months, varenicline increased the odds of quitting in women by 3.49 times (95% CI, 2.64 to 4.57) and by 2.59 times (95% CI, 2.20 to 3.06) in men, with the interaction demonstrating that varenicline was 31 percent more efficacious in women (OR, interaction for treatment condition by sex 1.31 [95% CI, 0.97 to 1.84; p<0.05]). Equal efficacy was seen between men and women for both point prevalence abstinence and continuous abstinence at 1 year.
Other Medications

In addition to the seven FDA-approved medications for smoking cessation (i.e., five forms of NRT, bupropion, and varenicline), various other antidepressants and nicotine receptor partial agonists have been evaluated for their effectiveness and safety in helping people stop smoking.

The review by Hughes included a synthesis of the effectiveness of antidepressants including bupropion (discussed above), nortriptyline, selective serotonin reuptake inhibitors (SSRIs: fluoxetine, paroxetine, sertraline, citalopram and zimelidine), monoamine oxidase inhibitors (MAOIs: moclobemide, selegiline, lazabemide, EVT302), and other antidepressants (venlafaxine, St. John’s wort, S-Adenosly-L-Methionine, doxepin, imipramine, tryptophan). There was limited evidence for all comparisons, which prevents drawing robust conclusions about these therapies. A pooled analysis of six trials showed evidence of a significant benefit of nortriptyline versus placebo at 6 or more months followup (RR 2.03 [95% CI, 1.48 to 2.78]; \(I^2=16\%\); \(k=6\); \(n=975\)). In contrast, none of the individual trials of SSRIs (\(k=7\)), MAOIs (\(k=6\)), or other antidepressants (\(k=4\)) showed a benefit on smoking cessation at 6 or more months followup nor did pooled estimates of these medications. Furthermore, comparing any of these other antidepressants as an adjunct to nicotine patch therapy versus nicotine patch alone did not show evidence of an additional benefit over NRT.

In addition to synthesizing the evidence on varenicline (discussed above), the review by Cahill on nicotine receptor partial agonists included five trials testing the effects of cytisine (\(k=4\), \(n=3461\)) to increase smoking abstinence. The pooling two of the more recent trials of cytisine found that more participants taking cytisine stopped smoking compared with placebo at 6 or more months’ followup, with a pooled RR of 3.98 (95% CI, 2.01 to 7.87).

Comparative Effectiveness of Different Pharmacotherapy Agents or Regimens

Comparison of different types of NRT. As noted above, no studies that compared fast-acting NRT with a nicotine patch found a differential effect on smoking cessation (RR 0.90 [95% CI, 0.77 to 1.05]; \(I^2=0\%\); \(k=8\); \(n=3319\)). One trial (\(n=1410\)) included in the Lindson review also compared participant- versus clinician-selected NRT and found no difference in quit rates at 6 months.

Combination NRT vs. single NRT. As stated above, combination NRT (i.e., the use of a fast-acting product and nicotine patch) was found to be superior to a single form of NRT in a pooled analysis of 14 direct comparisons (RR 1.25 [95% CI, 1.15 to 1.36]; \(I^2=4\%\); \(k=14\); \(n=11,356\)) (Table 5).

NRT vs. bupropion. Hughes included eight studies that directly compared NRT (any form) with bupropion. Pooled results for all forms of NRT did not detect a significant difference between the two types of pharmacotherapy (RR 0.96 [95% CI, 0.85 to 1.09]; \(I^2=27\%\); \(k=8\); \(n=4086\)) (Table 5). Similarly, in the EAGLES trial, there was no evidence of a difference in continuous abstinence rates between those randomized to an NRT patch (15.7%) versus bupropion (16.2%) at 6 months (OR 1.04 [95% CI, 0.88 to 1.24]; \(n=4072\)). The pooling of two studies (\(n=720\))
that included a comparison of combination nicotine patch and lozenge versus bupropion suggested that combined NRT is more effective than bupropion alone.\textsuperscript{74}

**NRT vs. varenicline.** Cahill and colleagues included eight trials that tested NRT against varenicline.\textsuperscript{87} A pooled analysis of all of the trials indicated a benefit for varenicline over NRT at 6 months (RR 1.25 [95% CI, 1.14 to 1.37]; I$^2$=39%; k=8; n=6264) (Table 5). Removing three open-label trials (all at high risk of bias for blinding) slightly strengthened the effect estimate (RR 1.34 [95% CI, 1.19 to 1.50]) and increased the $I^2$ to 47%. The EAGLES trial similarly found a statistically significant greater benefit in continuous abstinence at 6 months of varenicline (21.8%) versus NRT patch (15.7%) (OR 1.52 [95% CI, 1.29 to 1.78]; n=4075).\textsuperscript{160} In a separate review examining sex differences in the relative effectiveness of pharmacotherapy, the benefits of varenicline over NRT were greater for women than with men (RR for interaction effect, 1.19 [95% CI, 1.01 to 1.40]).\textsuperscript{125} In that review, women treated with varenicline were 41 percent more likely to achieve 6-month abstinence than women treated with NRT (RR 1.41 [95% CI, 1.12 to 1.76]). For men, the benefit of varenicline over NRT (16%) was smaller and not statistically significant (RR 1.16 [95% CI, 0.91 to 1.47]).\textsuperscript{125}

**NRT vs. cytisine.** One recent trial comparing cytisine with NRT in 1310 people found a benefit for cytisine at 6 months (RR 1.43 [95% CI, 1.13 to 1.80]).\textsuperscript{87}

**Bupropion vs. varenicline.** Five trials included in the Cahill review directly compared the effects of bupropion versus varenicline on smoking cessation. All five studies showed more favorable effects for varenicline compared with bupropion, and all but one found these differences to be statistically significant. A pooled estimate of the five trials found a significantly higher rate of quitting with varenicline than bupropion (RR 1.39 [95% CI, 1.35 to 1.54]; I$^2$=0%; k=5; n=5877) (Table 5).\textsuperscript{87} Likewise, a direct comparison of the effectiveness of 12 weeks of varenicline versus bupropion in the EAGLES trial showed greater rates of continuous abstinence among adults randomized to varenicline (21.8%) versus bupropion (16.2%) (OR 1.45 [95% CI, 1.24 to 1.70]; n=4071).\textsuperscript{160} A separate review and network meta-analysis found greater effectiveness of varenicline versus bupropion in achieving 6-month abstinence among women (RR 1.38 [95% CI, 1.08 to 1.77]) versus men (RR 1.11 [95% CI, 0.85 to 1.45] (RR for interaction effect, 1.22 [95% CI, 1.02 to 1.47])).\textsuperscript{125}

**Bupropion plus NRT vs. NRT.** A pooled estimate of 12 studies that directly compared the addition of bupropion to NRT versus NRT alone did not suggest a significant benefit of this combination of drugs versus NRT alone (RR 1.19 [95% CI, 0.94 to 1.51]; I$^2$=52%; k=12; n=3487), although studies were clinically and statistically heterogeneous.\textsuperscript{74}

**NRT plus varenicline vs. varenicline.** A review by Chang and colleagues (2015) included three RCTs with 904 participants that compared combined varenicline and NRT therapy with varenicline alone.\textsuperscript{89} Only two of the trials reported continuous smoking abstinence at 6 months. Both trials showed a favorable effect of combination therapy, although only one reached statistical significance.

**Bupropion plus varenicline vs. varenicline.** We identified one new fair-quality trial (n=506) published subsequent to the systematic review by Hughes that compared the efficacy and safety
of varenicline plus bupropion with varenicline plus placebo. After 6 months of followup, 36.6 percent of the combination therapy group achieved prolonged abstinence compared with 27.6 percent in the varenicline monotherapy group (OR, 1.52 [95% CI, 1.04 to 2.22; p=0.03]). Prolonged abstinence remained high in both groups (30.9% versus 24.5%) but no longer had a statistically significant difference at 1-year followup (OR, 1.39 [95% CI, 0.93 to 2.07; p=0.11). There was no difference between groups at any time point for results related to 7-day point prevalence abstinence.

**Support for Medication Adherence**

Finally, a 2019 review by Hollands assessed the effectiveness of interventions that aimed to increase adherence to medications for smoking cessation. The review included 10 studies, all of which reported the effects of the intervention on adherence outcomes. There was some evidence that interventions that devote special attention to improving adherence through the provision of information and facilitation of problem-solving can lead to modest increases in adherence, when added to behavioral support for smoking cessation. Five studies also reported on the effects of the adherence intervention on abstinence at 6 months or greater, with evidence of no effect on smoking abstinence (RR 1.16 [95% CI 0.96 to 1.40]; I²=48%; k=10; n=3593) (Table 5).

**Behavioral Interventions**

**Behavioral Support as an Adjunct to Pharmacotherapy**

**Primary results.** The high-credibility review by Hartmann-Boyce (2018) assessed the effect of increasing the intensity or changing the content of behavioral support among smokers using smoking cessation medications. The review included RCTs in which adult smokers in both the intervention and control conditions received pharmacotherapy for smoking cessation, but they differed by the amount or content of behavioral support. Participants in the control condition received less-intensive behavioral support than participants in the intervention condition, often limited to written information alone, or a different approach to behavioral support but matched for contact time.

Eighty-three studies were included, of which 36 are new for this update. Over 29,000 participants are represented in the included study arms, with a range of 30 to 4614 participants in the individual trials. A meta-analysis of 65 trials suggested that increasing the intensity of behavioral support for smokers making a cessation attempt with the aid of pharmacotherapy typically leads to a relatively small increase in the proportion who have quit at 6 to 12 months. The estimated RR was 1.15 (95% CI 1.08 to 1.22; I²=8%; k=65; n=23,331) (Table 5). The average absolute quit rate of both the intervention (20%) and control groups (17%) were quite high and were comparable to the intervention groups in the trials of pharmacotherapy versus placebo. While most studies reported point prevalence abstinence instead of continuous or prolonged abstinence, the review found no difference in the relative effect between studies that reported point prevalence rather than continuous abstinence at 12 months.

Twenty-nine studies (35%) recruited people in a health care setting (excluding smoking cessation clinics), including 10 studies that took place in primary care. Since the intervention included the
provision of pharmacotherapy, most of the studies recruiting in a health care setting enlisted volunteers who were interested in making a quit attempt, although motivation to quit was not always an explicit eligibility criterion. The remaining studies recruited community volunteers interested in quitting.

Most studies offered NRT, specifically the nicotine patch. Seven studies provided bupropion alone, one provided nortriptyline alone, and four provided varenicline alone. The remaining studies offered participants a choice or combination of medications. The intensity of the behavioral support, in both the number of sessions and their duration, was very heterogeneous for both the intervention and control arms. In seven studies, the controls received no counseling. In 30 studies, the control arms had one to three contacts (either face-to-face or by telephone), and most of these had a total contact duration of 4 to 30 minutes. In 34 studies the control group was scheduled to receive four to eight contacts, with most involving a total contact duration of over 90 minutes. The 12 remaining studies scheduled over eight contacts for the controls. Typically, the intervention involved only a little more contact than the control, so that the least intensive control conditions were in trials with only moderate-intensity interventions.

**Evidence of effect modification.** The effect was similar and statistically significant for the subgroup of studies that examined behavioral support as an adjunct to NRT (k=50) and bupropion (k=5) specifically. Results of the remaining trials among smokers using other pharmacotherapies (e.g., varenicline) or a choice of pharmacotherapy were generally not statistically significant, although there were few trials in these subgroups and a test for difference between subgroups was not significant. There was little evidence of any dose-response effect according to the number of contacts in the intervention and control groups (and the contrast between those groups), although the point estimate was highest for the subgroup in which controls did not have any personal contact (RR 1.20 [95% CI, 1.02 to 1.43]). Seventeen studies, all new to this update, compared interventions matched for contact time but provided through different modalities, providing different content, or employing different behavior change techniques. All studies in this group employed different comparisons and were not pooled. Only one trial – comparing motivational interviewing with health education – found a statistically significant difference between the two interventions, with the finding in favor of health education.

*Physician Advice*

**Primary results.** The high-credibility review by Stead (2013b) summarized evidence from 42 trials on the effectiveness of physician advice in promoting smoking cessation published through January 2013.\(^\text{126}\) This review included RCTs that compared physician advice to stop smoking versus no advice (or usual care), or compared different levels of physician advice to stop smoking. Advice was defined as verbal instructions from the physician with a “stop smoking” message regardless of whether information was provided about the harmful effects of smoking. In a meta-analysis, smokers who were offered cessation advice by a physician had a statistically significant increase in the likelihood of quitting at 6 months or longer compared with smokers receiving no advice or usual care (RR 1.76 [95% CI, 1.58 to 1.96]; \(I^2=40\%\); k=26; n=22,239) (Table 5). Absolute quit rates ranged from 1 to 23 percent among intervention participants (mean: 8.0%), and from 1 to 14 percent among control participants (mean: 4.8%).
**Evidence of effect modification.** The results of the main meta-analyses were not sensitive to exclusion of trials at high risk of bias for any item. When stratified by intervention intensity, both brief advice (single consultation lasting less than 20 minutes plus up to one followup visit) (RR 1.66 [95% CI, 1.42 to 1.94]) and intensive advice (greater time commitment at the initial consultation, use of additional materials beyond a brochure, or more than one followup visit) (RR 1.86 [95% CI, 1.60 to 2.15]) showed statistically significant increases in quit rates when compared with no advice controls. There was no evidence of an interaction effect between strata (p=0.31). However, direct comparisons between intensive and minimal advice in 15 trials suggested a statistically significant advantage of more intensive advice (RR 1.37 [95% CI, 1.20 to 1.56]; I²=32%; k=15; n=9,775). Subgroup analyses within this group of 15 trials suggested that this effect might be small or nonexistent among smokers without smoking-related disease (10 studies), but the effect might be larger when the intervention is provided to smokers in high-risk groups (e.g., those with heart disease, chronic obstructive pulmonary disease) (based on only 5 trials).

An indirect comparison between subgroups of studies within the main analysis suggested that interventions that included additional followup visits had a slightly larger effect estimate (RR 2.27 [95% CI, 1.87 to 2.75]; I²=27%; k=6; n=4,510) compared with no advice than interventions delivered at a single visit versus no advice (RR 1.55 [95% CI: 1.35 to 1.79]; I²=35%; k=18; n=14,675). Five additional included trials directly compared the addition of further followup to a minimal intervention but were not included in the main analysis of advice versus no advice. None of these five trials individually detected significant differences between groups.

**Nurse Advice**

**Primary results.** A more recent high-credibility review by Rice (2017) synthesized the evidence on nursing interventions for smoking cessation.120 Similar to the review of physician advice, included nursing interventions consisted of the provision of advice, counseling, and/or other strategies to help people stop smoking provided by a nurse. This review used the same definition of what constituted “advice” but defined intervention intensity slightly differently. In the Rice review, low-intensity interventions were those that were conducted during a single consultation lasting 10 minutes or less, with up to one followup visit (as opposed to 20 minutes in the physician advice review) and high-intensity interventions as those in which the initial contact lasted more than 10 minutes (again, as opposed to more than 20 minutes for physician advice). These high-intensity interventions also distributed additional materials, used additional strategies, and typically included more than one followup visit.

The Rice review included 58 trials, nine of which are new to this update. Twenty-eight trials (48%) recruited from primary care or outpatient settings, and another 22 trials (38%) intervened with hospitalized patients. The remaining trials recruited from workplaces, communities, universities, and other sites. Just under half of the trials recruited individuals with chronic diseases (e.g., cardiovascular disease, respiratory disease, diabetes) or hospitalized patients. Most trials (k=44) compared a nursing intervention to a usual care or minimal intervention control and contributed to the primary meta-analysis. The remaining comparisons were made between two nursing interventions that involved different components or a different number of contacts (k=11) or were excluded from meta-analyses because of incomplete data (k=6). The estimated
pooled RR comparing smoking cessation support provided by a nurse with usual care or minimal intervention was 1.29 (95% CI, 1.21 to 1.38; \( I^2 = 50\% \); k=44; n=20,881) (Table 5).

**Evidence of effect modification.** There was no evidence of different effects among interventions classified as low- versus high-intensity (Chi\(^2\) test for subgroup difference, p=0.87).

**Individual Behavioral Counseling**

**Main results.** We identified one recent high-credibility review by Lancaster (2017) that reviewed the evidence on individual counseling in promoting smoking cessation.\(^{104}\) The review included studies among nonpregnant smokers that tested the effect of an individual counseling intervention compared with no treatment, brief advice, self-help materials, or a less intense individual counseling intervention. Individual counseling was defined as a face-to-face encounter between a smoker and a counselor trained in providing smoking cessation assistance. Studies of counseling delivered by physicians or nurses, those that combined counseling with pharmacotherapy, and those using motivational interviewing were excluded given their inclusion in other relevant reviews (which are all included in this overview of reviews). Forty-nine trials were included, with around 19,000 participants. Thirty-three studies contribute to the primary analysis comparing individual counseling with a minimal-contact behavioral intervention. Eleven studies compared different intensities of interventions, and five compared counseling approaches that were similar in intensity of contact. The recruitment settings and study populations were highly variable and included those recruited as medical or surgical inpatients or outpatients, at primary care clinics and worksites, and as community volunteers. The counseling intervention typically included a review of a participant’s smoking history and motivation to quit, help in identification of high-risk situations, and the generation of problem-solving strategies to deal with such situations. Some studies also provided additional components such as written materials or videos. The therapists who providing the counseling were generally described as smoking cessation counselors with professional backgrounds in social work, psychology, psychiatry, health education, and nursing.

The pooled effect size based on 33 studies demonstrated statistically significant benefit of individual counseling compared with a minimal contact control (RR 1.48 [95% CI, 1.34 to 1.64]; \( I^2 = 46\% \); k=33; n=13,762) (Table 5). In these studies, a minimal contact control ranged from usual care to up to 15 minutes of advice, with or without the provision of self-help materials. Most of the interventions implemented multiple sessions of face-to-face support in addition to telephone contact. Within this group of studies, six trials included pharmacotherapy for both arms. The effect estimate was higher in the subgroup of studies when pharmacotherapy was not provided (RR 1.57 [95% CI, 1.40 to 1.77]; \( I^2 = 50\% \); k=27; n=11,100) than in the studies testing the additional effect of counseling when participants had access to pharmacotherapy (RR 1.24 [95% CI, 1.01 to 1.51]; \( I^2 = 0\% \); k=6; n=2662) and the test for a subgroup difference was statistically significant (Chi\(^2\) test for subgroup difference, p=0.04). There was some evidence that more intensive versus less intensive counseling resulted in greater cessation (16.8% vs. 12.7% absolute quit rates, respectively) (RR 1.29 [95% CI, 1.09 to 1.53]; \( I^2 = 48\% \); k=8; n=2920), and there was a difference in this effect according to whether pharmacotherapy was also provided (Chi\(^2\) test for subgroup difference, p=0.04). There was limited evidence from studies comparing different types of individual counseling.
Group Behavioral Therapy

**Primary results.** The moderate-credibility review by Stead (2017) synthesized the evidence on the effect of group-delivered behavioral interventions in achieving long-term (6 months or more) smoking cessation among nonpregnant adult smokers. Included interventions were those in which smokers attended scheduled meetings and received some form of behavioral intervention, such as information, advice, and encouragement or cognitive behavioral therapy delivered over at least two sessions. The review included 66 trials, 44 of which compared a group program with a non-group-based cessation intervention or a no-intervention control. The remaining 22 did not have a non-group control and only contributed to comparisons between different group-based programs. Most studies recruited community volunteers prepared to participate in group programs; only three recruited from primary care. The group programs varied in length, format, and content. Most programs offered six to eight sessions, with the first few sessions devoted to motivation for quitting, health benefits, and strategies for planning a quit attempt. Compared with non-group self-help programs, group-based therapy interventions resulted in a statistically significant increased risk of quitting tobacco at 6 or more months’ followup (RR 1.88 [95% CI, 1.52 to 2.33]; $I^2=0$; k=13; n=4395) (Table 5). A separate analysis of 14 trials found a small benefit of group support compared with brief support from a physician, nurse, or pharmacist with a conference interval just excluding no effect (RR 1.22 [95% CI, 1.03 to 1.43]; $I^2=59$%; k=14; n=7286). When combining the results of five trials (n=1523) that examined group therapy as an adjunct to pharmacotherapy, the analysis did not detect a statistically significant increased quit rate for combined therapy over pharmacotherapy without group support. Similarly, there was no evidence, based on six trials (n=980), that group therapy was more effective than individual therapy when the number of sessions were matched.

Motivational Interviewing

**Primary results.** A 2019 high-credibility review by Lindson (2019b) reviewed the evidence on the effectiveness of motivational interviewing (MI) to promote smoking cessation. In this review, RCTs conducted among nonpregnant smokers with an MI intervention were included. The intervention must have been based on the MI principles as defined by Miller and Rollnick, making explicit reference to at least some MI principles: exploration of ambivalence, decision balance, assessment of motivation and confidence to quit, elicitation of “change talk,” and support for self-efficacy and in the opinion of the review authors, complied with these principles and practices. The review identified 37 trials, involving over 15,000 participants. The included MI interventions were conducted in one to 12 sessions, with the total duration of MI ranging from 5 to 315 minutes. Interventions were primarily delivered by primary care physicians, nurses, or counselors. Pooling studies that compared a smoking cessation intervention supplemented by MI with the same smoking cessation intervention without MI suggested a small potential benefit of MI; however, the 95% CI spanned one and there was moderate heterogeneity detected (RR 1.07 [95% CI, 0.85 to 1.36]; k=12; n=4167; $I^2=47$%) (Table 5). Nineteen trials compared an MI intervention to another type of smoking cessation intervention. The point estimate was in favor of MI; however, the confidence intervals were consistent with substantial benefit and with potential harm (RR 1.24 [95% CI, 0.91 to 1.69]; k=19; n=5192; $I^2=54$%). Furthermore, there was no evidence of a benefit of a MI smoking cessation intervention when compared with no intervention within four trials.
Evidence of effect modification. There was no clear evidence to suggest that the effect of MI was moderated by the intervention provider participants’ motivation to quit at baseline, whether MI was delivered face-to-face, or whether MI fidelity monitoring took place. Five trials directly compared the effectiveness of more intensive versus less intensive MI intervention. There was some suggestion that more intensive interventions were associated with greater smoking abstinence; however, this analysis included several studies at high risk-of-bias and removing those studies produced a nonsignificant result.

Decision Aids

Primary results. A 2018 moderate-credibility review by Moyo synthesized the evidence on the effectiveness of decision aids for smoking cessation in adults. Both experimental and quasi-experimental studies that evaluated the use of decision aids to promote shared decision making between a patient and healthcare provider were included. For the purpose of this review, a decision aid was defined as a tool any healthcare provider used to share with and inform people about treatment options, including the risks, and costs and benefits of potential choices. Any form of decision aid was included such as pamphlets, brochures, cards, DVDs, or web-based applications. The review identified seven studies that met eligibility criteria with decision aids including web- or computer-based aids (3 studies), a video decision aid (1 study), a print-based aid (2 studies), and a video plus print decision aid (1 study). The decision aids were delivered by a healthcare provider in only two cases. The other studies all evaluated a decision aid where provider followup was optional based on the participant’s decision after use of the aid. Of the six studies that measured abstinence, only two suggested a benefit of using a decision aid (versus usual care) on smoking abstinence and only one was statistically significant.

Print-Based Self-Help Materials

Primary results. A recent updated moderate-credibility review by Livingstone-Banks (2019b) assessed the effectiveness of different forms of print-based self-help materials compared with no treatment or other minimal intervention strategies. The review included 75 studies, with only 3 of them new to this update. Self-help interventions were defined as any manual or program designed to be used by individuals to assist a quit attempt not aided by health professionals, counselors, or group support. For the most part, that included written materials such as booklets and leaflets/brochures, but information could also have been provided via audio, video, or a similar medium. Brief leaflets on the health effects of smoking were considered a control condition if they were compared with a more substantial print-based intervention. Interventions that included a single face-to-face session for the purpose of supplying the print-based materials were included, but interventions that provided repeated sessions of advice in addition to self-help materials were excluded. Additionally, interventions delivered via a computer or mobile phone as well as those that included telephone counseling as adjuncts to self-help materials were excluded because these interventions were covered in other published reviews (which are also included in this overview of reviews).

The content and format of the self-help programs varied. The most frequently used materials were the American Lung Association’s cessation manual: Freedom From Smoking in 20 Days, and the maintenance manual: A Lifetime of Freedom From Smoking. Most other programs
were not named or fully described. Most of the recent studies used computerized expert systems
to provide tailored materials judged to be relevant to the characteristics of each smoker, based on
baseline data.

Overall, after pooling 32 studies of non-tailored self-help materials compared with no self-help,
irrespective of the level of contact and support common between groups, the point estimate
showed a small, but not statistically significant, benefit of the intervention (RR 1.06 [95% CI,
0.95 to 1.19]; $I^2=25\%$; $k=32$; $n=28,451$) (Table 5). Trials varied considerably in ways that could
potentially impact results, such as whether the materials were tailored, and the amount of face-to-
facing advice or counseling provided to both the intervention and control groups.

**Evidence of effect modification.** When isolated to only studies that compared groups who
received self-materials versus groups who received no intervention at all, results were
statistically significant: a meta-analysis of 11 trials that provided standard non-tailored self-help
manuals or materials compared with no materials for the control group showed some benefit of
self-help materials, although the confidence interval only narrowly excluded 1.0 (RR 1.19 [95% CI,
1.03 to 1.37]; $I^2=0\%$; $k=11$; $n=13,241$). Relative effects were also larger when comparing the
subset of studies in which participants in the intervention group received tailored self-help
materials versus controls receiving no intervention (RR 1.34 [95% CI, 1.19 to 1.51]; $I^2=0\%$;
$k=10$; $n=14,359$). However, there was no evidence that tailored materials were superior to
nontailored materials in indirect or direct comparisons.

**Telephone Counseling and Support**

**Primary results.** A recent moderate-credibility review by Matkin (2019) evaluated the effects of
telephone support to help smokers quit.\(^{111}\) Included trials evaluated the impact of proactive (i.e.,
recruiter-initiated contact) and reactive (i.e., smoker-initiated contact) among smokers of any
age, including pregnant individuals. The review identified 104 trials (30 of which are new to this
update) including 111,653 participants that met inclusion criteria. All included trials were
relatively large, with a median sample size of 735 and only 7 trials with a sample size of less
than 100. Participants were mostly adult smokers from the general population, but some studies
included adolescents, pregnant women, and people with long-term or mental health conditions.
Most studies (100/104) assessed proactive telephone counseling programs as opposed to reactive
forms. Proactive telephone counseling interventions included: 1) additional counseling calls that
took place following smokers calls to helplines and 2) counseling calls from counselors or other
health care providers that were among samples of smokers who had not originally contacted a
help line (essentially a “cold call”). Some studies provided telephone counseling alone, but many
others provided telephone counseling along with minimal support such as self-help materials, or
more active support such as face-to-face counseling, or with medications. The number of calls
ranged from a single call to 12 calls. The duration of the calls was typically 10 to 20 minutes,
although the first calls were often longer. Counseling was most often provided by professional
counselors or trained health care professionals.

Among trials including smokers who contacted helplines, quit rates were higher for smokers
receiving multiple additional telephone counseling sessions (mean quit rate, 10.8%) compared
with a control condition that was provided self-help materials or brief counseling in a single call
Likewise, in studies that recruited smokers who did not call a helpline, telephone counseling increased quit rates (mean quit rate, 13.9%) modestly compared with other minimal or brief counseling control groups (mean quit rate, 11.0%) (RR 1.25 [95% CI, 1.15 to 1.35]; I²=52%; k=65; n=41,233) (Table 5). Both proactive and reactive telephone counseling appeared to increase quit rates compared with health care provider counseling, but this finding is limited by the small number of trials testing this comparison (four trials).

Evidence of effect modification. The exclusion of trials among pregnant women, adolescents, and those at high risk of bias did not have a large influence on the effect size or statistical heterogeneity in the review. Likewise, subgroup analyses based on the baseline support provided to both intervention and control groups, counseling intensity, or motivation did not fully explain the heterogeneity in the results. However, there was some evidence through multivariate meta regression that the baseline support offered to both treatment arms as well as whether participants were selected for motivation to quit may have had some influence on the effect size related to proactive telephone counseling for smokers who did not call quit lines. The relative difference was greater for those receiving adjunctive self-help materials (35% greater) or brief face-to-face counseling (37% greater) than pharmacotherapy (referent). In the same model, studies that selected participants because of their motivation to quit were associated with a 26 percent increased relative risk compared with studies that did not select participants based on their motivation to quit. There was not enough evidence to suggest that a higher number of calls would result in a larger effect, although there was limited evidence that offering 3 to 6 calls may be more effective than offering just one single proactive call.

Mobile Phone–Based Support

Primary results. The high-credibility review by Whittaker (2019) identified 26 RCTs 14 of which are new) (n=33,849) that included an evaluation of a mobile phone-based intervention.139 The review included interventions that were aimed at mobile phone users, were based on delivery via mobile phone, or used any functions or applications that could be used or sent via a mobile phone. The review excluded trials that used mobile phones as an adjunct to face-to-face or Internet-based programs or that could not separate the effects of the mobile phone intervention components from the effects of a multicomponent intervention. All studies tested automated text messaging interventions (SMS) as a central component of the intervention. Several studies paired SMS with in-person visits, although the majority were purely test-messaging interventions. Five studies tested the effectiveness of smoking cessation smartphone apps alone, although the apps varied considerably in intervention content and components. Trials represented both young adults (mean age 18–27 years) and middle-age adults (up to mean age of 45 years).

A meta-analysis of 13 studies that compared a text messaging intervention with minimal smoking cessation support showed a positive benefit of text messaging interventions on smoking cessation at 6 months’ followup (RR 1.54 [95% CI, 1.19 to 2.00]; I²=71%; k=13; n=14,133)
Evidence of effect modification. The review found minimal differences in the overall result when pooled subgroups of studies were based on frequency of text messages (high-frequency vs. low-frequency), text message-only interventions, or those with only minimal (versus active) controls.

Real-Time Video Counseling

Primary results. A new high-quality review by Tzelepis (2019) assessed the effectiveness of real-time video counseling delivered individually or to a group (e.g., via video communication software such as Skype and FaceTime) in increased smoking cessation. Only two trials were identified (n=615). Both studies delivered real-time video counseling for smoking cessation individually, compared with telephone counseling. There was no statistically significant treatment effect for smoking cessation across the two included studies (RR 2.15 [95% CI, 0.38 to 12.04]; ℐ²=66%; k=2; n=608) (Table 5).

Internet-Based Support

Primary results. An updated high-credibility review by Taylor (2017) was designed to determine the effectiveness of Internet-based interventions for smoking cessation and to evaluate whether intervention effectiveness was altered by tailoring interactive features, and if there was a difference in effectiveness between adolescents, young adults, and adults. Any type of Internet intervention was eligible, and the comparison could be a no-intervention control, a different Internet intervention, or a non-Internet intervention. The review identified 67 RCTs, including data from over 110,000 participants. Thirty-nine of the trials were new to this update. Most of the studies were among adults; three studies recruited adolescents only and seven studies recruited young adults or university or college students. Most studies were conducted in the United States and recruitment and all intervention components were Web-based, with participants finding the sites through search engines and browsing. As a result of the recruitment methods, participants in these trials were motivated to quit smoking and chose the Internet as a tool for smoking cessation support. Sample sizes ranged from fewer than 70 to nearly 12,000.

A range of Internet interventions was tested in the included studies, from a very low-intensity intervention providing a list of Web sites for smoking cessation, to highly intensive interventions consisting of Internet-, email- and mobile phone-delivered components. Many interventions provided tailored interventions but differed substantially in the amount of tailoring. Some trials also included counseling or support from nurses, peer coaches, or tobacco treatment specialists. Some of the more recent trials incorporated online social networks such as Facebook, Twitter, and online forums. In 15 trials, all participants were using, or were offered, pharmacotherapy and the Internet component was thus evaluated as an adjunct to pharmacotherapy. Nine trials of lifestyle interventions provided content on a range of topics, including smoking cessation. These
trials were not included in the main synthesis and meta-analysis given that results were not isolated for smokers only.

Given the heterogeneity of the included evidence in terms of the interventions (i.e., tailored vs. not, interactive vs. not) and control conditions (i.e., nonactive controls [printed self-help guides, usual care], active controls [telephone, face-to-face counseling], addition of an Internet program plus behavioral support, or comparing one Internet intervention with another), the results were synthesized into distinct subgroups. Compared with a nonactive control group, pooled results demonstrated an effect in favor of interactive and tailored Internet-based interventions (RR 1.15 [95% CI, 1.01 to 1.30]; \( I^2 = 58\% \); \( k=8, n=6786 \)) (Table 5). However, these results should be interpreted with caution, as statistical heterogeneity was high and was unexplained despite perceived clinical homogeneity. Furthermore, though the pooled effect was in the direction of potential benefit, this analysis was based on a fixed effect model which can result in substantially different results compared with a random effect model when there are big imbalances in sample sizes in the studies being pooled. In fact, in this analysis, average absolute quit rates were slightly lower for the intervention (12.8%) vs. control (12.9%) groups. Five studies evaluated an Internet intervention plus behavioral therapy compared with a nonactive control and indicated a collective positive effect on the intervention (RR 1.69 [95% CI, 1.30 to 2.18]; \( k=5; n=2334 \)), although again, the statistical heterogeneity was quite high (\( I^2 = 60\% \)).

**Evidence of effect modification.** Given the heterogeneity in the included interventions and comparators, the review analyzed studies within distinct groups (interactive and tailored Internet-based interventions, interactive but not tailored Internet-based interventions, and neither interactive nor tailored Internet-based interventions). When compared with a nonactive control group, in all cases, statistical heterogeneity was high and unexplained; although the review performed no further analyses to explain this heterogeneity (likely due to largely null effects). In direct comparisons, none of the studies comparing an Internet intervention or Internet intervention plus behavioral support with an active control detected statistically significant evidence for differences between the conditions. Seven studies compared an interactive and/or tailored Internet program or Web site with an Internet intervention that was neither tailored nor interactive. Pooled results favored the intervention group; however, they were not statistically significant (RR 1.10 [95% CI, 0.99 to 1.22]; \( I^2 = 0\% \); \( k=7; n=14,623 \)).

**Incentives**

**Primary results.** We included one high-credibility review by Notley (2019) that examined whether incentives and contingency management programs led to higher long-term quit rates among smokers.117 Thirty-three studies among adults met inclusion criteria, including over 21,600 participants. Nearly three-quarters of the trials (22/33) took place in the United States. The incentives included cash rewards or monetary incentives in the form of vouchers, prize drawings alongside a guaranteed reward, the recovery of money deposited by those taking part, or a combination of incentive types. Seven studies included complex payment schedules that specifically rewarded continuous abstinence. The total financial amount of incentives (where reported) varied considerably between trials, from zero (self-deposits) to a range between $45 and $1,185. All but one study included additional cessation support such as brief advice, pharmacotherapy, and in one case – e-cigarettes. Most of the studies took place in worksites or
substance misuse clinics; six studies delivered support in a health clinic including mental health clinics, head and neck cancer clinics, or primary care clinics. The pooled RR for quitting with incentives at longest followup (6 months or more) compared with usual care or a non-incentive-based intervention was 1.49 ([95% CI, 1.28 to 1.73]; \( I^2 = 33\%\); k=30; n=20,097) (Table 5).

**Evidence of effect modification.** There was no significant difference between studies that offered incentives up until the point of measuring abstinence (i.e., at 6 months) versus those where the longest followup occurred after the incentive schedule had ended. In the subgroup of studies in which followup was beyond the provision of incentives a statistically significant benefit was found, suggesting that the impact of incentives continues for at least some time after incentives are no longer provided. The results of an exploratory meta-regression suggested that there was no clear direction of effect between trials offering low or high total value of incentives. Two studies conducted a head-to-head comparison between a rewards-based and deposit-refund-based approach and found both to be effective with no significant differences or negligible differences between groups.

**Biomedical Risk Assessment**

**Primary results.** We identified one moderate-credibility review, Clair (2019), that evaluated the efficacy of biomedical risk assessment (with or without other behavioral counseling) to aid in smoking cessation.\(^9\) Biomedical risk assessment interventions included a physical measurement to increase motivation to quit smoking, such as exhaled carbon monoxide (CO), spirometry, atherosclerotic plaque imaging, and genetic testing. The review identified 20 studies, 5 of which are new to this update, that met inclusion criteria. These trials represented over 9000 participants, with studies ranging from 64 to 2110 participants per study. In most studies, the biomedical testing component was added to intensive quit-smoking sessions (which both the intervention and control groups received), with counseling lasting up to 60 minutes and complemented by written material and reinforcement sessions or followup phone calls.

Five studies tested feedback on smoking exposure, each measuring the effect of exhaled CO measurements; there was no evidence of a statistically significant benefit from these studies in pooled analysis (RR 1.00 [95% CI, 0.83 to 1.21]; \( I^2 = 0\%\); k=5; n=2368) (Table 5). Likewise, there was no evidence of a significant benefit of interventions providing feedback on participants’ genetic susceptibility to smoking-related cancer or Crohn’s disease (RR 0.80 [95% CI 0.63 to 1.10]; \( I^2 = 0\%\); k=5; n=2064). Eleven studies provided feedback on smoking-related harm: four tested the combination of exhaled CO measurement and spirometry, five tested the effect of spirometry alone or with the addition of feedback on lung age; and two tested the effect of undergoing an ultrasonography of carotid arteries and/or femoral arteries with photographic demonstration of atherosclerotic plaques when present. A pooled analysis of all 11 studies resulted in an unclear effect on smoking cessation (RR 1.26 [95% CI, 0.99 to 1.61]; \( I^2 = 34\%\); k=11; n=3314).

**Evidence of effect modification.** There was no evidence that the effectiveness of these interventions differed according to the type of biomedical feedback given (i.e., smoking exposure risk, smoking-related disease risk, or smoking-related harm).
Exercise

**Primary results.** We included one high-credibility review by Ussher (2019) that evaluated the effect of exercise on smoking cessation (n=7,279).\(^{136}\) The review included RCTs that compared an exercise program alone, or an exercise program as an adjunct to another smoker cessation program, with a cessation program alone or another non-exercise control group among adult smokers who were motivated to quit. Trials among adolescents as well as persons with psychological health conditions were excluded. The review included 24 trials that met inclusion criteria; six new studies were identified since the last review on this subject. Most of the trials used supervised, group-based aerobic exercise intervention supplemented by home-based exercise. In most cases, the exercise intervention started before the stated quit date. Twenty-two studies included smoking cessation support as the comparator, and two studies had relapse prevention support as the comparator, with all but one study offering this support for both exercise and control groups. The sample size in these trials was smaller than that seen in other smoking cessation trials, ranging from 20 to 2318, with more than half of the studies enrolling fewer than 100 participants.

In pooled analyses, there was no statistically significant difference between smoking cessation interventions that included exercise versus those that did not (RR 1.08 [95% CI, 0.96 to 1.22]; \(I^2=0\%\); k=21; n=6607) at 6 or more months’ followup (Table 5).

**Evidence of effect modification.** Considering the type of exercise, there was no evidence in the review that the effects differed according to whether the exercise included aerobic exercise, resistance training combined modalities, or unknown types of physical activity. None of the effects were statistically significant among these subgroups by exercise type, and the confidence intervals of pooled analyses and individual effects all overlapped. Excluding studies among special populations such as those with mental health issues, or pregnant populations did not affect the interpretation of the results.

**Complementary and Alternative Therapies**

**Primary results.** We included two reviews that examined the effectiveness of complementary and alternative therapies on smoking cessation, one on acupuncture and acupressure\(^{138}\) and one on hypnotherapy.\(^{84,166}\) The high-credibility review on acupuncture, by White (2014), included 38 RCTs that compared the effects of acupuncture (23 studies), acupressure (5 studies), laser therapy (3 studies), and electrostimulation (7 studies) versus no or sham intervention for smoking cessation at short-term (6 weeks or less) and long-term (6–12 months) followup.\(^{138}\) This review reported a positive effect for acupuncture compared with sham acupuncture on short-term cessation (RR 1.22 [95% CI, 1.08 to 1.38]; \(I^2=46\%\); k=16; n=2,588) but failed to find a pooled effect on longer term outcomes (RR 1.10 [95% CI, 0.86 to 1.40]; \(I^2=23\%\); k=9; n=1,892) (Table 5). Similarly, there was no evidence of a benefit of acupressure, continuous auricular stimulation, or electrostimulation versus sham interventions on long-term cessation.

The high-credibility review on hypnotherapy, by Barnes (2019), included 14 trials.\(^{84}\) Given the clinical heterogeneity of intervention and control conditions in the body of evidence, this review grouped the studies into comparisons according to the control conditions (i.e., no intervention,
attention-matched behavioral interventions, brief behavioral interventions, intensive behavioral interventions, rapid/focused smoking, drug, and placebo). The studies varied greatly in the method of hypnotic induction and the number and duration of hypnotherapy sessions. In general, this review found no evidence of a difference in smoking cessation at 6 months’ or greater followup among trials that compared hypnotherapy versus no intervention or other smoking cessation interventions (Table 5). In the group with the most trials, there was no overall difference in smoking cessation rates between groups at 6 months or greater followup between hypnotherapy versus attention-matched smoking cessation behavioral intervention (RR 1.21 [95% CI, 0.91 to 1.61]; k=6; n=957; I²=36%).

**Systems-Level Interventions**

**Primary results.** We included two reviews that addressed the effectiveness of system-level interventions to support smoking cessation. The reviews contained mutually exclusive bodies of evidence given differences in scope. The first high-credibility review, by Boyle (2014), focused on the effectiveness of electronic health record (EHR)-facilitated interventions on smoking cessation support actions by clinicians, clinics, and health care delivery systems. The most common enhancement of the EHR was connecting smoking patients with a telephone-based quit line. While the review included 16 studies (6 group RCTs, 1 individual RCT, and 9 nonrandomized observational studies), none of the studies included a direct assessment of patient quit rates (Table 5). One group RCT (n=9589) reported a comparison of quit rates between intervention and control clinics that were measured indirectly based on EHR documentation of smoking status. In that study, significantly more smokers in the intervention clinics were subsequently documented as nonsmokers compared with smokers in the control clinics 6 months after changes were implemented (5.3% vs. 1.9%, p<0.001). The remaining studies focused on the impact of EHR changes on smoking support actions by clinicians, clinics, and health systems and specifically focused on the 5 A’s (Ask, Advise, Assess, Assist, Arrange). In general, most studies found an increase in the documentation of tobacco use and quit assistance following the introduction of an electronic reminder.

The other high-credibility review, by Thomas (2017), was more broadly scoped and focused on the effectiveness of practice and policy changes within organizations to integrate the identification of smokers and the subsequent offering of evidence-based nicotine dependence treatments into usual care, beyond just changes to the EHR. The review included seven group RCTs, of which all but one was conducted in the United States. The settings included primary care clinics (2 trials), dental clinics (2 trials), a community pharmacy (1 trial), VA medical center (1 trial), and a pediatric practice focused on parents (1 trial). Interventions were characterized based on the provision of six system change components: 1) identification/documentation of smoking status, 2) smoking cessation training/resources/feedback for providers, 3) dedicated staff to support cessation activities, 4) policies to improve access to cessation interventions, 5) free smoking cessation treatment from the organization, and 6) reimbursement of clinics for providing smoking cessation support. None of studies incorporated all six system change strategies. The identification of all smokers and training staff and provision of evidence-based treatment were components of all seven included studies. All included studies used the services of existing staff to provide the intervention. Four studies (n=7142) reported the effects of the intervention on smoking cessation. Of these, two studies found that the quit rate was higher in
the intervention group than in the control group at 6 and 12 months’ followup whereas the other two showed no difference between groups. There was some evidence for the effectiveness of the interventions on secondary outcomes such as documentation of smoking status and provision of cessation counseling, but each outcome was not consistently reported and several showed mixed effects (Table 5).

Reduce-to-Quit Interventions

Most standard smoking cessation interventions, including most of the interventions synthesized above, encourage quitting smoking abruptly on a designated quit day. One recent high-credibility review by Lindson (2019c) assessed the effect of reduction-to-quit interventions versus no cessation intervention or abrupt quitting on long-term (6 months or more) cessation.106 Trials that included at least one arm where smokers were advised to reduce their smoking consumption before quitting smoking altogether were included. This advice could be delivered through self-help materials or behavioral support or alongside smoking cessation medications. Fifty-one trials (n=22,509) were identified. Compared with no smoking cessation intervention, there was no evidence that reducing smoking consumption before quitting was more effective for abstinence at 6 months or greater (RR 1.74 [95% CI, 0.90 to 3.38]; I²=45%; k=6; n=1599) and no evidence that reducing consumption was superior (or inferior) to abrupt quitting (RR 1.01 [95% CI, 0.87 to 1.17]; I²=29%; k=22; n=9219) (Table 5).

Relapse Prevention Interventions

A separate moderate-credibility review by Livingstone-Banks (2019a) focused on relapse prevention interventions for tobacco cessation.109 While there is no clear definition of a relapse prevention intervention, in general, relapse prevention is considered to apply to interventions that explicitly seek to reduce relapse rates after an acute treatment phase is successfully completed, or at some time after the quit date. The duration of the acute treatment phase varies, leading to variability in the post at which measurement of a relapse prevention effect begins. Studies of interventions for relapse prevention may randomly assign people who have already quit, or they may randomly assign smokers before their quit attempt and provide a general smoking cessation intervention to all participants, in addition to an extra component provided for those randomly assigned to relapse prevention.

The 77 studies included in the review were highly variable and included both pharmacologic and behavioral interventions to help prevent relapse. They (a) focused on people who had already quit or (b) helped people to quit, then tested treatments to prevent relapse. Several studies centered on special populations that needed to stop smoking for a limited period of time because they were pregnant (18 studies), in a hospital (5 studies, or serving in the military (3 studies). Analyses of behavioral interventions among abstainers did not detect an effect in both studies of assisted abstainers (RR 0.99 [95% CI, 0.87 to 1.13]; I²=56%; k=10; n=5408) and unaided abstainers (RR 1.06 [95% CI, 0.96 to 1.16]; I²=1%; k=5; n=3561) from the general population. Twelve included studies focused on pharmacologic interventions for existing abstainers (either unaided or following cessation pharmacotherapy, 11 studies) or for those that were randomly assigned extended treatment (1 study). There was some evidence that extending varenicline could be beneficial in preventing relapse, but it was only reported by two studies. NRT was
found to help in unassisted abstainers, but no difference was seen among those who achieved abstinence with NRT. None of the six studies that examined the use of bupropion to prevent relapse found a statistically significant effect.

Ancillary and Population Subgroup Effects

Two reviews specifically explored the differences in the effectiveness of pharmacotherapy according to sex\textsuperscript{113, 125} and were discussed within the sections on pharmacotherapy results. Nineteen additional reviews synthesized the evidence on the benefits of pharmacotherapy or behavioral interventions among specific subpopulations of adults (Table 2). These included: eight reviews limited to persons with severe mental illness;\textsuperscript{82, 101, 102, 119, 121, 134, 137, 143} two limited to those with or in treatment for alcohol or drug dependence;\textsuperscript{83, 133} five focused on adapted interventions for ethnic minorities\textsuperscript{88, 100, 108} or otherwise disadvantaged persons;\textsuperscript{85, 140} two limited to smokeless tobacco users;\textsuperscript{83, 133} one among individuals categorized as not motivated to quit,\textsuperscript{142} and one that explored the effectiveness of pharmacotherapy by subgroups defined by genetically informed biomarkers.\textsuperscript{123} Within these 19 reviews, most included trials were \textit{limited} to these subpopulations and very few included trials (or reviews) addressed the relative effectiveness according to subgroup (e.g., the relative effects among those with or without depression). Results of these reviews were consistent with the broader evidence among general adult populations (reviews in which many of these subpopulation studies were included) and suggested effectiveness of both pharmacotherapy and behavioral interventions, alone and combined, to quit smoking. Where pooled results were presented, the direction and magnitude of effects was almost identical to that seen with the broader evidence base, although the number of studies within each review was considerably smaller given the focus on specific subpopulations.

\textbf{E-Cigarettes}

We identified four fair-quality RCTs that evaluated the effectiveness of using e-cigarettes to help current conventional smokers stop or reduce smoking compared with placebo or nicotine replacement (Table 6).\textsuperscript{145, 147, 151, 156} The four trials all took place outside of the United States with one in the United Kingdom, one in Italy, and two in New Zealand. The mean age of enrolled smokers was 41 to 44 years in all four trials. three trials enrolled mostly females (~60-70\%) whereas the other enrolled mostly males (36.7\% female). Smokers within all four trials were heavy smokers with the median cigarettes smoked per day ranging from 15 to 20 and most had tried to quit in the past year. Further demographic details of the enrolled samples were sparsely reported (Appendix F Table 1). The types of e-cigarettes, nicotine content, delivery of the intervention, and additional intervention components differed across all four trials as did the comparisons (Appendix F Table 2). One trial compared 1) NRT patch plus a nicotine e-cig (18 mg/mL), 2) NRT patch plus a nicotine-free e-cig (0 mg/mL), and 3) NRT patch only. Another trial compared 1) nicotine e-cig (18 mg/mL) to 2) any form of NRT. Another trial compared 1) nicotine e-cig (16 mg/mL), 2) nicotine patch (21 mg), and 3) nicotine-free e-cig. And, the final trial compared 1) nicotine e-cig (7.2 mg/mL) for 12 weeks, 2) nicotine e-cig (7.2 mg/mL for 6 weeks followed by 5.4 mg for 6 weeks), or 3) nicotine-free e-cigs. Whereas one trial allowed participants to use any brand of e-cigarette with any concentration of nicotine after a 4-week run-in period with a starter kit, three trials provided participants with e-cigarette cartridges for the whole study period. Of the four e-cigarettes evaluated for cessation, only the eVOD device
(Walker trial) and OneKit Aspire (TEC trial) are currently available in US markets; the Elusion e-cigarette model used in the ASCEND trial has been discontinued and the Categoria e-cigarette (ECLAT trial) is not sold in US markets.

The largest and most recent trial, conducted in New Zealand, randomized participants to a 12-week treatment phase of 1) a nicotine patch plus a nicotine e-cig (n=500); 2) a nicotine patch plus a nicotine-free e-cig (n=499), or 3) a nicotine patch only (n=125). All three groups also received behavioral counseling, although compliance data indicated that the patch plus nicotine e-cig group received more calls than the patch-only group. After 6 months following the agreed-upon quit date, verified continuous abstinence was statistically significantly higher in the patches plus nicotine e-cig group (7%) versus the patch plus nicotine-free e-cig group (4%) (RR 1.75 [95% CI, 1.02 to 2.98; p=0.038) but not the patch-only group (2%) (RR 2.92 [95% CI, 0.91 to 9.33]; p=0.05) (Table 7). Complete case and per-protocol analyses produced similar results with differences found between the two e-cig groups but not the nicotine-containing e-cig versus patch only groups. Absolute rates of self-reported quitting at 6 months were considerably higher than verified abstinence in all three groups (patch plus nicotine e-cigs: 18%, patch plus nicotine-free e-cigs: 11%, and patches only: 8%) with statistically significant differences found when comparing the nicotine-containing e-cigs to the other two groups, respectively.

Median time to relapse (defined as smoking at least 5 cigarettes in the past 7 days) did not differ significantly between the patch plus nicotine e-cig group (193 days) versus the patch plus nicotine-free e-cig group (153 days) (hazards ratio [HR] 0.85 [95% CI, 0.70 to 1.03]; p=0.01) or patch only group (160 day (HR 0.90 [95% CI, 0.63 to 1.28; p=0.56). Thirty-nine percent of the participants in the patch plus nicotine e-cig group relapsed within 6 months versus 43 percent of participants in the patch plus nicotine-free e-cig group and 31 percent of participants in the patch only group. Furthermore, in those still smoking at 6 months, there was no significant difference in change from baseline in the average number of cigarettes smoked per day or the proportion who reduced the number of cigarettes smoked per day by at least 50 percent.

The results of this trial should be interpreted in light of some considerable limitations including high and differential loss to followup: at 6 months, only 50 percent of participants in the patch-only group were retained as opposed to 68 percent in both the nicotine and nicotine-free e-cig groups. The majority of participants in the patch group who withdrew did so immediately post-randomization citing not wanting to be in that group. Furthermore, of those retained in the patch-only group, 15 percent crossed over and used an e-cigarette during the trial, with most crossing over within the first 6 weeks. Similarly, 11 percent of those randomized to the nicotine-free e-cig group crossed over to using nicotine-containing e-cigarettes. Detection bias was also likely with 70 percent of the nicotine e-cig group correctly identifying the presence of nicotine in their e-liquid. At 6 months, 22 to 40 percent of participants in all three groups were still using the patch whereas 49 to 56 percent of participants were still using an e-cig only or both a patch and e-cig.

In another large trial (the TEC trial) in the United Kingdom, Hajek and colleagues randomized 886 smokers participating in National Health Services stop-smoking services to tobacco flavored e-cigarettes with 18 mg nicotine/ml (intervention group) or any form of NRT (comparison group). Both groups received 4 weeks of behavioral counseling. The primary outcome was abstinence at 1 year, defined as self-report of not more than five cigarettes from the target quit
date, validated by expired CO<8 parts per million (ppm). At 1 year, 18 percent in the e-cigarette group were abstinent from smoking, compared with 9.9 percent in the comparison group (RR 1.83 [95% CI, 1.30 to 2.58]) (Table 7). However, 80 percent of abstinent subjects assigned to the intervention group were still using e-cigarettes, compared with 9 percent in the comparison group continuing to use nicotine replacement at 1 year. Overall loss to followup was 21 percent (19% in the e-cigarette group and 23% in the NRT group).

In the ASCEND trial, Bullen and colleagues randomized 657 smokers in New Zealand who wanted to stop smoking to one of three interventions: 16 mg nicotine e-cigarette (n=285), 21 mg nicotine patch (n=295), or placebo e-cigarette (n=73). Those randomized to one of the e-cigarette arms were directly mailed the e-cigarette, a spare battery and charger, cartridges, and simple instructions on how to use the e-cigarette, whereas those randomized to receive a patch were mailed cards and vouchers to redeem a patch from community pharmacies. All participants were also offered telephone-based support via a quit line that called them directly; participants who declined or did not call back were still able to access other quit line support such as text messages. The primary outcome, abstinence at 6 months, was verified by exhaled CO<10ppm. Tobacco smoking cessation was generally low in all three groups: 7.3 percent with e-cigarettes, 5.8 percent with nicotine patches (RR for nicotine e-cigarettes vs. patches 1.26 [95% CI, 0.68 to 2.34]), and 4.1 percent with placebo e-cigarettes (RR for nicotine e-cigarettes vs. placebo 1.77 [95% CI, 0.54 to 5.77]) (Table 7). Thirty-eight percent of those who were abstinent and assigned to e-cigarettes still used e-cigarettes at 6 months, although it was unknown whether they were using nicotine or non-nicotine cartridges. There was differential loss-to-followup between groups at 6 months: 27 percent of those assigned to the patch versus 17 percent and 22 percent of those randomized to the nicotine and placebo e-cigarette groups, respectively.

In a secondary analysis of cessation data from the ASCEND trial, O’Brien and colleagues examined the effectiveness of e-cigarettes among patients with (n=86) and without (n=571) a mental illness (defined as taking prescription medication for a diagnosed mental illness) at the time of randomization. At the 6-month followup among participants randomized to e-cigarettes, there were no significant differences in smoking cessation between people with (5%, n=2/39) and without mental illness (n=7%, 19/250) (p=0.75). Among those with a mental illness (n=86), there were no significant differences in quit rates among those randomized to e-cigarettes (5%, 2/39) had biochemically verified smoking abstinence) as compared with those who used nicotine patches (14%, 5/35) (p=0.245). Among participants with mental illness randomized to placebo e-cigarettes, none had achieved cessation at 6 months (Table 7).

Caponnetto and colleagues conducted an RCT in Italy, the ECLAT trial, in which 300 conventional smokers who were not intending to quit were randomized to receive one of three e-cigarette nicotine cartridge doses for the Categoria brand model 401 e-cigarette: 7.2 mg nicotine for 12 weeks; 7.2 mg nicotine for 6 weeks followed by 5.4 mg nicotine for 6 weeks; or cartridges with no nicotine. The appearance of the cartridges was identical to maximize blinding, although it is unclear whether allocation was concealed. After the 12-week intervention phase, participants were free to purchase e-cigarettes on their own. At 1 year, abstinence rates (verified by <7.5 ppm exhaled CO) were 11 percent for participants in the combined nicotine groups compared with 4 percent in the group receiving no-nicotine cartridges (p=0.04) (Table 7). At the 1-year assessment, 26.9 percent of all study participants were still using e-cigarettes. There was
substantial loss to followup in the study: no followup data was available for 36 percent of those randomized to one of the nicotine-containing cartridges and 45 percent of those receiving no-nicotine cartridges.

Key Question 3. What Harms Are Associated With Tobacco Cessation Interventions in Adults?

Combined Pharmacotherapy and Behavioral Interventions

None of the included reviews synthesized the evidence on harms related to combined pharmacotherapy and behavioral support versus no or minimal interventions. Any harms of combined therapy are assumed to be like those of the pharmacotherapy being used.

Pharmacotherapy Interventions

We included nine primary reviews and one original RCT (EAGLES) that reported AEs related to pharmacotherapy interventions for smoking cessation in general adult populations. In addition, six reviews and the EAGLES trial addressed the harms of pharmacotherapy among persons with severe mental illness.

Nicotine Replacement Therapy

Harms related to NRT use were reported in four reviews among the general adult population and one review among persons with severe mental illness. All five of these reviews were rated as moderate or high credibility. AEs from the use of NRT are typically related to the type of product and include skin irritation from patches and irritation to the inside of the mouth from gum and lozenges. Pooled results from multiple reviews indicate a higher risk of heart palpitations and chest pains, or any CV event (any clinical diagnoses of a CV event including minor events such as palpitations, bradycardia, and arrhythmia) from NRT versus non-NRT control groups (Table 8). For instance, among non-high-risk adults, one review found an approximate 80 percent increase risk of any CV event among those randomized to NRT compared with placebo (RR 1.81 [95% CI, 1.35 to 2.43]; I²=0%; k=21; 11,647). A sensitivity analysis found that these treatment effects were driven predominantly by more minor CV events, however, including bradycardia and arrhythmia, and occurred primarily in studies with longer followup periods. When restricted to major adverse CV events (defined by the FDA as a combined outcome of cardiovascular death, nonfatal myocardial infarction, and nonfatal stroke), pooled results did not clearly establish harm (RR 1.38 [95% CI, 0.58 to 3.26]; I²=0%), but the confidence interval was quite wide and incorporated potential benefit as well as significant harm and the overall number of SAEs was very low. Eight studies reported on mortality and did not find a significant association between NRT and controls (OR 0.74 [95% CI, 0.33 to 1.67]; I²=0%; k=8; n=2765).
There was no evidence of an effect on cardiac AEs, SAEs, or withdrawals when looking at different forms, deliveries, doses, durations, and schedules of NRT (Table 8).

Furthermore, there was no evidence of a difference in harms, including a worsening of psychiatric symptoms, related to NRT within three reviews that focused on trials limited to smokers with severe mental illness.

**Bupropion**

Harms related to bupropion use were reported in two moderate-to-high credibility reviews among unselected adults and one moderate credibility review among persons with severe mental illness. The Hughes review (2014) examined SAEs reported in 33 trials of bupropion versus placebo or no pharmacotherapy control, including trials that were excluded from their efficacy analysis because of short followup (i.e., less than 6 months). SAEs were defined per the FDA as any event that was life-threatening, resulted in hospitalization, death, disability, or permanent damage, or required intervention to prevent one of the above outcomes reported during or within 30 days of drug treatment. This review found a nonstatistically significant increased risk in the rate of SAEs while on treatment among those randomized to bupropion versus control (RR 1.30 [95% CI, 1.00 to 1.69], I²=0%; k=33; n=9,631), with very low SAE rates of 2.1 percent for bupropion users and 1.9 percent for placebo users or non-bupropion participants (Table 8).

The Hughes review also found no difference between groups in terms of cardiovascular serious events (RR 1.16 [95% CI, 0.65 to 2.06]; k=25; data not shown). Similarly, the Mills (2014) review suggested no significant increased risk of any CV event for bupropion versus placebo (RR 1.03 [95% CI, 0.71 to 1.50], I²=0%; k=27; n=10,402) (Table 8). The confidence interval of the pooled estimate was wide and consistent with a mildly beneficial or mildly harmful effect. While the results for major CV events were imprecise due to small numbers of events, they were consistent with a possible protective effect or very minor harms (RR 0.57 [95% CI, 0.31 to 1.04]; I²=0%; k=27; n=10,402) (Table 8). When restricted to the eight trials of high-risk patients, the results were in the same direction as non-high-risk adults but were not statistically significant. In the recent EAGLES trial, there was no significant difference in the incidence of cardiovascular events during treatment between those on bupropion versus placebo, nor a significant difference in time to onset of major cardiovascular AEs (hazard ratio [HR] 0.50 [95% CI, 0.10 to 2.50]).

There is also no evidence of a difference in the risk of psychiatric serious events for those taking bupropion. In the review by Hughes, a pooled analysis of 19 placebo-controlled trials found a 40 percent reduced risk of neuropsychiatric AEs among those taking bupropion (RR 0.60 [95% CI, 0.28 to 1.28]; k=19; data not shown). Similarly, in the recent EAGLES trial, there was no evidence of a significant increase in neuropsychiatric AEs attributable to bupropion relative to nicotine patch or placebo. The primary endpoint in this trial was a composite measure based on post marketing reports of neuropsychiatric AEs in smokers taking bupropion and varenicline, and included 16 neuropsychiatric symptom categories. The overall incidence of neuropsychiatric AEs was similar across the bupropion (4.5%, 90 of 2006 participants), nicotine patch (3.9%, 78 of 2022 participants), and placebo (3.7%, 74 of 2014 participants) groups. For both the nonpsychiatric and psychiatric cohort, there was no significant difference in neuropsychiatric AEs in those assigned to bupropion versus placebo (risk difference [RD] -0.08 [95% CI, -1.37 to
Likewise, there was no difference between the bupropion and placebo groups in rates of suicidal behavior and ideation.

A separate moderate-credibility review by Roberts (2016) synthesized the direct and indirect evidence on pharmacologic tobacco cessation treatment among adult smokers with any form of severe mental illness, defined as any nonorganic disorder with psychotic features that results in a substantial disability including schizophrenia, schizoaffective disorder, bipolar disorder, delusional disorder or depressive psychoses. Harms were measured using a tolerability outcome which equaled the number of patients discontinuing the trial due to any adverse event. Across six trials that compared bupropion with placebo, three trials reported that no participants in either group discontinued the trials because of AEs. In the remaining three trials, two found greater rates of dropout among those in the placebo group versus bupropion group, whereas the remaining found five versus two dropouts due to AEs among the bupropion versus placebo groups, respectively. Pooling all six trials showed no statistically significant difference between groups (OR, 0.93 [95% CI, 0.18 to 4.74]; I² = 26%; k=3; n=2011) (Table 8).

**Varenicline**

Harms related to varenicline use were reported in three reviews among unselected smokers, four reviews among persons with severe mental illness, and one review limited to smokeless tobacco users. The most commonly reported adverse effect of varenicline was nausea, which was mostly at mild to moderate levels and usually subsided over time. Other common side effects of varenicline versus placebo with a statistically significant increase were insomnia, abnormal dreams, headache, and fatigue. A meta-analysis of SAEs occurring during or after active treatment suggested there may be a 25 percent increase in the chance of SAEs among people using varenicline compared with placebo (RR 1.25 [95% CI, 1.04 to 1.49]; k=29; 15,370) (Table 8); however, many of these events included comorbidities that were mostly considered by the trialists to be unrelated to the treatments. Across all reviews, very few deaths were reported in the included trials and no review found a difference in all-cause mortality between varenicline and placebo.

Pooled analyses representing over 12,000 participants do not indicate a statistically significant increased risk of cardiovascular events (Table 8). For instance, within the Mills (2014) review, among 18 trials comparing varenicline with placebo, there was no evidence of an increased risk of cardiovascular AEs (RR 1.24 [95% CI, 0.85 to 1.81]; I² = 0%; k=18; n=9072) of major cardiovascular AEs among adults (RR 1.44 [95% CI, 0.73 to 2.83]; I² = 0%; k=18; n=9072). Similarly, in a more recent low-credibility review, when pooling data across 38 studies, the review by Sterling (2016) found no significant difference for cardiovascular SAEs when comparing varenicline (57 events within 7213 participants) with placebo (43 events within 5493 participants) (RR 1.03 [95% CI, 0.72 to 1.49]). Furthermore, similar results were found among patients with and without a history of cardiovascular disease. In the EAGLES trial, during the initial 12-week treatment phase, there was no significant difference in time to onset of major cardiovascular event between those taking varenicline (n=909) versus placebo (n=999) (HR 0.29 [95% CI, 0.05 to 1.68]). A similar lack of difference was seen for other, longer periods of followup. Likewise, there was no observable difference in the incidence of any component
cardiovascular event (e.g., nonfatal MI, new or worsening peripheral vascular disease) at any point.

There was also no evidence of a statistically significantly higher risk of neuropsychiatric AEs for those on varenicline versus placebo (Table 8). In the most recent review by Cahill (2016), 23 trials representing nearly 9000 smokers found no difference in the number of people experiencing a neuropsychiatric event between those randomized to varenicline versus placebo (RR 0.82 [95% CI, 0.57 to 1.19]). Likewise, in the review by Thomas (2015), there was no evidence of an increased risk of suicide or attempted suicide (Peto OR 1.67 [95% CI 0.33 to 8.57]), suicidal ideation (Peto OR 0.58 [95% CI, 0.28 to 1.20]), or depression (Peto OR 0.96 [95% CI, 0.75 to 1.22]) associated with varenicline. There was no evidence that the risk of depression and suicidal ideation differed by age, sex, ethnicity, smoking status, the presence or absence of psychiatric illness, or study sponsorship. The effect estimates (Peto OR) for the trials in which all participants had psychiatric illnesses compared with those where none of the participants had psychiatric illness were 0.79 (95% CI, 0.32 to 1.93) versus 0.34 (95% CI, 0.09 to 1.29) for suicidal ideation and 1.49 (95% CI, 0.84 to 2.65) versus 0.91 (95% CI, 0.69 to 1.21) for depression. Four other reviews similarly found no differences in neuropsychiatric AEs or discontinuation due to AEs between smokers with severe mental illness taking or not taking varenicline (Table 8). In the EAGLES trial, 4.0 percent of those assigned varenicline (80 of 2016 participants) experienced a neuropsychiatric event compared with 4.5 percent of those assigned bupropion, 3.9 percent assigned nicotine patch, and 3.7 percent assigned placebo. There was a treatment by subgroup effect such that for the non-psychiatric cohort, the risk of a neuropsychiatric AE was lower for those assigned to varenicline versus placebo (RD -1.28 [95% CI, -2.40 to -0.15]) and for the psychiatric cohort, there was no difference (RD 1.59 [95% CI, -0.42 to 3.59]). Finally, no differences in the rates of nausea, sleep disturbances, or mood disorders were seen within three trials testing the effectiveness of varenicline versus placebo among smokeless tobacco users.

**Other Medications**

The review by Hughes (2014) included five studies that compared nortriptyline to placebo or to a no-pharmacotherapy control that measured and reported SAEs occurring during treatment. Across all trials, only one SAE was reported (collapse/palpitations) and was thought to be possibly due to treatment. However, studies of nortriptyline used for depression, typically used at higher doses than what was seen in the included evidence, suggest it may have the potential for more SAEs (including fatal overdoses) than those reported in trials of nortriptyline for smoking cessation. Because nortriptyline is not approved for smoking cessation in any country, we are unaware of any observational data examining harms among smokers. Harms of the use of other antidepressants for smoking cessation were not reported by this review.

In general, four trials of cytisine that all reported on harms did not identify more AEs or SAEs in the intervention versus control arm, but this data is limited by the few numbers of trials and lack of reporting at longer followup.
Behavioral Interventions

Only three of the reviews on behavioral interventions included any discussion of potential harms from behavioral-based tobacco cessation interventions, including the review on internet-based interventions, the review on incentives, and the review on hypnotherapy. There was no clear harm related to any of these interventions. In the review on internet-based interventions, few trials reported AEs (6 of 67 included trials) and in those that did, AEs were rare and minor (i.e., weight gain, perceived stress, sleep disorder, fatigue). In the review on incentives for smoking cessation, one trial found no evidence of worsened psychiatric symptoms among smokers with serious mental illness. None of the other included studies reported on any harms, unintended consequences or AEs associated with the offering incentives. The Barnes review looked for reported AEs among participants taking part in hypnotherapy interventions and found that none of the 14 included studies reported AEs.

Reduction-to-Quit Interventions

The review by Lindson (2019c) reported no clear evidence that the number of people reporting SAEs, or changes in withdrawal symptoms, differed between those advised to reduce their smoking versus those receiving no advice or advice for abrupt quitting; although pre-quit AEs, SAEs, and withdrawal symptoms were measured and reported variably and infrequently across studies.

E-Cigarettes

The four RCTs that evaluated the effectiveness of e-cigarettes to aid in efforts to quit smoking conventional cigarettes at 6 months or longer, as well as four RCTs of e-cigarettes with shorter followup periods, were included in the evaluation of e-cigarettes’ harms. No cohort studies met criteria for inclusion. Characteristics of studies included for harms are described in Table 6 and Appendix F Tables 1 and 2.

None of the studies reported statistically significant differences in SAEs between intervention and control groups (Table 9). All four trials that evaluated e-cigarette effectiveness reported nonsignificant distributions of AEs between the intervention and control groups at ≥6 months of followup (Table 9). The ASCEND trial, conducted by Bullen and colleagues, found no statistically significant difference in the incidence rate ratio (IRR) for AEs between these groups at 6 months’ followup (IRR 1.05 [95% CI, 0.82 to 1.34], p=0.7), despite a higher number and proportion of SAEs occurring in the nicotine e-cigarette group (27 serious events, 19.7%) than in the nicotine patch group (14 events, 11.8%). The authors deemed none of the AEs to be related to product use in any of the treatment groups. Similarly, the ECLAT study by Caponnetto and colleagues found no difference in the frequency of AEs among study groups at 12 and 52 weeks. No serious events occurred during the study. In the TEC trial, Hajek and colleagues reported that, as compared with participants assigned to NRT, those assigned to e-cigarettes had higher rates of throat and mouth irritation (e-cigarettes: 65.3% vs. NRT: 51.1%; RR 1.27 [95% CI, 1.13 to 1.43]) and lower rates of cough (e-cigarettes: 30.8% vs. NRT: 39.8%; RR 0.8 [95% CI, 0.6 to 0.9]) at 12 months of followup. SAEs occurred in both groups, but the trial clinicians determined that none of these events were attributable to study
product use (Table 9). In the most recent trial, SAEs occurred in 16 participants in the patch plus nicotine e-cig group, 22 people in the patch plus nicotine-free e-cig group, and 3 people in the patch only group; although the incidence rate ratios between group were not statistically significant and the authors deemed that none of the SAEs were considered treatment related.

Among the four trials newly identified by this review with followup periods <6 months, no significant differences in the incidence of AEs overall or SAEs between intervention and control groups were reported (Table 9). At 4 months of followup, Carpenter and colleagues found that participants in a U.S. trial who were randomized to e-cigarettes (either 16 mg/mL or 24 mg/mL nicotine concentration), as compared with participants with ongoing conventional cigarette (CC) use, reported higher rates of cough (e-cigarettes: 32% vs. CCs: 21%), but exhibited similar rates of throat irritation (e-cigarettes: 16% vs. CCs: 17%). Although differences in the incidence of AEs between the intervention and control groups were observed, statistical comparisons were not made, and no AEs resulted in study withdrawal. Similarly, Cravo and colleagues, comparing e-cigarettes with ongoing CC use in the United Kingdom at 4 months, found higher rates of cough (e-cigarettes: 17.0% vs. CCs: 7.8%), sore throat (e-cigarettes: 27.8% vs. CCs: 8.8%), and headache (e-cigarettes: 47.4% vs. CCs: 33.3%), but no statistical comparisons were made. Compared with a nonnicotine-containing e-cigarette (placebo), Masiero and colleagues found the subjects who used nicotine-containing e-cigarettes reported higher rates of burning throat (e-cigarette: 5.7% vs. placebo: 2.9%) and cough (e-cigarette: 10.0% vs. placebo: 2.9%) at 3 months of followup, but statistical comparisons were not made. In a study by Tseng and colleagues, young adult smokers in the United States who were randomized to low-nicotine (4.5%) e-cigarettes reported almost twice the proportion of AEs (22.5%) over a 3-week followup period as participants randomized to no-nicotine placebo e-cigarettes (10.3%); however, this difference was not statistically significant (p=0.14).

Evidence for Pregnant Women

Included Evidence

Based on a review of 59 full-text articles, we identified six RCTs (reported in 10 publications) evaluating the use of NRT among pregnant women and three large observational studies (reported in four publications) that reported on the harms of NRT and bupropion use (Appendix B, Figure 3).

Using the overview of reviews approach, we identified five reviews that addressed the benefits and harms of behavioral interventions for supporting women to stop smoking pregnancy (Table 2). The review by Chamberlain (2017) included any behavioral support intervention including counseling, health education, feedback, incentives, social support, exercise, and dissemination of cessation interventions. The included bodies of evidence within the three other reviews focused on digital interventions, incentives, and psychotherapy were mostly duplicative and the results were entirely consistent with those of Chamberlain. Additionally, one review on relapse prevention provided a detailed synthesis of interventions among pregnant women and is reported below.
We identified no studies that met eligibility criteria that addressed the benefits or harms of the use of e-cigarettes to help pregnant women quit smoking.

**Credibility/Quality Assessment**

Of the six RCTs included that examined the benefits and harms of NRT among pregnant women, we rated two as good quality and the remaining four as fair quality (Table 10). Increased risk of bias in the fair quality studies was primarily owing to lack of allocation concealment, attrition, and study arm imbalances in baseline characteristics. Of the three observational studies included for harms, we rated two of them as good quality and one as fair quality. The fair quality study was assessed to have elevated risk of bias due to limitations in the data source for assigning individuals to the exposed and unexposed groups and insufficient adjustment for possible confounding factors.

The review by Chamberlain (2017) was rated as having high credibility according to AMSTAR-2 criteria and had no critical weaknesses. The other reviews that included evidence for pregnant women were all rated as moderate or high credibility with only minor weaknesses in the methodology noted.

**Key Question 1. Do Tobacco Cessation Interventions Improve Mortality, Morbidity, and Other Health Outcomes in Adults Who Currently Use Tobacco, Including Pregnant Women?**

**Pharmacotherapy Interventions**

**Nicotine Replacement Therapy**

All six included RCTs were designed to test the effectiveness of NRT on smoking cessation and reported infant, child, and maternal health outcomes (Table 10). Most evaluated NRT patch interventions, but one gave participants a choice of patch, gum, or lozenge and one trial offered NRT gum (Appendix G Table 2). In all cases, women were offered behavioral support in addition to NRT. Only four of the six RCTs were placebo controlled. The largest study (n=1050) was the Smoking, Nicotine, and Pregnancy trial (SNAP), which was a multisite RCT of NRT patches conducted in the United Kingdom. The second largest and most recent NRT trial was conducted in France at multiple sites, randomizing 402 women to nicotine patches or placebo nicotine patches. Women enrolled in the six trials were mainly ages 18 years and older (mean ages ranged from 25.1 to 29.3 years). One trial exclusively enrolled African-American women. Study recruitment tended to be at the first antenatal visit or before the end of the second trimester of pregnancy; one small trial allowed women to enroll any time before 30 weeks gestation but the average gestation at baseline was in the early second trimester (Appendix G Table 1). In one trial women were invited to participate if they smoked 1 or more cigarettes per day during pregnancy and in the other trials 5 or more cigarettes per day. Four trials, including the two largest, reported the percentage of participants with a history of preterm birth (range 9% to 15%). Low adherence to NRT therapy was noted in the trials. For example, in the SNAP trial, only 7.2 percent of
women in the NRT condition and 2.8 percent with placebo used the patch for more than 1 month and in the trial offering a choice of gum, patch, or lozenge, average use of NRT was lower than the prescribed and dispensed medications.

Four placebo-controlled trials reported on preterm birth (delivery at <37 weeks gestation). The most recent study reported similar numbers of women with preterm birth in the NRT and placebo arms (13.5% v 13.1%, respectively), two reported only slightly fewer women with preterm birth in the NRT arm, and the smallest study reported reduced incidence of preterm birth with NRT compared with placebo (RR 0.40 [95% CI, 0.17 to 0.92]) (Appendix G Figure 1). This trial was a parallel-design RCT allocating 194 pregnant women who smoked to either 2 mg gum NRT or placebo NRT gum at or before 26 weeks of pregnancy. The three trials that did not report statistically significant differences had larger samples and estimated effects closer to null, ranging from a RR 0.85 to 1.04. Two trials without placebo controls were imprecise and estimated effects in opposite directions.

Six trials reported mean birthweight with two placebo-controlled trials finding significantly higher birthweights among women allocated to the NRT arm (Appendix G Figure 2). Accordingly, the two trials reporting higher mean birthweights reported similar results for the proportion of infants categorized as having low birthweight (Appendix G Figure 3). The two largest, good-quality, placebo-controlled trials of NRT patch interventions, conducted by Coleman and Berlin, did not find evidence of increased infant birthweight with NRT treatment, and for Coleman more low birthweight infants were reported for the NRT condition, although the result was not statistically different from null (RR 1.38 [95% CI, 0.90, 2.09]). Four trials also reported stillbirths, but low event rates and imprecision limit inference (Appendix G Figure 4).

The trial by Coleman and colleagues, reported 2-year followup data on child health outcomes. In this trial, just under one-third of participants in each arm completed the 2-year questionnaire. Nonrespondents’ family physicians were also surveyed. Both study trial arms reported that 88 percent of participants or clinicians completed followup at 2 years, with similar rates of withdrawal and nonresponse between arms over the time period (NRT n=445 and placebo n=446). Comparison group characteristics were similar in the original and followup cohort. This study’s authors reported composite variables based on an a priori statistical analysis plan. The main outcomes were survival with no impairment (i.e., developmental, neuromotor, and sensory) and respiratory problems (i.e., respiratory symptoms, asthma diagnosis, and admissions to hospital for respiratory problem). Group comparisons using intention-to-treat analyses with multiple imputation indicated that survival with no impairment was significantly higher among those allocated to the NRT group compared to placebo (73% versus 65%; OR 1.40 [95% CI, 1.05 to 1.86]). There was no significant difference in rates of definite developmental impairment (11% NRT, 14% placebo; OR 0.71 [95% CI, 0.47 to 1.09]) between the groups. For respiratory problems, a 5 percent observed difference between the arms (30% NRT vs. 25% placebo) was not statistically significant (OR 1.30 [95% CI 0.97 to 1.74]). Results from a complete case analysis that included twins were consistent with these results.
Bupropion

We identified no trials that addressed the effectiveness of bupropion among pregnant women that met our eligibility criteria.

Varenicline

We identified no trials that addressed the effectiveness of bupropion among pregnant women that met our eligibility criteria.

Behavioral Interventions

The review by Chamberlain (2017) identified 102 trials that addressed the effects of smoking cessation interventions during pregnancy on smoking behavior and perinatal health outcomes (Tables 2 and 3). Most of the trials in this review included generally healthy women over 16 years of age, while two trials targeted women younger than 20 years of age, eight trials specifically targeted women with psychosocial risk factors, and two trials were limited to women under methadone treatment for opioid addiction (Table 4). About half the trials (k=52, 66 study arms) explicitly recruited women categorized as having low socioeconomic status, and 10 trials included mainly women belonging to an ethnic minority population. Most of the included trials recruited women during their first antenatal visit or second trimester of pregnancy and excluded women in their last trimester of pregnancy due to the limited time available to receive an intervention. There were, however, four trials that targeted women who smoked into late pregnancy.

Within the trials that were included for any meta-analysis, 94 were aimed exclusively at supporting smoking cessation and 12 trials aimed to improve maternal health, which included smoking cessation. The latter studies were only included for KQ 2 (cessation outcomes) given that there is a potential for other aspects of these interventions to have impacted birth outcomes. All interventions differed substantially in their intensity, duration, and interventionists. Included trials presented many comparisons. Interventions included counseling, health education, feedback, incentives, social support, exercise, and dissemination (active dissemination of a smoking cessation intervention) and comparators included usual care, less intensive interventions, and alternative interventions (e.g., cognitive behavioral counseling versus traditional health education). The review excluded trials comparing efficacy of pharmacotherapy with equal levels of behavioral support. Of interventions categorized as counselling interventions (54 intervention arms), most involved face-to-face contact, using a variety of strategies either alone or in combination (such as motivational interviewing, cognitive behavioral therapy, stages of change). The duration and frequency of counseling varied considerably but has generally increased over time. Health education (12 intervention arms) were those interventions that provided information about the risk of smoking and advice to quit but did not give further support or advice on how to make this change. Most were provided through automated support such as self-help materials or automated text messaging. Feedback interventions (6 intervention arms) were those where the mother was provided feedback with information about the fetal health status or measurement of by-products of tobacco smoking to the mother. Incentive-based interventions (13 arms) included interventions were women received a financial incentive,
contingent on their smoking cessation, including gift vouchers. Social support interventions (7 arms) were those that explicitly included the provision of support from a peer or partners.

Of the 102 included trials, 26 study arms reported mean birthweight, 17 arms reported rates of low-birthweight babies (less than 2500 g) and three reported rates of very low birthweight babies (less than 1500 g), and 19 study arms reported rates of preterm births (less than 37 weeks’ gestation). Other, less commonly reported data included stillbirths (k=8), perinatal deaths (k=4), and neonatal deaths (k=5).

When all 26 studies that reported mean birthweight were combined, there was evidence that infants born to women receiving behavioral smoking cessation interventions had an increase in mean birthweight of 55.60 g, compared with women in the usual care control groups (MD 55.60 g [95% CI, 29.82 to 81.38]; I²=31%; k=26; n=11,338) (Table 11). The magnitude and significance of the effect was similar when limited to counseling interventions (42.17 g [95% CI, 11.79 to 72.55], I²=0%; k=14; n=5471), and a test for subgroup differences showed no evidence of effect modification by type of intervention (p=0.11). The magnitude of the mean difference between groups for all types of interventions was modest, yet there was general consistency in the direction of effects across studies, with only six reporting effects (none statistically significant) favoring the control condition. Evidence of beneficial effects was also observed in the pooled analyses across all interventions and comparators for low birthweight (under 2500 g). The pooled effect estimate suggested a 17 percent risk reduction for delivery of a low birthweight baby (RR 0.83 [95% CI, 0.72 to 0.94]; I²=0%; k=18; n=9402) (Table 11). When restricted to specific types of interventions, while results suggested similar benefits, none of the pooled results were statistically significant. None of the three trials reporting on rates of birth to very low birthweight babies (less than 1500 g) found a beneficial effect of the behavioral intervention versus control.

Of the 19 trials reporting the effects of the intervention on preterm birth (less than 37 weeks), results were mixed, although the majority reported a reduced risk of preterm birth among women within the behavioral interventions versus control groups. Meta-analysis of these trials resulted in uncertainty in the potential benefit of behavioral interventions compared with controls on rates of preterm birth (RR 0.93 [95% CI 0.77 to 1.11]; I²=18%; k=19; n=9222) (Table 11). In separate comparisons of studies, the effect was also unclear across comparisons by type of specific intervention and control groups.

Among the eight trials reporting stillbirth, none of the trials found significant differences between study groups, and the pooled result was consistent with either potential benefit or harm (RR 1.20 [95% CI, 0.76 to 1.90]; I²=0%; k=8; n=6170) (Table 11 8). There were very low event rates within each group across trials, however, overall, there were slightly more stillbirths recorded in the intervention groups (40/3053) compared with the control groups (33/3117). Three trials of counseling, one trial of a feedback intervention, and one exercise trial reported on neonatal deaths, but events were too rare to inform valid conclusions. Similarly, there was no pattern of effects across four trials reporting perinatal death.
E-Cigarettes

We identified no trials that addressed the effectiveness of e-cigarettes among pregnant women that met our eligibility criteria.

**Key Question 2. Do Tobacco Cessation Interventions Increase Tobacco Abstinence in Adults Who Currently Use Tobacco, Including Pregnant Women?**

**Pharmacotherapy Interventions**

*Nicotine Replacement Therapy*

There was no evidence of differences in smoking cessation with NRT intervention across the included RCTs. Meta-analysis of four placebo-controlled trials generated a pooled effect of NRT on validated smoking cessation at followup (RR 1.17 [95% CI 0.78 to 1.76]; $I^2 = 0\%$, n=1896) and low statistical heterogeneity (*Appendix G Figure 5*). Quit rates in these trials ranged from 5 to 28 percent in the intervention groups and 5 to 25 percent in the control groups (mean, 11.9% vs. 10.1%). The results across trials for the efficacy of NRT were relatively consistent, with effect estimates ranging from 1.08 to 1.24 in the placebo-controlled trials. The results of the two smaller trials with no treatment controls were not statistically significant, and estimates of efficacy were greater than for the placebo-controlled trials. Including these studies in meta-analysis did not change the overall findings (data not shown). Low rates of adherence to the intervention were described (mean adherence rates of less than 25 percent were often observed); particularly in the trials with good reporting.

With regard to continuation of cessation after pregnancy related to NRT use during pregnancy, the 2-year SNAP followup study found continuous smoking abstinence rates to be very low when conservatively estimated—3 percent among NRT users and 2 percent among placebo participants at 2 years, with no statistical difference between groups. Cessation was ascertained by clinician survey for over half of the trial participants at 2 years. Nonrespondents were assumed to be smokers and included in the denominator. While there were no significant differences between groups earlier in the postpartum period (6 months), a significant effect was observed at one year (4% NRT vs. 2% placebo) with further adjustment (site, baseline salivary cotinine, partner smoking status, and years completed education).

*Bupropion*

We identified no trials that addressed the effectiveness of bupropion among pregnant women that met our eligibility criteria.

*Varenicline*

We identified no trials that addressed the effectiveness of bupropion among pregnant women that met our eligibility criteria.
**Behavioral Interventions**

**Primary Results**

The review by Chamberlain (2017) identified 102 trials with 120 study arms testing the effects of a behavioral interventions for smoking cessation among pregnant women. Of the 120 study arms included in the review, 97 arms reported the primary outcome measure of smoking abstinence in late pregnancy, up to and including the period of hospitalization for birth. In 71 of these study arms (73%), this abstinence was biochemically validated. In most trials, women were classified as “current smokers”; some other studies included women who had spontaneously quit in early pregnancy but are included here. The remaining trials did not report a measure of smoking abstinence in late pregnancy but focused on abstinence in the postpartum period only, smoking reduction, or perinatal outcome measures.

Pooled analyses of all behavioral interventions (k=97), regardless of type and including self-reported outcomes, indicated a statistically significant effect on smoking cessation in late pregnancy when compared with usual care or a minimal intervention (RR 1.35 [95% CI, 1.23 to 1.48]; k=97; n=26,637), with moderate heterogeneity of estimated effects ($I^2=44\%$) (Table 12). While an overall Chi$^2$ test for subgroup differences found no difference by the type of intervention (p=0.39), the number of studies varied considerably by intervention type (counseling [51 trials], health education [11 trials], feedback [6 trials], incentives [13 trials], social support [14 trials], exercise [1 trial], and other [1 trial]. The results were similarly beneficial when restricted to trials comparing counseling with any type of control (RR 1.31 [95% CI, 1.16 to 1.47]; $I^2=40\%$; k=51; n=182,786) as well as when comparing counseling with usual care (RR 1.44 [95% CI 1.19 to 1.73]; $I^2=49\%$; k=30; n=12,432). Results of trials of feedback and incentives were also suggestive of a benefit; but there was no evidence of a statistically significant effect of social support interventions from analysis of 10 trials that were included in the review (RR 1.29 [95% CI, 0.97 to 1.73]). The effects of other types of interventions versus any comparator or usual care generally favored the intervention conditions, but pooled results did not rule out the possibility of no benefit. Direct comparisons between interventions of greater versus less intensity were found to be statistically significant for trials testing counseling, but not for the fewer studies of health education (4 trials), feedback (3 trials), or social support (7 trials) interventions (Table 12). There was some evidence that the positive effects of behavioral interventions on smoking cessation in late pregnancy continued into the postpartum period, up until approximately 18 months postpartum. For instance, in an examination of counseling interventions compared with usual care, the average RR was 1.59 (95% CI, 1.26 to 2.01; k=11) at 0 to 5 months postpartum, 1.33 (95% CI, 1.00 to 1.77; k=6) at 6 to 11 months postpartum, and 2.20 (95% CI, 1.23 to 3.96; k=2) at 12 to 17 months.

**Evidence of Effect Modification**

Regarding the whole set of trials, meta regression analyses found no differences in the effects of behavioral interventions according to the specific intervention strategies, comparator, intensity (categorized according to frequency of contact), intervention duration, the provision of self-help manuals, including telephone support, the SES of the sample, newly added studies, or study design (cluster versus individually randomized trials). In general, interventions of higher
intensity typically also had control groups of higher intensity, potentially explaining why no clear differences were seen with increasing intervention intensity. There was some evidence that studies with a high risk of bias related to allocation concealment had a larger pooled-effect size estimate compared with lower risk or unclear risk of bias studies. Studies with unclear and low risk of bias for equal baseline characteristics in study arms showed larger effect sizes than those at high risk of bias for this item. No other measures of risk of bias (random sequence generation, attrition bias, selective reporting bias, detection bias, blinding, contamination, or intervention fidelity) predicted larger effect estimates.

Several of the individual trials provided findings of subgroup analyses based on participant characteristics. Of 13 studies that reported a sensitivity analysis by a measure of socioeconomic status with studies (such as education levels and employment), eight reported lower abstinence rates among women with lower SES, three reported no difference, and two reported higher rates of intervention success among women with low SES. Among the eleven trials that reported outcomes by ethnic status results were inconsistent: one study reported the intervention was less effective among Hispanic and African American women compared with white women, one study reported the intervention was less effective among Hispanic compared with African American women, four studies reported no difference in outcomes by race or ethnicity, and five study arms reported higher quit rates among African American and/or Hispanic women compared with women of other races and ethnicities. Four studies reported a negative association between treatment effectiveness and higher rates of depression, and of six studies that reported measures of social support, four reported a negative association with low social support and quitting.

**Interventions for Relapse Prevention**

The moderate-credibility review by Livingstone-Banks (2019a) included 18 trials focused on relapse prevention among pregnant and/or postpartum ex-smokers. Pooled results from eight studies of interventions in pregnancy did not demonstrate a clear benefit on relapse prevention at the end of pregnancy (RR 1.05 [95% CI, 0.99 to 1.11]; k=8; n=1523; $I^2=0\%$). There was also no significant benefit seen among 15 studies that included followup into the postpartum period overall or when subgrouped according to timing of the intervention (overall RR 1.02 [95% CI, 0.94 to 1.09]; k=15; n=4606; $I^2=3\%$).

**E-Cigarettes**

We identified no trials that addressed the use of e-cigarettes to quit smoking among pregnant women that met our eligibility criteria.

**Key Question 3. What Harms Are Associated With Tobacco Cessation Interventions in Adults, Including Pregnant Women?**

**Pharmacotherapy Interventions**

**Nicotine Replacement Therapy**

Given the low number of trials and high statistical heterogeneity, we did not report pooled
analyses for health outcomes that could also be evaluated as potential harms of NRT treatment (e.g., stillbirth). The available trials (Table 10) were underpowered for assessing rare harms with statistical confidence. As reported above, significant effects of NRT on health outcomes included beneficial effects for some individual studies, including higher birthweight in two trials174, 177 and reduced risk of preterm birth in one.174 The Coleman and Berlin trials reported miscarriage by study arm, but there were too few events in the study arms to draw valid inference and no difference was evident, with Berlin reporting one miscarriage in each study arm and Coleman reporting three in the intervention and two in the control group.168, 169

The two large, good-quality NRT patch trials reported detailed maternal and fetal AEs.168, 169 These trials reported that the most common adverse event was skin reaction at the patch site, with higher rates in the active NRT patches—nearly 9 percent of NRT users in the one RCT discontinued treatment due to the reaction. In the Berlin trial, there was insufficient statistical power to assess the statistical significance of the observed 4 percent difference in having one or more serious maternal adverse event (NRT 12%, placebo 8%).168 The trial did, however, report a statistically significant 0.02 mm Hg per day rise in diastolic blood pressure over time in the trial among NRT compared with placebo allocated participants (p=0.01). Reported cases of preeclampsia were few, but consistent with the differences in blood pressure, preeclampsia was diagnosed among more women in the NRT condition than the placebo control (3/203 vs. 1/199).168 The Coleman trial, however, did not find differences in high blood pressure readings on at least two occasions between study groups and reported slightly fewer cases of preeclampsia/eclampsia in the intervention group (3/521 versus 5/529), although again, event rates were too low to establish a valid association.169

In the Coleman study, SAEs, defined as any miscarriage, stillbirth, neonatal or post neonatal death, were higher in the intervention group, but precision was too low to assess statistical differences (NRT 9/521 vs. placebo 6/529).169 A composite outcome of any serious adverse event was also reported in the Oncken trial and included birth outcomes, miscarriage, stillbirth, and neonatal death as well as neonatal or maternal hospitalization. More serious AEs were observed in the placebo condition than in the intervention group, and the difference approached statistical significance (NRT 24/97, placebo 33/87, p=0.06), with much of the difference attributed to lower rates of preterm birth and low birthweight in the intervention group.174 A similar composite outcome reported in the Pollak trial, however, found more events in the intervention group, also a nearly statistically significant (NRT 30.1%, 34/113 versus placebo 17.2%, 10/58, risk difference 0.13 [95% CI 0.00 to 0.26]).175

In the two larger studies reporting counts of stillbirths, nine occurred in the NRT arms and seven occurred in the placebo control groups (1.3% versus 1.0% respectively).168, 169 More events would be necessary for statistical certainty for this outcome and also for neonatal death. Three trials reported neonatal deaths;168, 169, 174 there were a total of three cases in the intervention arms and four cases in the control arms in the trials. Congenital malformations were reported in the Berlin and Coleman trials, with fewer cases occurring in the NRT group for both studies (Berlin, NRT 4/203 versus placebo 6/203; Coleman, NRT 9/507 versus placebo 13/517). Between group differences were lower than 1 percent, however, and the confidence intervals crossed null.
A good-quality cohort study using the Quebec Pregnancy Cohort study conducted by Berard and colleagues analyzed comparisons designed to ascertain effects of treatment with bupropion during pregnancy on preterm birth and small-for-gestational-age health outcomes. The comparison groups for analysis of potential harms were as follows: pregnant women using bupropion, pregnant women using NRT, and pregnant women who smoked during pregnancy and did not use bupropion or NRT. The NRT and bupropion groups included women who continued to smoke during pregnancy and those who did not, whereas the group not using either therapy included only women who smoked during the pregnancy.

Adjusted and unadjusted comparisons of the NRT and bupropion groups with ongoing smokers indicated lower statistically significant incidence of premature delivery (<37 weeks’ gestation) but no difference in the incidence of small for gestational age (≤10th percentile for gestational age birthweight). There was no difference for either outcome when directly comparing women using NRT versus those using bupropion. The study did not report any other potential harms of bupropion or NRT or health outcomes. Despite efforts to address potential confounding in this observational study, the results remain subject to potential residual confounding due to possible selection effects and unrecognized differences between the study groups, as well as other sources of residual confounding. In addition, the study excluded all pregnancies that did not result in live births, limiting the ability to assess other potential serious adverse effects.

A fair-quality cohort study conducted in the United Kingdom using the Health Improvement Network database analyzed data from 220,630 singleton pregnancies to assess whether NRT exposure during pregnancy could be associated with stillbirth. A related study reported on congenital anomalies for live-born infants (n=192,498) using the same data source and similar comparisons. For the study comparisons, women with a prescription for NRT during pregnancy or in the 4 weeks prior to conception were identified as NRT users. Smokers and nonsmokers were identified using an algorithm developed for the cohort and validated against other data sources including national smoking estimates; the control group for the study was nonsmokers. A comparison group of smokers that did not use NRT was also defined. NRT use was not associated with a statistically significant difference in stillbirth compared with a non-smoking control group (AOR 1.35 [95% CI 0.91 to 2.00]) or a smoking control group (AOR 0.95 [95% CI 0.62 to 1.48]), but there was a higher risk of stillbirth for smokers compared with nonsmokers (AOR 1.41 [95% CI 1.13 to 1.77]). The study of congenital malformations also found no difference between NRT users and nonsmokers for a composite of all types of major congenital anomalies (AOR 1.07 [95% CI 0.78 to 1.47]). There was, however, some evidence that the odds of urinary system and respiratory system anomalies might be higher for NRT users relative to nonsmokers, and this association was not seen among smokers compared with nonsmokers. The effect diminished for urinary system anomalies when the comparison group of nonsmokers was defined more broadly to include women who smoked before or during pregnancy rather than only during gestation but remained for respiratory anomalies (AOR 3.49 [95% CI 1.05 to 11.62]). The estimate, however, was based on only 10 exposed cases, and potential residual confounding, statistical power, and multiple comparisons warrant some caution when interpreting the finding. Nevertheless, this rare potential harm cannot be ruled out.

The 2-year followup data from the Coleman SNAP trial described for KQ1 did not find evidence of longer-term developmental or respiratory harms associated with NRT use during pregnancy.
compared with a placebo. Longer-term child health outcomes were also assessed in an included good-quality cohort study\textsuperscript{181} using Danish National Birth Cohort data (n=84,803). The study analyzed outcomes for children up to age 14 who were born to women who smoked and for women who used NRT during pregnancy, quit smoking during pregnancy, or did not smoke, and considering whether the father smoked. Diagnosis of attention-deficit hyperactivity disorder (ADHD) after age 5 was the primary outcome. The highest hazard ratio for the development of ADHD during followup was seen for children whose mothers reported using NRT and had nonsmoking fathers (HR 2.26 [95% CI 1.48 to 3.51]) with a comparison group of nonsmoking mothers and fathers. However, the results are based on small numbers, resulting in wide confidence intervals and unstable estimates. Only seven ADHD cases were identified among children in the NRT group with a smoking father and 22 ADHD cases among children in the NRT group with a nonsmoking father. The estimate was not statistically significant for children with mothers using NRT and fathers who smoked. There also were several differences between the study groups, some accounted for using statistical adjustments, and likely unmeasured confounders that could account for the differences observed.

\textit{Bupropion}

We identified no trials that addressed the effectiveness of bupropion among pregnant women that met our eligibility criteria.

\textit{Varenicline}

We identified no trials that addressed the harms of varenicline among pregnant women that met our eligibility criteria.

\textbf{Behavioral Interventions}

The Chamberlain review\textsuperscript{182} found that behavioral smoking cessation interventions have minimal adverse effects, including the possibility of a paradoxical effect (i.e., increased smoking). Four studies that measured whether women increased their smoking following exposure to the intervention showed mixed results with two studies reporting an increase in smoking behavior among women who did not quit. Thirteen trials reported postintervention psychological outcome measures, and none reported any negative psychological effects. Other potential harms of these interventions were sparsely reported, and none suggested an increase in AEs.

\textbf{E-Cigarettes}

We identified no trials that addressed the harm of e-cigarettes among pregnant women that met our eligibility criteria.
Chapter 4. Discussion

Summary of Evidence

We conducted an overview of reviews to update the evidence on the benefits and harms of tobacco cessation interventions among the general adult population and pregnant adults. This approach allowed us to summarize the evidence on health outcomes, cessation outcomes, and harms of pharmacotherapy (nicotine replacement in various forms, bupropion, and varenicline), a variety of primary care-applicable behavioral interventions, and various combinations of pharmacotherapy and behavioral intervention approaches from 67 relevant systematic reviews, with more than 1500 RCTs and observational studies represented. We supplemented the overview of reviews approach with a primary search for studies evaluating the use of e-cigarettes for smoking cessation, given the more recent emergence of this technology and the existing USPSTF determination of insufficient evidence for this approach.1 Similarly, we conducted a primary search for literature to locate all recent studies related to the use of bupropion among adults given no updated review on the subject and of all pharmacotherapy among pregnant women, given the small evidence base we previously identified and potential harms related to these medications among this population.

The results of our review are consistent with the conclusions of the 2020 Surgeon General’s report on Smoking Cessation.31

General Adult Population

Available evidence on the impact of tobacco cessation interventions on health outcomes (KQ 1) from systematic reviews among general adults represented a single behavioral intervention (physician advice) with no pharmacological treatment (Table 13). Our ratings of “low” and “insufficient” for this key question reflect the lack of evidence on health outcomes presented in the included reviews, not a lack of confidence in the beneficial association between quitting smoking and improved health outcomes. The research field has largely moved past the question of whether tobacco cessation interventions improve health outcomes, given that the health benefits of quitting smoking are already firmly established. Within the included reviews, the vast majority of included studies reported smoking cessation as the primary outcome and emphasized improved validity through biochemical verification of use or more stringent definitions of abstinence.

We have moderate to high confidence that all seven FDA-approved medications for tobacco cessation, a variety of behavioral support and counseling approaches, and the combination of pharmacotherapy plus behavioral support—all interventions that may be readily available to primary care patients and clinicians—can significantly increase the rate of smoking cessation at 6 months and longer compared with usual care or brief self-help materials (KQ 2) (Table 13). Treatment effects appear to be comparable in a range of populations, settings, and types of behavioral support. Furthermore, despite adding nearly 5 more years of research, the effect estimates for each pooled comparison have been remarkably stable for at least the past three
decades (i.e., the time period in which these reviews have been completed and updated). Analyses of **combined pharmacotherapy and behavioral counseling** interventions suggested an increase in smoking cessation by 68 to 98 percent (RR 1.83) compared with usual care or brief cessation advice or self-help. Likewise, there was clear evidence of effectiveness of pharmacotherapy on smoking abstinence. Based on research involving almost 65,000 smokers, nicotine replacement therapy in any form was effective in increasing relative quit rates by 49 to 61 percent (RR 1.55) compared with placebo or no NRT. A smaller yet still robust body of evidence (27 trials representing over 12,000 smokers) comparing varenicline with placebo found relatively larger effects on smoking cessation (RR 2.24 [95% CI, 2.06 to 2.43]) (defined stringently as 100% biochemically verified continuous abstinence). The absolute differences in mean cessation rates between the medication and control arms was 6.4 percent (16.9% vs. 10.5%), 8.2 percent (19.7% vs. 11.5%), and 14.5 percent (25.6% vs. 11.1%), for NRT, bupropion, and varenicline, respectively. Certain combinations of these medications (e.g., long-term NRT patch plus NRT gum, NRT patch plus bupropion) may also improve quit rates compared with no intervention or a single medication; but fewer trials have tested each combination. Direct comparisons of these drugs, including those with the EAGLES trial, consistently showed that 12 weeks of treatment with varenicline produced higher statistically significant absolute and relative effects on rates of smoking cessation versus NRT and bupropion. No differences have been found between the relative effectiveness of NRT and bupropion in direct or indirect comparisons.

Although often reported as “pharmacotherapy” interventions in our report for brevity, we note that these interventions almost always include some level of behavioral support that is offered to both medication and placebo arms. In trials, the level of behavioral support is often more intense than what is seen in real world settings where most smokers who use cessation medications do not access any type of behavioral support. Robust observational studies have found no relationship between the use of medications and smoking abstinence, especially when not paired with brief advice or behavioral support. The incremental effect of **adding additional behavioral support to pharmacotherapy** versus pharmacotherapy alone or with minimal behavioral support was found to be small but statistically significant (RR, 1.15 [95% CI, 1.08 to 1.22]). In these trials, both arms on medication achieved high rates of quitting (mean quit rates in intervention vs. control, 19.5% vs. 17.1%), and the incremental difference in intensity of the behavioral support between arms was quite modest, about a 0.5 to 5 hours difference in intervention contact time.

Research on **behavioral support interventions** spans a broad range of approaches, including in-person advice and support from health care clinicians or tobacco cessation counselors to a plethora or non-face-to-face formats (tailored and nontailored self-help materials, quit lines, outreach or “proactive” telephone counseling, mobile phone-based interventions, and Internet interventions). Compared with various controls, these behavioral interventions produced modest improvements in relative smoking cessation at 6 months or more (15% to 88%). Physician or nurse advice, even brief, resulted in a significant relative improvement in smoking cessation compared with usual care or self-help materials (RR 1.76 [1.58 to 1.96] and RR 1.29 [95% CI, 1.21 to 1.38], for physician and nurse advice, respectively). These results suggest that there are many effective approaches to aid cessation, and that because of the wide array of options, smokers – with their clinicians – can choose an option that works best for them.
Within and between reviews, there was no strong evidence that specific study, population, or intervention characteristics predicted larger effects or that certain types of behavioral support were more effective than others. The direct evidence on such comparisons was synthesized in many of the reviews but is based on far fewer trials. Furthermore, very few reviews presented direct comparisons of the effects of tobacco cessation interventions between specific subgroups of adults (e.g., those at high risk vs. not at high risk for cardiovascular disease, men vs. women, those with vs. without severe mental illness). Twenty-one reviews summarized the effectiveness of pharmacotherapy and/or behavioral interventions for specific subpopulations of adults (e.g., studies limited to smokeless tobacco users, indigenous populations, those with schizophrenia). None of these reviews suggested findings that differed in direction or magnitude of effects on smoking cessation.

The mean quit rates in the control groups across all the reviews was highly variable, ranging from approximately 5 percent (in trials among smokers receiving usual care in primary care) to approximately 11 to 15 percent (in trials including minimal tobacco cessation behavioral support to control groups). However, the relative effects of the interventions were much less variable and the general absence of substantial heterogeneity between trials within given bodies of evidence makes for reliable estimate of relative effects. If we assume an unassisted quit rate of 5 percent at 12 months in a population of adults attending primary care and use the confidence intervals of interventions using physician advice, 1.58 to 1.96, the result is a number needed to treat (NNT) of 21–34 for additional benefit. If we use the pooled estimate from nurse advice versus usual care, we would decrease the lower confidence interval (1.21) and increase the upper estimate of the NNT to 95. If we assumed a higher quit rate in the usual care control groups (e.g., 10%), less smokers would be needed to treat to see an additional benefit of more intensive advice and/or medications (<20).

There was no evidence of an increased risk of serious AEs, including major cardiovascular AEs and serious neuropsychiatric AEs, among the general adult population associated with NRT, bupropion, or varenicline (KQ 3) (Table 13). NRT was associated with a higher rate of any cardiovascular event, although this was largely driven by low-risk events, typically tachycardia (a well-known risk). Reviews that included AEs related to medication use among individuals with severe mental illness found no difference between study groups in the rates of AEs, including a worsening of psychiatric symptoms or serious psychiatric events (suicide or suicidal ideation).

In contrast to the robust evidence on pharmacotherapy and behavioral interventions for smoking cessation, our review identified only four RCTs that provide data on the use of e-cigarettes versus placebo e-cigarettes or nicotine replacement for quitting conventional smoking at 6 or more months’ followup (Table 13). We did not identify any primary evidence on the use of e-cigarettes as tobacco cessation interventions that reported health outcomes. In two of the four trials (n=2008), smokers randomized to e-cigarettes containing nicotine (with or without the co-use of NRT) were found to have statistically significantly greater rates of abstinence than those randomized to NRT alone or NRT plus non-nicotine e-cigarettes at 6- to 12-months followup. In both trials, continued use of e-cigarettes was high at 6- and 12-months followup (~3-9 months after the treatment phase) with 45 to 80 percent of participants still using nicotine-based e-cigarettes as opposed to only 9 to 40 percent of participants still using NRT. Another trial
compared the use of e-cigarettes (two arms using different nicotine concentrations) with placebo at 12 months and found 11 percent abstinence in the nicotine containing e-cigarette groups compared to 4 percent abstinence in the placebo group (p=0.04) but 27 percent of those who quit smoking continued to use e-cigarettes at 1 year. The remaining trial reported no clear difference in the rates of smoking cessation among those randomized to nicotine e-cigarettes versus placebo e-cigarettes at 6 to 12 months’ followup. Surprisingly few trials (8 identified in this review) and no large (n>1000) observational cohort studies reported on the potential AEs of e-cigarette use when used as a smoking cessation tool. This is particularly concerning given the apparent longer-term use of e-cigarettes for cessation compared to pharmacotherapy. The paucity of trial data on AEs related to e-cigarette use is part of the ongoing debate regarding the appropriateness of their use as a cessation tool. However, none of the included trials reported statistically significant differences in rates of serious AEs between intervention and control groups. A recent large series of more than 2600 case reports of severe lung injury associated with the use of e-cigarettes with resulting in 60 deaths is discussed further below. ¹⁸⁷

### Pregnant Women

Evidence on the potential benefits and harms of pharmacotherapy for smoking cessation during pregnancy is limited, with few efficacy trials and limited power for detecting both potential benefits and harms (Table 14). Our review identified six trials (only four of which were placebo controlled) that evaluated the potential benefits and harms of NRT among pregnant women; our review included no trials evaluating other pharmacotherapies. Across the included trials, there were mixed findings for birth outcomes (KQ 1). Only one small trial had statistically significant findings of a benefit across birthweight, low birthweight (<2500 grams) and preterm birth (<37 weeks) outcomes. The largest trial provided evidence from 2-year followup data that survival without impairment was higher with NRT vs. placebo. The trials reported other rare outcomes such as stillbirth but were underpowered for detecting differences in potential adverse consequences of NRT use in pregnancy. Evidence from three large cohort studies did not find differences in stillbirth, birth outcomes, or any congenital anomaly for users of NRT, but comparison groups and exposure categorization, as well as incomplete adjustment for confounding limit these findings. Based on the evidence, we could not rule out the possibility of health benefits or of potential harms of NRT use in pregnancy.

There was evidence of statistically significant infant health benefits from behavioral tobacco cessation interventions among pregnant women (KQ 1). In pooled analyses, the mean birthweight of infants was modestly higher in the intervention group when considered across all types of interventions and when limited to counseling interventions. Consistent with this finding, the risk for low birthweight (<2500g) was also reduced with behavioral interventions. Meta-analysis of the trials reporting preterm birth resulted in statistical uncertainty for the estimate of a small potential benefit of behavioral interventions compared with controls. The number of trials reporting outcomes and event rates for very low birthweight, stillbirth, and neonatal death was too low to estimate effects with enough precision to draw conclusions.

In terms of the effects of interventions on smoking cessation outcomes, there was considerably more evidence available on the effects of behavioral interventions during pregnancy than for pharmacotherapies (Table 14). Based on pooled data from trials among over 26,000 women,
behavioral interventions were more effective than usual care or minimal support for smoking cessation in late pregnancy (RR 1.35 [95% CI, 1.23 to 1.48]). Although the most common type of intervention was counseling, trials of financial incentive interventions, feedback, and health education had consistent findings of benefit, including some significant individual trials. There was some evidence that the positive effects on smoking cessation in late pregnancy continued into the postpartum period until approximately 18 months postpartum, although the smaller effect sizes show that many women who did quit during pregnancy relapsed postpartum.

In contrast, there was no evidence of NRT efficacy for validated smoking cessation in late pregnancy based on the currently available evidence (four placebo-controlled trials), although all trials reported slightly more cessation events in the intervention group. The low adherence to NRT reported in the trials hinders interpretation of the evidence since potential benefits and harms from exposure to NRT are more difficult to discern when exposure is limited and variable.

In terms of potential harms related to NRT cessation interventions used during pregnancy, the available evidence is somewhat reassuring in terms of common health outcomes, such as birthweight, but there was limited power to rule out potential rare harms (KQ 3) (Table 14). While there was no evidence showing differences in rare outcomes such as miscarriage, stillbirth, and neonatal death, these data are sparse and limited. There was no evidence of AEs related to behavioral interventions among pregnant women.

**E-Cigarettes**

Laboratory tests of e-cigarette ingredients, in vitro toxicological tests, and short-term human studies suggest that e-cigarettes are likely less harmful than combustible tobacco cigarettes. The 2018 National Academies of Sciences, Engineering, and Medicine (National Academies) report on the “Public Health Consequences of E-Cigarettes” concluded that there was substantial evidence that except for nicotine, under typical conditions of use, exposure to potentially toxic substances from e-cigarettes is significantly lower compared with combustible tobacco cigarettes. However, due to the lack of long-term epidemiological studies and large clinical trials, the associations between e-cigarette use and morbidity and mortality, especially in the long-term, are not yet clear. Furthermore, much is unknown about their absolute safety profile including concerns about the toxic properties of the variable combination of chemicals present in e-liquids and the additional chemicals generated during the aerosolization of e-liquids.

Since August 2019, CDC, the FDA, state and local health departments, and public health and clinical stakeholders have been investigating a nationwide outbreak of e-cigarette, or vaping, product use–associated lung injury (EVALI). As of January 14, 2020, a total of 2,668 hospitalized cases of EVALI have been reported to the CDC from all 50 states, the District of Columbia, and 2 U.S. territories (Puerto Rico and U.S. Virgin Islands) and 60 deaths have been confirmed. The number of EVALI cases reported to CDC peaked during the week of September 15, 2019; and the weekly number of hospitalized patients has since steadily declined (as of January 17, 2020).

Analyses of bronchoalveolar lavage (BAL) fluid samples of patients with EVALI identified vitamin E acetate, an additive in some tetrahydrocannabinol (THC)-containing e-cigarette, or
vaping, products, as a common component.\textsuperscript{189} Within these cases, 94 percent had detectable tetrahydrocannabinol (THC) or its metabolites in their BAL fluid or had reported vaping THC products in the 90 days before the onset of illness and nicotine or its metabolites were detected in 64 percent of the case patients.\textsuperscript{189} In an analysis among those hospitalized with EVALI, 82 percent reported using THC-containing products (with 33\% reporting exclusive use of THC-containing product) and 57 percent reported using nicotine-containing products (14\% was exclusive use of nicotine).\textsuperscript{190} Other potential chemicals of concern including plant oils, petroleum distillates like mineral oil, and terpenes were not detected in the BAL samples, although evidence is not yet sufficient to rule out the contribution of these and other chemicals. The latest national and state findings suggest THC-containing e-cigarette, or vaping, products, particularly from informal sources like friends, or family, or in-person or online dealers, are linked to most of the cases and play a major role in the outbreak.\textsuperscript{190} Given this data, the CDC and FDA recommends that people do not use THC-containing e-cigarette, or vaping, products.\textsuperscript{190} CDC also recommends that people should not buy any type of e-cigarette, or vaping products particularly those containing THC from informal sources like friends, family, or in-person or online dealers or modify or add any substances to e-cigarette or vaping products that are not intended by the manufacturer.\textsuperscript{190} CDC recommends that adults using nicotine-containing e-cigarettes or vaping products as an alternative to cigarettes should not go back to smoking; they should weigh all available information and consider using FDA-approved cessation medications.\textsuperscript{190} Because the specific cause or causes of EVALI are not yet known, the only way for persons to assure that they are not at risk is to consider refraining from use of all e-cigarette, or vaping, products while the investigation continues.\textsuperscript{191} Furthermore, guidance suggests that providers evaluating patients with respiratory illnesses should ask them about e-cigarette or vaping use, evaluate whether they require hospital admission, and consider empiric use of antimicrobials, including antivirals, as well as possible corticosteroids.\textsuperscript{192} Those hospitalized for EVALI should be followed up, optimally within 48 hours of discharge, to reduce the risk of rehospitalization and death.\textsuperscript{193}

Finally, the nicotine in the e-liquid can be hazardous if mishandled and is toxic to children. A national review of over 4000 e-cigarette related poison center calls found that monthly calls regarding e-cigarette exposures in children increased by almost 16 times during the three-year study period. Compared with other tobacco products, children exposed to e-cigarettes had 5.2 times high odds of health care facility admission and 2.6 times higher odds of a severe outcome.\textsuperscript{194} Studying the toxicity and safety of e-cigarettes is complicated by the large variation in devices and cartridge fluids available, and the new products rapidly entering the market.

Understanding the public health implications of e-cigarette use at the population level necessitates consideration of not only the risks of e-cigarettes on individual health outcomes, but also the relationship between e-cigarette use and the use of other tobacco products – namely combustible cigarettes. The context surrounding e-cigarette use is markedly different in adolescents and young adults versus middle-aged and older adults. Use of e-cigarettes by adolescents increased markedly in 2018 after a prior decline. The National Youth Tobacco Survey reported that in 2018, 20.8 percent of high school students reported use of e-cigarettes on at least one day in the previous 30 days (“current use”), compared with 11.7 percent in 2017.\textsuperscript{20} Some of the main conclusions of the National Academies 2018 report was that there was substantial evidence that e-cigarette use increases risk of ever using combustible tobacco
cigarettes among youth and young adults and moderate evidence that e-cigarette use increases the frequency and intensity of subsequent combustible tobacco cigarette smoking among those who had ever used combustible cigarettes.\textsuperscript{5}

The relationship between e-cigarette use and combustible tobacco use among adult smokers could take many pathways, including promoting cessation of combustible cigarette smoking (transitioning to e-cigarette use alone or quitting both products), causing former smokers to relapse to combustible smoking after e-cigarette use, or in facilitating dual use of both products simultaneously.\textsuperscript{5} Among adults, nearly all e-cigarette users report having started e-cigarette use after having been a regular smoker\textsuperscript{195} and most report that quitting smoking and health improvement are major reasons for starting e-cigarettes use.\textsuperscript{196, 197} Given what we know about the relative safety of e-cigarettes compared with combustible cigarettes, established combustible tobacco smokers who completely switch to using e-cigarettes would be expected to reduce their tobacco-related health risks. Additional benefit would be expected if e-cigarette users subsequently stopped using both e-cigarettes and combustible tobacco products. Unfortunately, we found no studies meeting inclusion criteria that reported on potential health benefits related to e-cigarette use for quitting smoking among current smokers (Table 13). Our review identified four RCTs that examined use of e-cigarettes (with or without NRT) for conventional cigarette cessation at 6 months or longer. Evidence from the two most recent trials indicated that nicotine-based e-cigarettes (with or without co-use of nicotine replacement) may be superior in effectiveness to FDA-approved forms of nicotine replacement alone or e-cigarettes that contain no nicotine. The observed self-reported quit rates at 6 months in these two trials varied considerably: one trial reported 35 percent of e-cigarette users (versus 25\% in the NRT group) quitting combustible smoking whereas the other reported 18 percent of e-cigarette plus patch users (versus 8\% of patch users) quitting smoking. Though the treatment phase in both studies was 12 weeks, more than half of participants continued using e-cigarettes at 6 to 12 months followup, substantially more than subjects who were assigned nicotine replacement.

None of the eight trials included in our review to evaluate harms reported any serious AEs considered to be plausibly related to e-cigarette use. Moreover, we found no trials or large cohort studies reporting on long-term health outcomes of e-cigarettes. The paucity of long-term data on AEs and health outcomes related to use is of concern given the recent reports of severe lung injury and the uncertainty about how long persons who use e-cigarettes to quit smoking continue their e-cigarette use even after quitting smoking.

**Limitations of the Review**

Our review has several limitations, including our overview of reviews approach, the methods and quality of the included reviews that synthesized the bodies of evidence, and the primary studies themselves.

The comprehensiveness of our overview of reviews is inevitably limited by the recency and quality of the source reviews. Although most of the primary reviews that served as the basis for the Primary results included evidence at least through 2015, there may be evidence on population and intervention subsets that has been published after each review’s last search date. If this
occurred, the respective bodies of evidence may not reflect these newer studies. Given the consistency of the effects within each group over time, however, we expect that any new trials regardless of their sample size and effect estimates would have little bearing on the overall results of this overview of reviews.

By adopting an overview of reviews approach, we relied on the data as described and assessed by the original reviewers. In doing this we trusted that each review generally included the full available and eligible evidence base, that the data abstraction was accurate, and that the analyses were scientifically sound. We did apply scientific judgment when choosing which reviews to present as the basis for the primary findings and which pooled data were appropriate to present. For instance, although review authors may have presented several pooled analyses based on various subgroups within the main analysis, we carefully chose which data to include in our synthesis based on our *a priori* questions of interest (e.g., type and intensity of intervention, setting and provider, participant selection, verification of abstinence measures). We did not reassess the risk of bias or quality of individual trials; instead we reviewed the risk of bias as presented in the review and interpreted results considering these potential biases. Although we did not quality-rate the reviews based on the specific choice of meta-analytic models (i.e., random vs. fixed effects), we were cautious about reporting pooled results for small numbers of studies or highly heterogeneous bodies of evidence. We did not present pooled estimates for meta-analyses of less than six studies except in the case of a small number of highly clinically and statistically homogeneous trials (e.g., NRT among pregnant women). We also narratively described results rather than presenting pooled estimates in cases of substantial or considerable statistical heterogeneity produced in meta-analyses. Twenty-five of the 32 primary reviews were Cochrane reviews. The general consistency and rigor of methods employed by the review authors strengthened this overview of reviews. Furthermore, we quality-rated each review according to AMSTAR 2 criteria and relied upon the available best-quality reviews for each body of evidence.

We did not describe or cite individual trials because of the large volume of trials represented among the primary reviews (over 1400). Although our text and descriptive tables provide some information on the types of interventions included in the bodies of evidence, we did not include a detailed description of each intervention or replicate the study characteristics data that were presented by the original review authors. More detailed information is available in the original reviews.

Because the included reviews were not mutually exclusive in their eligibility criteria and, as a result, were not mutually exclusive in their included studies, there are individual trials that are represented in more than one review and/or meta-analysis, particularly for trials related to behavioral interventions in adults. We could not address this overlap by recalculating all the estimates reported in reviews, but we do not expect such adjustments would alter our conclusions. By basing our estimates on primary reviews rather than reporting results from multiple reviews, we likely mitigated this potential shortcoming.

Furthermore, our presentation of results was limited according to the categories of interventions that have been systematically reviewed. That is, we present pooled findings according to categories of interventions that were developed by the systematic reviewers themselves – namely
the Cochrane Tobacco Group. While we believe the totality of reviews to reflect the majority of tobacco cessation trials that are applicable to primary care in the United States (e.g., physician advice, nurse advice, group counseling, telephone-based counseling), there still may be applicable tobacco cessation trials that are not represented in any of the source reviews given scoping decisions. Additionally, our reporting of stratified analyses and potential population and intervention effect moderators was limited by the analyses and reporting by included reviews. While most reviews did conduct prespecified stratified analyses and meta-regression, there were few variables that were explored across all reviews.

While we did not re-evaluate the risk of bias within individual trials, several limitations are applicable to all included studies. Biochemical validation of self-reported quitting ranged from less than a quarter of included studies to 100 percent of trials within the included reviews. Most of the reviews that had a smaller percentage of included studies that required biochemical validation included a higher percentage of large community-based samples and included limited face-to-face contact (e.g., print-based self-help materials, telephone counseling, and computer-based interventions). It should be noted that the Society for Research on Nicotine and Tobacco subcommittee on measurement considers that verification is not necessary under these conditions. It is also important to remember that while biochemically validated findings will almost always reduce the absolute quit rate, the absence of validation will only lead to an overestimate of effects if intervention participants are more likely to misreport abstinence than control group participants. The likelihood of differential misreporting is small among those studies of large community-based samples with limited face-to-face contact. Similarly, while results based on point prevalence abstinence and sustained abstinence measures are strongly related and almost always result in similar relative effects, the absolute rates often differ with sustained or continuous abstinence rates averaging around 50 to 70 percent of point prevalence rates.

There is some evidence that industry funding is associated with greater NRT efficacy; but not for bupropion and is less clear for varenicline. This association for NRT may be an indication of a selection bias to publish trials with positive but not negative results. The possibility of small studies effects or potential publication bias is supported by the review we included here that found some evidence of asymmetry in a funnel plot for trials included in the main NRT vs. placebo comparison. Another reasonable explanation, however, is that industry-funded trials often recruit participants who are less likely to quit without medication (heavier smokers) and result in much lower quit rates among control group participants. One review found that industry funding was associated with lower odds of quitting smoking among varenicline versus placebo conditions, but the effect was entirely due to two influential trials. Thus, it is somewhat unclear if industry function influences varenicline trials.

Finally, the mechanism by which AEs are recorded (generally passively) makes them susceptible to underreporting. As a result, these findings may be less reliable than for those related to abstinence outcomes.
Applicability

Most of the included studies within each review were conducted in North America and, as such, should be applicable to the U.S. health system. Most studies enrolled only individuals who were smokers who were generally motivated to quit with varying degrees of baseline smoking (i.e., cigarettes smoked per day) and nicotine dependence. These trials took place within a very wide range of settings with different types of providers and included individuals with smoking-related disease and those with mental health conditions. The literature almost exclusively addressed treatment for cigarette smoking, as opposed to the use of other forms of tobacco, so the results may not be generalizable to all forms of tobacco. The homogeneity of results across interventions and specific populations reflects the general applicability of the evidence. To that end, we believe the body of evidence represented in this overview of reviews is very applicable to primary care in the United States. Synthesized information regarding the details of the types of behavioral support represented in this review is provided in Appendix H to provide guidance to those wishing to implement smoking cessation interventions.

The available evidence on the use of e-cigarettes to help smokers quit smoking has very low applicability to clinical practice in the United States. Most importantly, giving the rapidly changing landscape of available products (we are currently in the fourth generation of products), the devices that were tested in the included trials are almost all either not available on the market or in the United States anymore or are not being used by most users. Furthermore, within trials, investigators are typically providing specific e-cigarette devices with predefined nicotine doses and schedules; whereas, clinically, we have no guidance on the appropriate devices, delivery of nicotine (e.g., liquid, salt), or dose that would be most effective to prescribe.

Future Research Needs

The findings of these reviews, and the estimated sizes of the treatment effects, have remained remarkably stable over nearly three decades of evidence for the majority of smoking cessation interventions. For instance, in the original Cochrane review on nurse advice to support tobacco cessation published in 1999, 15 studies contributed to the main analysis, with a pooled RR of 1.30 (95% CI, 1.16 to 1.44). The number of studies and participants have more than doubled (now 44 trials and over 20,000 participants) and thus narrowed the CIs but have had very little impact on the point estimate, which in this most recent update is essentially the same as it was in 1999 (RR 1.29 [95% CI, 1.21 to 1.38]). Likewise, the Cochrane review on NRT was first published in 1996. Despite the number of included studies more than doubling over this time, the effect estimate has remained stable (and represents 136 trials) and per the Cochrane Tobacco Addiction group, this latest review on NRT compared with placebo will be its final review on this subject. The review states: “In summary, based on 20 years of research and 136 randomized controlled trials in over 64,000 participants, we believe the question of whether NRT helps people to quit smoking to be definitively answered. We consider that further research is highly unlikely to change our confidence in the effect of NRT, and funders and researchers should give careful thought before pursuing further studies comparing established forms of NRT with control.”
This is not to say that all questions about tobacco cessation interventions have been answered. Evidence is still needed to compare different forms, doses, and durations of drugs; to compare drugs with one another; and to test interventions in special populations for which we may reasonably hypothesize that effectiveness differs from that in the general population (e.g., pregnant women, persons with current severe mental illness), including direct subgroup comparisons. Furthermore, given the promising results of a few trials testing the effectiveness of cytisine and its widespread use in other countries, more research on its effectiveness, comparative effectiveness, and harms are warranted. More trial evidence on the effectiveness of medications to stop smoking with and without behavioral support (including NRT bought over-the-counter) would help elucidate the potential generalizability of the broader evidence base as applied to populations for which intense behavioral support is not being provided or sought alongside medication-based treatment. Additionally, though the evidence has grown over the past 5 years in these areas, more research is warranted on the effectiveness of remotely delivered interventions such as Internet- and mobile phone-based interventions. Though a few reviews sought to include trials evaluating tobacco cessation smartphone applications, none were identified that met inclusion criteria. Given the plethora of these programs that are publicly available, future research should be conducted to evaluate their effectiveness on long-term smoking rates. Finally, there is a pressing need for future research on relapse prevention to aid in long-term cessation as well as the optional duration of treatment to maximize long-term abstinence.

Given the variation and the limited evidence available from well-designed studies on the association between e-cigarette use and smoking cessation, further research is clearly needed. To definitively answer the question of e-cigarette efficacy for tobacco cessation, trials must compare an e-cigarette intervention with the most effective known combination of pharmacotherapy and behavioral support. Only such a comparative effectiveness study could address how e-cigarette use for cessation compares with known effective intervention. Furthermore, before such research is conducted, additional strategies and research to help standardize and quantify e-cigarette use and nicotine levels is imperative. Future studies should test the more recent generation of products, namely mod pods including JUUL or the Standard Research E-Cigarette developed by the National Institute on Drug Abuse and NJOY, LLC. Additionally, research on other novel tobacco products, including heated tobacco products such as IQOS, which was recently approved for sale by the FDA are encouraged. Studies of older variants of e-cigarettes which are no longer available or not being used by the public are not as helpful in the context of informing clinical practice. Work to understand the types of e-cigarettes and the e-cigarette use patterns that are associated with greater success in using e-cigarettes for smoking cessation is needed as is the types, if any, of behavioral support that are associated with greater success in using e-cigarettes for smoking cessation. Additional research on interventions to help dual users of conventional cigarettes and e-cigarettes quit convention cigarettes and eventually, quit e-cigarettes as well are needed. Urgent work is needed to better define the causes of acute, severe lung injuries associated with e-cigarette use. Research on the causes and frequency of poisonings from e-cigarette fluid and injuries from exploding devices is also needed. The long-term health effects of use have not been reported from any study to date. In addition, research is needed to examine the longer-term transition rates of young e-cigarette users to conventional cigarettes and the relapse rates of smokers who have employed e-cigarettes as cessation tools. We identified several clinical trials currently under way or planned that address, or will address, the effectiveness and
safety of e-cigarettes as a tobacco cessation aid that may be of interest to the USPSTF in the future (Appendix I Table 1).

Finally, further research on potential benefits and safety of NRT among pregnant women is warranted. Careful collection of AEs and systems for deriving long-term consequences of exposure during pregnancy is important in future trials, and data on adherence to NRT and levels of nicotine exposure relative to what occurs with smoking would also be valuable. Despite the established importance of NRT in aiding cessation in general populations, few studies of NRT use have been conducted during pregnancy. This is likely due to concerns about the potential harms of nicotine for fetal and child development mostly inferred from animal studies or extrapolated from observed effects of smoking in pregnancy. Since exposure to nicotine is present with smoking, shifting from smoking to NRT during pregnancy could reduce the risk of adverse infant health outcomes known to be caused by smoking. A recent systematic review and meta-analysis provides evidence that the nicotine exposure from standard-dose NRT is lower than the levels seen with smoking. Moreover, if NRT were found to increase the likelihood of long-term cessation after pregnancy, reduced exposure to second-hand smoke during infancy and childhood would further increase the health benefits. Recent evidence of child health benefits from 2-year followup on the largest NRT trial highlight the importance of further research. In the absence of clear evidence that NRT increases cessation in pregnancy, however, it is encouraging that behavioral counseling interventions alone are effective for some women.

For behavioral and NRT interventions, an effort to identify and enroll more representative samples of women into trials is needed to ensure intervention effects are observed in less select populations, or to simply report clearly on the characteristics of women approached who declined participation. Others have noted the importance of qualitative and observational research to understand why adherence to NRT in pregnancy is low. The effects of smoking cessation interventions on perinatal health outcomes are not recorded uniformly, and future behavioral trials should collect a comprehensive set of key outcomes, similar to those provided in the most recent, larger NRT trials. Well-powered trials of behavioral therapies that show promise for strong effects could serve to make important contributions to maternal and child health. Although few have been conducted, trials using incentives to aid smoking cessation efforts suggest possibly strong effects, but it is unknown how long-term cessation efforts are affected by this kind of short-term motivation. Different interventions spanning pregnancy, the postpartum period, and beyond may also be beneficial and should include longer-term trials that combine multiple interventions in sequence and their consequences for fetal, infant, child, and maternal health. Unfortunately, we identified few registered studies that appear to address these questions (Appendix I Table 2).

Conclusions

There is extensive evidence that confirms the effectiveness of a range of pharmacological and behavioral interventions, alone and in combination, for smoking cessation in adults. Though there has been no decline in the production, sales, or use of e-cigarettes since our previous review on this subject, research on the potential benefits of these devices to help adults quit smoking is still lacking. Furthermore, more research is desperately needed on the absolute safety
profile of e-cigarettes and the long-term health consequences of their use among former smokers as well as dual users of both combustible and electronic cigarettes. There is evidence that behavioral interventions can help pregnant women to quit smoking in late pregnancy and into the postpartum period but limited evidence on the benefits and harms of pharmacotherapy in pregnant women.

Further studies of medications and behavioral support among the general adult population are unlikely to yield new information that would change the direction and magnitude of effects of the findings of this overview of reviews. Clinicians have an array of tools to offer, refer, or prescribe, improving the likelihood that patients will find an acceptable option to which they can adhere. Continued research on the evolving landscape of available tobacco products and their role in helping smokers quit or reduce their use of combustible cigarette use and total nicotine exposure is warranted, along with the long-term risks associated with these products.
References


35. Prochaska JJ, Das S, Benowitz NL. Cytisine, the world's oldest smoking cessation aid. BMJ. 2013;347:f5198. https://doi.org/10.1136/bmj.f5198


91. Danielsson AK, Eriksson AK, Allebeck P. Technology-based support via telephone or web: a systematic review of the effects on smoking, alcohol use and gambling. Addict Behav. 2014;39(12):1846-68. PMID: 25128637. https://doi.org/10.1016/j.addbeh.2014.06.007


Palmer M, Sutherland J, Barnard S, et al. The effectiveness of smoking cessation, physical activity/diet and alcohol reduction interventions delivered by mobile phones for the prevention of non-communicable diseases: A systematic review of randomised


204. Food and Drug Administration. FDA permits sale of IQOS Tobacco Heating System through premarket tobacco product application pathway. Food and Drug Administration; 2019. PMID.
Figure 1. Analytic Framework

- Adults who currently use tobacco

  → Tobacco Cessation Intervention

  → Behavioral Outcomes
    - Tobacco cessation

  → Health Outcomes
    - Mortality
    - Morbidity
    - Other

  → Harms
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<th>Population</th>
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<td>Adults who are not pregnant</td>
<td>The USPSTF recommends that clinicians ask all adults about tobacco use, advise them to stop using tobacco, and provide behavioral interventions and U.S. Food and Drug Administration (FDA)—approved pharmacotherapy for cessation to adults who use tobacco.</td>
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<tr>
<td>Pregnant women</td>
<td>The USPSTF recommends that clinicians ask all pregnant women about tobacco use, advise them to stop using tobacco, and provide behavioral interventions for cessation to pregnant women who use tobacco.</td>
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<td>Pregnant women</td>
<td>The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of pharmacotherapy interventions for tobacco cessation in pregnant women.</td>
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<tr>
<td>All adults, including pregnant women</td>
<td>The USPSTF concludes that the current evidence is insufficient to recommend electronic nicotine delivery systems (ENDS) for tobacco cessation in adults, including pregnant women. The USPSTF recommends that clinicians direct patients who smoke tobacco to other cessation interventions with established effectiveness and safety (previously stated).</td>
<td>I</td>
</tr>
</tbody>
</table>
### Table 2. Characteristics of Included Systematic Reviews by Review Focus, Intervention, and Last Search Date

<table>
<thead>
<tr>
<th>Focus (Number of reviews)</th>
<th>Author, Year</th>
<th>Primary review†</th>
<th>Quality‡</th>
<th>Specific intervention or subgroup</th>
<th>Last search date</th>
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<th>KQ 2: Cessation</th>
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<tr>
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</table>

Tobacco Cessation in Adults 90 Kaiser Permanente Research Affiliates EPC
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<th>KQ 2: Cessation</th>
<th>KQ 3: Harms</th>
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<td>X</td>
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<tr>
<td></td>
<td>Schuit, 2017\textsuperscript{123}</td>
<td>High</td>
<td>Subgroup: Genetic biomarker differences NRT, bupropion, varenicline</td>
<td>Aug-2016</td>
<td>18</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Khanna, 2016\textsuperscript{101}</td>
<td>High</td>
<td>Subgroup: Persons with SMI Advice</td>
<td>Apr-2015</td>
<td>0</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Tsoi, 2013\textsuperscript{134†}</td>
<td>High</td>
<td>Subgroup: Persons with SMI Any tobacco cessation intervention</td>
<td>Oct-2012</td>
<td>34</td>
<td>X</td>
<td>X</td>
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</tr>
<tr>
<td></td>
<td>van der Meer, 2013\textsuperscript{137†}</td>
<td>Moderate</td>
<td>Subgroup: Persons with SMI Any tobacco cessation intervention</td>
<td>Apr-2013</td>
<td>49</td>
<td>X</td>
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<tr>
<td></td>
<td>Peckham, 2017\textsuperscript{119}</td>
<td>Moderate</td>
<td>Subgroup: Persons with SMI Any tobacco cessation intervention</td>
<td>Sept-2016</td>
<td>26</td>
<td>X</td>
<td>X</td>
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<tr>
<td></td>
<td>Roberts, 2016\textsuperscript{121}</td>
<td>Moderate</td>
<td>Subgroup: Persons with SMI NRT, bupropion, varenicline</td>
<td>Dec-2014</td>
<td>14</td>
<td>X</td>
<td>X</td>
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<tr>
<td></td>
<td>Ahmed, 2018\textsuperscript{82}</td>
<td>Moderate</td>
<td>Subgroup: Persons with SMI Varenicline</td>
<td>July-2018</td>
<td>4</td>
<td>X</td>
<td>X</td>
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<tr>
<td></td>
<td>Kishi, 2015\textsuperscript{102}</td>
<td>Moderate</td>
<td>Subgroup: Persons with SMI Varenicline (Harms only)</td>
<td>Aug-2014</td>
<td>7</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Wu, 2016\textsuperscript{43}</td>
<td>High</td>
<td>Subgroup: Persons with SMI Varenicline (Harms only)</td>
<td>Sept-2015</td>
<td>8</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Smith, 2016\textsuperscript{125}</td>
<td>Low</td>
<td>Subgroup: Sex differences NRT, bupropion, varenicline</td>
<td>Dec-2015</td>
<td>28</td>
<td>X</td>
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<td>McKee, 2016\textsuperscript{113}</td>
<td>High</td>
<td>Subgroup: Sex differences Varenicline</td>
<td>Dec-2014</td>
<td>16</td>
<td>X</td>
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<tr>
<td></td>
<td>Ebbert, 2015\textsuperscript{94}</td>
<td>High</td>
<td>Subgroup: Smokeless tobacco users Any tobacco cessation intervention</td>
<td>June-2015</td>
<td>34</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Schwartz, 2016\textsuperscript{124}</td>
<td>Low</td>
<td>Subgroup: Smokeless tobacco users Varenicline</td>
<td>Feb-2014</td>
<td>3</td>
<td>X</td>
<td>X</td>
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<td></td>
</tr>
</tbody>
</table>

* Primary reviews are those that represented the most current and/or applicable evidence within each population and intervention subgroup and served as the basis for the main findings of this report.
† Review credibility assessed using AMSTAR-2\textsuperscript{77}
‡ Included in previous USPSTF review and has not been updated

**Abbreviations:** KQ = key question; NRT = Nicotine replacement therapy; SMI = severe mental illness

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Kaiser Permanente Research Affiliates EPC
Table 3. Inclusion Criteria of Primary Systematic Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions, by Intervention Type

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<tr>
<th>Author, Year</th>
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<th>Intervention criteria</th>
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<th>Setting</th>
<th>Followup</th>
<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stead, 2016</td>
<td>Jul-2015</td>
<td>Adult smokers, excluding pregnant persons</td>
<td>Combined pharmacotherapy and behavioral support</td>
<td>Combined pharmacotherapy and behavioral support</td>
<td>Usual care; brief advice</td>
<td>Smoking abstinence</td>
<td>Any</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCT</td>
</tr>
<tr>
<td>Hartmann-Boyce, 2018</td>
<td>Jul-2017</td>
<td>Smokers of any age motivated to quit</td>
<td>NRT</td>
<td>NRT</td>
<td>Placebo; non-NRT control</td>
<td>Smoking abstinence; AEs; SAEs</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCT</td>
</tr>
<tr>
<td>Lindson, 2019</td>
<td>Apr-2018</td>
<td>Smokers of any age motivated to quit</td>
<td>NRT, different doses, durations, and combinations</td>
<td>Any form, dose, duration, schedule of NRT use</td>
<td>Any other forms, doses, durations, or schedules of NRT</td>
<td>Smoking abstinence; AEs; SAEs; drop-outs due to AEs</td>
<td>Any</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Hughes, 2014</td>
<td>Jul-2013</td>
<td>Smokers, or recent quitters of any age</td>
<td>Bupropion</td>
<td>Antidepressant medication, including bupropion</td>
<td>Placebo; no pharmacotherapy; alternative therapeutic control; different dosage of antidepressant</td>
<td>Smoking abstinence; AEs; SAEs; drop-outs due to AEs</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs and observational studies</td>
</tr>
<tr>
<td>Cahill, 2016</td>
<td>May-2015</td>
<td>Adult smokers, excluding smokeless tobacco users</td>
<td>Varenicline</td>
<td>Selective nicotine receptor partial agonists, including varenicline</td>
<td>Placebo or alternative pharm</td>
<td>Smoking abstinence; AEs; Cardiovascular AEs; SAEs</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Chang, 2015</td>
<td>Nov-2014</td>
<td>Adult smokers</td>
<td>Varenicline + NRT</td>
<td>Combination treatment of varenicline and NRT</td>
<td>Varenicline</td>
<td>Smoking abstinence; AEs</td>
<td>NR</td>
<td>NR</td>
<td>RCTs</td>
</tr>
<tr>
<td>Hollands, 2019</td>
<td>Sept-2018</td>
<td>Adult smokers</td>
<td>Support for medication adherence</td>
<td>Intervention with clear focus on increasing adherence to pharmacotherapy for tobacco cessation</td>
<td>Usual care</td>
<td>Smoking abstinence; AEs</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>Mills, 2010</td>
<td>Nov-2009</td>
<td>Smokers of any age</td>
<td>NRT (Harms only)</td>
<td>Any form of NRT (lozenge, skin patch, gum, nasal spray, inhaler, and tablet)</td>
<td>Placebo or standard of care</td>
<td>AEs</td>
<td>Any</td>
<td>Any</td>
<td>RCTs and observational studies</td>
</tr>
<tr>
<td>Author, Year</td>
<td>Last search date</td>
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</tr>
<tr>
<td>Mills, 2014</td>
<td>Mar-2013</td>
<td>Smokers of any age</td>
<td>NRT, bupropion, varenicline (Harms only)</td>
<td>NRT, bupropion, or varenicline</td>
<td>Placebo or no drug</td>
<td>Cardiovascular AEs</td>
<td>NR</td>
<td>Any</td>
<td>RCTs</td>
</tr>
<tr>
<td>Thomas, 2015</td>
<td>May-2014</td>
<td>Any*</td>
<td>Varenicline (Harms only)</td>
<td>Varenicline at the maximum dosage (1 mg twice daily)</td>
<td>Placebo</td>
<td>AEs; Psychiatric AEs</td>
<td>Any</td>
<td>Any followup accepted</td>
<td>RCTs</td>
</tr>
<tr>
<td>Sterling, 2016</td>
<td>Jun-2015</td>
<td>Tobacco users of any age</td>
<td>Varenicline (Harms only)</td>
<td>Varenicline</td>
<td>Placebo; behavioral intervention applied equally in intervention and control groups</td>
<td>Cardiovascular AEs; SAEs</td>
<td>NR</td>
<td>During study treatment or within 30 days of drug discontinuation</td>
<td>RCTs</td>
</tr>
<tr>
<td>Hartmann-Boyce, 2019</td>
<td>June-2018</td>
<td>Smokers of any age, excluding pregnant persons</td>
<td>Behavioral support as an adjunct to pharmacotherapy</td>
<td>Behavioral support as an adjunct to pharmacotherapy, where all participants had access to a smoking cessation pharmacotherapy and in which one or more intervention conditions received more intensive behavioral support than the control condition</td>
<td>Any behavioral support of a lower intensity than the intervention or testing specific behavioral components but matched for contact frequency and duration</td>
<td>Smoking abstinence</td>
<td>Any</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>Stead, 2013</td>
<td>Jan-2013</td>
<td>Smokers of any age, excluding pregnant persons</td>
<td>Physician advice</td>
<td>Physician advice to stop smoking. Advice was defined as verbal instructions from the physician with a &quot;stop smoking&quot; message irrespective of whether or not information was provided about the</td>
<td>No advice; usual care; differing levels of physician advice</td>
<td>Smoking abstinence</td>
<td>Any</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
</tbody>
</table>
Table 3. Inclusion Criteria of Primary Systematic Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions, by Intervention Type

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Last search date</th>
<th>Population</th>
<th>Specific intervention</th>
<th>Intervention criteria</th>
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<th>Setting</th>
<th>Followup</th>
<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice, 2017¹²⁰</td>
<td>Jan-2017</td>
<td>Adult smokers, excluding pregnant persons</td>
<td>Nurse support</td>
<td>Nursing intervention, defined as the provision of advice, counseling, and/or strategies to help people quit smoking. Advice was defined as verbal instructions from the nurse to stop smoking, whether they provided information about the harmful effects of smoking</td>
<td>Usual care; brief advice; no intervention</td>
<td>Smoking abstinence</td>
<td>Any</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Lancaster, 2017¹⁰⁴</td>
<td>May-2016</td>
<td>Adult smokers, excluding pregnant persons</td>
<td>Individual behavioral counseling</td>
<td>Individual counseling consisting of a face-to-face encounter between a smoker and a counselor trained in assisting smoking cessation, including counseling as an addition to pharmacotherapy†</td>
<td>NR</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>Stead, 2017¹²⁷</td>
<td>May-2016</td>
<td>Adult smokers, excluding pregnant persons</td>
<td>Group behavioral therapy</td>
<td>Group behavioral therapy in which smokers met for scheduled meetings and received some form of behavioral intervention, such as information, advice and encouragement or cognitive behavioral therapy delivered over at least two sessions</td>
<td>Non-group-based cessation intervention; no-intervention control</td>
<td>Smoking abstinence</td>
<td>Any, except for antenatal care settings</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
</tbody>
</table>
Table 3. Inclusion Criteria of Primary Systematic Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions, by Intervention Type

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<th>Setting</th>
<th>Followup</th>
<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lindson, 2019b</td>
<td>Aug-2018</td>
<td>Smokers of any age, excluding pregnant persons</td>
<td>Motivational interviewing</td>
<td>Behavioral intervention using motivational interviewing</td>
<td>No intervention, another smoking cessation intervention of any length or intensity, another type of MI intervention</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Moyo, 2018</td>
<td>July-2017</td>
<td>Adult smokers</td>
<td>Decision aids</td>
<td>Any tool a healthcare provider used to share with and inform people about treatment options, including print, video, and computer-based aids</td>
<td>Usual care without the use of shared decision-making and decision aids</td>
<td>Smoking abstinence</td>
<td>Any</td>
<td>Any</td>
<td>RCTs, nonrandomized controlled trials, before and after studies, interrupted time-series</td>
</tr>
<tr>
<td>Livingstone-Banks, 2019b</td>
<td>Mar-2018</td>
<td>Adult smokers, excluding pregnant persons</td>
<td>Print-based interventions</td>
<td>Print-based self-help intervention, defined as any manual or program designed to be used by individuals to assist a quit attempt that is not aided by health professions, counselors, or group support</td>
<td>Another print-based self-help intervention; minimal control.</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>Matkin, 2019</td>
<td>May-2018</td>
<td>Smokers of any age</td>
<td>Telephone counseling</td>
<td>Telephone counselling alone, in combination with self-help materials, or as an adjunct to another smoking cessation treatment</td>
<td>Minimal intervention; brief intervention; no telephone counselling</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>Whittaker, 2019</td>
<td>Oct-2018</td>
<td>Smokers of any age</td>
<td>Mobile phone-based support</td>
<td>Any intervention that could be considered predominantly a mobile phone-based program (such as</td>
<td>NR</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>Author, Year</td>
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<tr>
<td>Tzelepis, 2019&lt;sup&gt;135&lt;/sup&gt;</td>
<td>Aug-2019</td>
<td>Smokers of any age</td>
<td>Real-time video counselling</td>
<td>Interventions where real-time video counselling was delivered by smoking cessation advisors or healthcare professionals as either the primary intervention or an adjunct to other smoking cessation treatments. Studies were eligible where administration of the intervention occurred via telemedicine video conferencing technology or other platforms such as Skype, FaceTime, Google+Hangouts, Talky Core, Facebook Messenger, Viber, Tango (or both) or alternative forms of video communication.</td>
<td>No intervention control; health information or brief advice; written self-help materials; proactive telephone counselling; individual face-to-face support; group face-to-face support; web-based interventions or any other smoking cessation intervention</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Taylor, 2017&lt;sup&gt;130&lt;/sup&gt;</td>
<td>Aug-2016</td>
<td>Smokers of any age, including pregnant women</td>
<td>Internet-based interventions</td>
<td>Internet-based interventions delivered alone or alongside an additional behavioral component or pharmacotherapy</td>
<td>No treatment; other forms of treatment</td>
<td>Smoking abstinence; AEs</td>
<td>Any</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
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<td>Author, Year</td>
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<tr>
<td>Notley, 2019</td>
<td>July 2018</td>
<td>Adult smokers</td>
<td>Incentives</td>
<td>Incentive schemes, lotteries, raffles, and contingent or non-contingent payments, to reward cessation and abstinence in smoking cessation programs</td>
<td>Usual care, other smoking cessation intervention without incentives, another incentive-based intervention differing by incentive type or amount</td>
<td>Smoking abstinence, Aes</td>
<td>Any</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Clair, 2019</td>
<td>Sept 2018</td>
<td>Smokers of any age</td>
<td>Biomedical risk assessment</td>
<td>Biomedical risk assessment in which a physical measurement, such as exhaled carbon monoxide, spirometry, atherosclerotic plaque imaging, or genetic testing was used to increase smoking cessation</td>
<td>Any control group that did not include reporting of such measurements.</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Ussher, 2019</td>
<td>May 2019</td>
<td>Tobacco smokers wishing to quit, or recent quitters</td>
<td>Exercise</td>
<td>Interventions aimed at increasing exercise, either alone or as an adjunct to a smoking cessation intervention</td>
<td>Smoking cessation program alone or another type of nonexercise control group</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>White, 2014</td>
<td>Oct 2013</td>
<td>Tobacco users of any age wishing to stop smoking, excluding pregnant persons</td>
<td>Acupuncture</td>
<td>Acupuncture, acupressure, laser therapy or electrostimulation</td>
<td>No intervention; sham acupuncture (i.e., acupuncture to known spots that aren’t related to smoking cessation); usual care; placebo; other intervention</td>
<td>Smoking abstinence</td>
<td>Any</td>
<td>≥6 months</td>
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<tbody>
<tr>
<td>Barnes, 2019⁸⁴</td>
<td>July-2018</td>
<td>Smokers of any age wishing to stop smoking</td>
<td>Hypnotherapy</td>
<td>Hypnotherapy for smoking cessation</td>
<td>No treatment or other therapeutic intervention</td>
<td>Smoking abstinence, Aes</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Boyle, 2014⁸⁶</td>
<td>Jul-2014</td>
<td>Smokers of any age</td>
<td>Electronic health records support</td>
<td>Interventions that involved electronic health record systems in healthcare settings that were intended to improve documentation or assistance for patients who use tobacco, either by directly prompting clinician, clinic, or health system action or by measuring and reporting on clinical performance</td>
<td>NR</td>
<td>Smoking abstinence; changes in support action (system level)</td>
<td>Healthcare settings</td>
<td>≥6 months</td>
<td>RCTs or observational studies</td>
</tr>
<tr>
<td>Thomas, 2017¹³¹</td>
<td>Feb-2016</td>
<td>Smokers of any age who are receiving care in a healthcare setting</td>
<td>System change interventions</td>
<td>Policies and practices designed by organizations to integrate the identification of all smokers and the subsequent offering of evidence-based smoking cessation treatments (pharmacological, behavioral, or both) into the routine delivery of health care‡</td>
<td>NR</td>
<td>Smoking abstinence</td>
<td>Any healthcare setting</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
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<tbody>
<tr>
<td>Lindson, 2019c&lt;sup&gt;106&lt;/sup&gt;</td>
<td>Oct-2018</td>
<td>Smokers of any age, excluding pregnant persons</td>
<td>Reduction-to-quit interventions</td>
<td>Instruction, advice, or support for participants to reduce the number of cigarettes with an ultimate goal of quitting</td>
<td>No intervention; abrupt quitting interventions, or another reduction-to-quit intervention</td>
<td>Smoking abstinence, Aes</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Livingstone-Banks, 2019a&lt;sup&gt;109&lt;/sup&gt;</td>
<td>Feb-2018</td>
<td>Smokers of any age who quit on their own, were undergoing enforced abstinence, or were participating in treatment programs</td>
<td>Relapse prevention</td>
<td>Any pharmacologic, behavioral, or combination intervention aimed at tobacco relapse prevention</td>
<td>No intervention; shorter intervention; intervention not oriented towards relapse prevention</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>Chamberlain, 2017&lt;sup&gt;182&lt;/sup&gt;</td>
<td>Nov-2015</td>
<td>Women who are currently smoking or have recently quit smoking and are pregnant; women who are currently smoking or have recently quit smoking and are seeking a pre-pregnancy consultation; health professionals in trials of implementation strategies of psychosocial interventions to</td>
<td>Any behavioral support</td>
<td>Psychosocial interventions where a primary aim of the study was smoking cessation in pregnancy. Psychosocial interventions were defined as non-pharmacological strategies that use cognitive behavioral, motivational and supportive therapies to help women to quit, including counselling, health education, feedback, financial incentives, social support from peers and/or partners, and exercise</td>
<td>Usual care; less intensive intervention; alternative intervention</td>
<td>Smoking abstinence; Aes; smoking reduction; relapse prevention; perinatal outcomes; maternal outcomes; healthcare utilization</td>
<td>Any</td>
<td>≥6 months, ≥12 months (postpartum); late pregnancy</td>
<td>RCTs or quasi-RCTs</td>
</tr>
</tbody>
</table>
Table 3. Inclusion Criteria of Primary Systematic Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions, by Intervention Type

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Last search date</th>
<th>Population</th>
<th>Specific intervention</th>
<th>Intervention criteria</th>
<th>Comparison</th>
<th>Outcomes</th>
<th>Setting</th>
<th>Followup</th>
<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>support pregnant women to stop smoking.</td>
<td>interventions, as well as dissemination trials</td>
<td></td>
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</table>

* Includes studies among smokers and non-smokers
† Excludes studies of counseling delivered by doctors or nurses and studies of motivational interviewing as those studies are captured in other reviews
‡ Interventions that include at least one of the following six system-level strategies: 1. Implement a system for identifying smokers and documenting tobacco-use status in every clinic and hospital; 2. Provide education, resources and feedback to promote provider interventions; 3. Dedicate staff to provide smoking cessation treatment and assess its delivery in staff performance evaluations; 4. Promote hospital policies that support and provide smoking cessation services; 5. Provide evidence-based tobacco dependence treatments (both counselling and pharmacotherapy); 6. Reimburse providers for the delivery of effective tobacco dependence treatments and include these services among their defined duties.

**Abbreviations:** AE = Adverse event; mg = milligram; MI = motivational interviewing; NR = Not reported; NRT = Nicotine replacement therapy; RCT = Randomized controlled trial; SAE = Serious adverse event
Table 4. Descriptive Characteristics of Included Studies Within the Primary Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions, by Intervention Type

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<tr>
<th>Author, Year</th>
<th>Specific intervention</th>
<th>Number of included studies</th>
<th>Sample size (Range)</th>
<th>Mean age (Range)</th>
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<th>Intervention description</th>
<th>Setting</th>
<th>Providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stead, 2016&lt;sup&gt;128&lt;/sup&gt;</td>
<td>Combined pharmacotherapy and behavioral support</td>
<td>53</td>
<td>15 – 5887</td>
<td>31 – 65</td>
<td>11 – 31</td>
<td>Typical intervention involved multiple contacts with a specialist cessation adviser or counsellor, with most participants using some pharmacotherapy and receiving multiple contacts. However, there was a great deal of variation, including some interventions which involved making pharmacotherapy and behavioral components available to a large population in which take-up of treatment was low, or providing a brief intervention to all participants and offering stepped care for those willing to set a quit date. One intervention was delivered entirely by mail or prerecorded phone messages, using an expert system for tailoring contact and two by telephone counselling alone. All others included some face-to-face contact but additional sessions was sometimes provided by telephone. More than half the trials (n = 28, 53%) offered between four and eight sessions and a quarter (n = 13) over eight sessions. The modal category for contact time was 91 to 300 minutes (n = 22, 42%), with 17 (32%) offering between 31 and 90 minutes and eight (15%) over 300 minutes. We categorized interventions according to the maximum planned contact unless session duration was not described, so the typical time per participant would have been smaller, even in studies where the take-up of treatment was high.</td>
<td>Healthcare settings (k=43), community-based recruitment (k=8)</td>
<td>Healthcare settings (k=43), community-based recruitment (k=8)</td>
</tr>
<tr>
<td>Hartmann-Boyce, 2018&lt;sup&gt;96&lt;/sup&gt;</td>
<td>NRT</td>
<td>136</td>
<td>50 – 8000</td>
<td>15 – 62</td>
<td>8 – 38</td>
<td>Most trials comparing nicotine gum to control provided the 2 mg dose. A few provided 4 mg gum to more highly addicted smokers, and two used only the 4 mg dose. In three trials the physician offered nicotine gum but participants did not necessarily accept or use it. In one trial participants self-selected 2 mg or 4 mg doses. The treatment period was typically two to three months but ranged from three weeks</td>
<td>Primary care practices, workplace clinics (k=2), university clinic (k=1), recruited through community physicians (k=1), Therapists (sometimes specified as a GP but mostly not specified)</td>
<td>Healthcare settings (k=43), community-based recruitment (k=8)</td>
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<td>to 12 months. Some trials did not specify how long the gum was available. Many of the trials included a variable period of dose tapering, but most encouraged participants to be gum-free by six to 12 months. In nicotine patch trials the usual maximum daily dose was 15 mg for a 16-hour patch, or 21 mg for a 24-hour patch. Thirty-two studies used a 24-hour formulation and nine a 16-hour product; the rest did not specify. One study offered, among other dosage options, a 52.5 mg/24-hour patch. The minimum duration of therapy ranged from three weeks, to three months. There are eight studies of nicotine sublingual tablets or lozenges. Three used 2 mg sublingual tablets. One used a 1 mg nicotine lozenge. One used 2 mg or 4 mg lozenges according to dependence level based on manufacturers’ instructions, and one used 2 mg or 4 mg based on participants’ time to first cigarette of the day (TTFC); smokers whose TTFC was more than 30 minutes were randomized to 2 mg lozenges or placebo, whilst smokers with a TTFC less than 30 minutes had higher-dose 4 mg lozenges or placebo.</td>
<td>Veterans Affairs Medical Centers, and recruited people with cardiac diseases in the primary care category (k=1), antenatal clinics (k=4), specialized smoking cessation clinics to which participants had usually been referred (k=6), hospital in- or outpatients, some of whom were recruited because they had a co-existing smoking-related illness (k=13), settings intended to resemble ‘over the-counter’ (OTC) use of NRT (k=3), drug abuse treatment centers (k=2), psychiatric treatment setting (k=1), remaining trials were undertaken in</td>
<td></td>
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</table>

Tobacco Cessation in Adults

Kaiser Permanente Research Affiliates EPC
Table 4. Descriptive Characteristics of Included Studies Within the Primary Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions, by Intervention Type

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<tbody>
<tr>
<td>Lindson, 2019a</td>
<td>NRT, different doses, durations, and combinations</td>
<td>63</td>
<td>45 – 3575</td>
<td>15 – 56.7</td>
<td>17 – 38</td>
<td>Trials addressed a range of questions relating to the effectiveness of different types and uses of NRT. The variations on NRT use tested are included in the outcomes.</td>
<td>Community (k=31), internet advertisements (k=1), referrals from clinicians or from healthcare clinics, such as smoking cessation clinics or quit lines, substance abuse clinics, primary care clinics, referrals to a lung health clinic (k=1), previous smoking cessation studies (k=1), worksites (k=2), universities (k=1), a number of studies used a mixture of these approaches</td>
<td>Smoking cessation counsellors, research nurses, physicians</td>
</tr>
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Table 4. Descriptive Characteristics of Included Studies Within the Primary Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions, by Intervention Type

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<tr>
<td>Hughes, 201474</td>
<td>Bupropion</td>
<td>90</td>
<td>15 – 1524</td>
<td>16 – 56</td>
<td>5 – 37</td>
<td>Details of interventions not synthesized. Bupropion vs. control (2 trials had NRT in both arms) (k=44) Bupropion + NRT (k=12) Bupropion vs. NRT (k=8) Comparing bupropion and nortriptyline (k=3) Comparing bupropion and varenicline (k=4) Testing the extended use of bupropion for relapse prevention (k=7) Testing extended use of bupropion and its use for assisting in reducing the amount smoked (k=1) Nortriptyline (k=7) Fluoxetine (k=5) Moclobemide (k=1) Selegiline (k=5) St. John’s wort (k=2) Paroxetine (k=1) Sertraline (k=1) Venlafaxine (k=1) SAMe (k=1)</td>
<td>Community-based health care center, cessation outpatient clinics, community clinics, hospitals, community mental health center, Veterans Medical Center, primary care clinics, university, substance use disorder clinics, continuation high schools, preoperative clinic, prisons, HMO</td>
<td>NR</td>
</tr>
<tr>
<td>Cahill, 201687</td>
<td>Varenicline</td>
<td>44</td>
<td>32 – 8144</td>
<td>38 – 57</td>
<td>NR</td>
<td>33 studies used the standard 12-week regimen of varenicline, routinely titrating the first week up to the recommended daily dose of 1 mg twice a day; 3 trials compared different dosage arms of varenicline against a placebo arm; 1 trial in non-responders regulated dosage up to the target quit date (day 21) to a maximum of 5 mg a day; 1 allowed participants to regulate their own dosage throughout the treatment phase; 5 trials used NRT as a comparator condition and provided a 12-week course, reducing the dosage as a weaning process; 2 trials provided an 8-week course, one of which progressively reduced the dosage at the end of treatment; 1 trial gave a 24-week course of NRT, tailored to the level of nicotine</td>
<td>Smoking cessation clinics, hospitals, universities, and other research centers</td>
<td>NR</td>
</tr>
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Table 4. Descriptive Characteristics of Included Studies Within the Primary Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions, by Intervention Type

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<tbody>
<tr>
<td>Chang, 2015&lt;sup&gt;89&lt;/sup&gt;</td>
<td>Varenicline + NRT</td>
<td>3</td>
<td>117 – 435</td>
<td>44.5 – 46.3</td>
<td>NR</td>
<td>One study administered trial patch two weeks before the Target Quit Date (TQD), while the other two studies started patch use on the TQD. Two studies used a 15 mg/16 hours patch, while the other used a 21 mg/24 hours patch. The use of varenicline was similar among the studies: All started at 0.5 mg per day one week before TQD, with increase to 2 g/day on TQD, and continued for 12 weeks. One study tapered the dose of varenicline on the 13&lt;sup&gt;th&lt;/sup&gt; week. All studies provided concurrent behavioral counseling during the treatment phase.</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Hollands, 2019&lt;sup&gt;92&lt;/sup&gt;</td>
<td>Support for medication adherence</td>
<td>10</td>
<td>40 – 928</td>
<td>32-49</td>
<td>NR</td>
<td>The interventions typically provided information on the rationale for, and emphasized the importance of, adherence to medication, and aided participants in developing strategies to overcome problems and barriers to maintaining adherence. As such, they included a combination of two intervention strategies: a) instruction for patients on medication use or b) counselling about smoking, and the value of medication in overcoming addiction.</td>
<td>Clinic settings apart from one study delivered by phone</td>
<td>Trained counselors, project staff, nurses, cognitive behavioral therapy practitioners</td>
</tr>
<tr>
<td>Mills, 2010&lt;sup&gt;115&lt;/sup&gt;</td>
<td>NRT (Harms only)</td>
<td>120</td>
<td>7 – 1,429 (RCTs) 22 – 65,599 (obs)</td>
<td>NR</td>
<td>21 – 35</td>
<td>Details of interventions not synthesized. RCTs (k=92); placebo controlled (k=83): Patch (k=42) Gum (k=26) Spray (k=6) Inhaler (k=6) Tablet (k=4) Lozenge (k=1) NRT combination (k=35) *59 RCTs included co-interventions Counseling (k=20)</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Author, Year</td>
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<tr>
<td>Mills, 2014&lt;sup&gt;114&lt;/sup&gt;</td>
<td>NRT, bupropion, varenicline (Harms only)</td>
<td>63</td>
<td>32 – 3,296</td>
<td>NR</td>
<td>17 – 31</td>
<td>Details of interventions not synthesized.</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Thomas, 2015&lt;sup&gt;132&lt;/sup&gt;</td>
<td>Varenicline (Harms only)</td>
<td>44</td>
<td>9 – 1210</td>
<td>15 – 72</td>
<td>Average, 20 (range NR)</td>
<td>Varenicline at the maximum dose (1 mg twice daily)</td>
<td>Smokers in hospital (k=1)</td>
<td>NR</td>
</tr>
<tr>
<td>Sterling, 2016&lt;sup&gt;129&lt;/sup&gt;</td>
<td>Varenicline (Harms only)</td>
<td>38</td>
<td>10 – 1510</td>
<td>13.5 – 69.1</td>
<td>10.7 – 26.0</td>
<td>The most common dose of varenicline was 1 mg twice daily, with some studies in which lower doses were prescribed. Length of treatment with varenicline ranged from 1 to 52 weeks, with the majority of studies treating patients for 12 weeks.</td>
<td>Varied: General population, inpatient, outpatient</td>
<td>NR</td>
</tr>
<tr>
<td>Hartmann-Boyce 2019&lt;sup&gt;97&lt;/sup&gt;</td>
<td>Behavioral support as an adjunct to</td>
<td>83</td>
<td>30 – 4614</td>
<td>17 – 61</td>
<td>21.2</td>
<td>NRT was offered in the majority of studies, with 41 providing nicotine patch only. Most provided a supply of NRT for between eight Primary care, chest clinic, cardiovascular</td>
<td>Trained counselors, community-</td>
<td></td>
</tr>
<tr>
<td>Author, Year</td>
<td>Specific intervention</td>
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<tr>
<td>Stead, 2013¹²⁶</td>
<td>Physician advice</td>
<td>42</td>
<td>60 – 3,215</td>
<td>NR</td>
<td>13 – 25</td>
<td>and 12 weeks. Eight studies used nicotine gum only, one used sublingual tablets and three did not specify the type. Five studies offered patch and/or gum. Seven studies provided bupropion alone, one provided nortriptyline alone and four provided varenicline alone. Three studies offered a choice of pharmacotherapy; NRT or bupropion, or NRT, bupropion, or varenicline. Three studies provided combination therapy of both NRT and bupropion. The intensity of the behavioral support, in both the number of sessions and their duration, was very varied for both intervention and control conditions. In seven trials, there was no counselling contact for the controls. In 30 studies, the control arms had between one and three contacts (which could be face-to-face or by telephone) and most of these had a total contact duration of between four and 30 minutes. In 34 studies, the control group was scheduled to receive between four and eight contacts, with all except eight involving a total contact duration of over 90 minutes. Twelve studies offered over eight contacts for the controls. Typically, the intervention involved only a little more contact than the control, so that the most intensive interventions were compared with more intensive control conditions. In five trials, the intervention consisted of between one and three sessions, with a total duration of 31 to 90 minutes. Forty-five studies tested interventions of between four and eight sessions, about half of which were in the 91- to 300-minute-duration category. The remaining 32 studies offered more than eight sessions, typically providing over 300 minutes of counselling in total.</td>
<td>Mostly family/general practice, but</td>
<td></td>
</tr>
</tbody>
</table>

¹²⁶ The definition of what constituted ‘advice’ varied considerably. In one study participants were asked whether they smoked and were disease |

Tobacco Cessation Interventions, by Intervention Type

Disease outpatient clinic, rheumatology clinic, immunology clinic, HIV clinic, lesbian, gay, bisexual, and transgender health center, mental health clinic, mental health research center, substance abuse clinic, Veterans Administration hospital, cardiac ward, any ward |

based educators, nurse practitioners, research staff with bachelor's degree or higher, psychologists, masters-level counselors, research nurses, telephone counselors, exercise physiologist, smoking cessation specialists, trained advisors, abuse therapist, physicians, American Cancer Society-trained volunteers, advisors from helpline centers, wellness coaches, trained facilitator, study personnel, mental health clinicians |
<table>
<thead>
<tr>
<th>Author, Year</th>
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</thead>
<tbody>
<tr>
<td>Rice, 2017</td>
<td>Nurse support</td>
<td>59</td>
<td>25 – 2700</td>
<td>20.3 – 70</td>
<td>12 – 23</td>
<td>Nine studies examined a smoking cessation intervention as a component of multiple risk factor reduction interventions in adults with cardiovascular disease; 36 interventions were considered high-intensity (i.e., initial contact lasted more than 10 minutes, there were additional materials or strategies or both,</td>
<td>Recruited from primary care or outpatient clinics (k=28), hospitalized patients (k=22), remaining trials</td>
<td>Nurses or health visitors</td>
</tr>
</tbody>
</table>

given a leaflet if they wanted to stop. The control group were not asked about their smoking status until followup. In all other studies the advice included a verbal ‘stop smoking’ message. This verbal advice was supplemented by provision of some sort of printed ‘stop smoking’ material (27 studies), or additional advice from a support health worker or referral to a cessation clinic or both. Four studies described the physician intervention as behavioral counselling with a stop-smoking aim. One study compared motivational consulting (based on information from theoretical models) with simple advice. In two studies the smoker was encouraged to make a signed contract to quit. One study provided an incentive (a telephone card) to those who successfully quit. Three studies included an intervention which involved a demonstration of the participant’s pulmonary function), or expired air carbon monoxide. One study, using a cluster design, compared information and a letter alone to advice from a pediatrician to mothers of babies attending well-baby clinics with a view to reducing exposure of the children to passive smoke. One study used a computer-generated tailored report to assist with cessation, and another study compared brief advice to computer-generated tailored letters and to no intervention. One study compared brief advice, tailored letters and the combination of both. It only contributed to the direct comparison of advice and tailored letters.

also
government clinic, adult diabetic outpatient clinic, hospital cardiac unit, worksite, and community settings

registrar, physicians, hospital consultants)
### Table 4. Descriptive Characteristics of Included Studies Within the Primary Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions, by Intervention Type

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<tr>
<td>Lancaster, 2017&lt;sup&gt;104&lt;/sup&gt;</td>
<td>Individual behavioral counseling</td>
<td>49</td>
<td>39 – 2095</td>
<td>24 – 63</td>
<td>8 – 29</td>
<td>Counselling interventions typically included the following components: review of a participant’s smoking history and motivation to quit, help in the identification of high-risk situations, and the generation of problem-solving strategies to deal with such situations. Counsellors may also have provided non-specific support and encouragement. Some studies provided additional components such as written materials, video or audiotapes.</td>
<td>Healthcare and community settings; primary care (k=4)</td>
<td>Generally described as smoking cessation counselors; professional backgrounds included social work, psychology, psychiatry, health education and nursing</td>
</tr>
<tr>
<td>Stead, 2017&lt;sup&gt;127&lt;/sup&gt;</td>
<td>Group behavioral therapy</td>
<td>66</td>
<td>45 – 2720</td>
<td>21 – 61</td>
<td>13 – 32</td>
<td>Most programs used between six and eight sessions, with the first few sessions devoted to discussion of motivation for quitting, health benefits, and strategies for planning a quit attempt. Specific components at this stage may include signing a contract to quit, or making a public declaration, and nicotine fading (changing the type of cigarette smoked to a lower nicotine brand). Participants may also keep records of the number of cigarettes smoked and the triggers for smoking (self-monitoring). Part of the group process also includes discussion and sharing of experiences and problems (intra-treatment social support). Participants may also be instructed on ways to seek appropriate</td>
<td>Most studies recruited community volunteers; recruited in primary care settings (k=3); recruited participants with specific health problem (inpatient included) (k=5); conducted or recruited at work site (k=4)</td>
<td>NR</td>
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<tr>
<td>Lindson, 2019b&lt;sup&gt;107&lt;/sup&gt;</td>
<td>Motivational interviewing</td>
<td>37</td>
<td>56 – 4614</td>
<td>15 – 63</td>
<td>2 – 30</td>
<td>support from friends, colleagues and family (extra-treatment social support). A range of other problem-solving skills may also be introduced, including identifying high-risk situations for relapse, generating solutions and discussing or rehearsing responses. Some programs incorporate more specific components intended to help manage poor mood or depression associated with quitting and withdrawal. MI was conducted in one to 12 sessions, with the total duration of MI ranging from five to 315 minutes across studies. MI was delivered in face-to-face sessions in 17 of the 37 studies; in another 12 studies, the counselling was delivered in a combination of face-to-face and telephone sessions, usually with an initial session or sessions conducted face-to-face, followed by follow-up counselling over the phone. Six studies provided counselling over the phone only; a further study had an MI intervention group that received calls and text messages based on CBT and MI and another MI group that received text messages only, and a final study provided MI counselling for adolescents in an online virtual environment. Twenty of the 37 studies offered or recommended the use of pharmacotherapy for smoking cessation to all, or a subset of participants.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moyo, 2018&lt;sup&gt;116&lt;/sup&gt;</td>
<td>Decision aids</td>
<td>7</td>
<td>8 – 1014</td>
<td>NR</td>
<td>NR</td>
<td>Only two decision aids were delivered directly by a healthcare provider. The other studies all evaluated a decision aid where provider</td>
<td>Outpatient clinic, psychosocial</td>
<td>NR</td>
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Table 4. Descriptive Characteristics of Included Studies Within the Primary Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions, by Intervention Type

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<tbody>
<tr>
<td>Livingstone-Banks, 2019b¹¹⁰</td>
<td>Print-based interventions</td>
<td>75</td>
<td>40 – 6697</td>
<td>34 – 57*</td>
<td>15 – 32</td>
<td>Thirty-four of the included studies compared standard self-help materials with no intervention or provided standard materials as an adjunct to advice. The other studies compared targeted or tailored self-help methods or compared other variations of programs. Some studies used multiple interventions, testing the effects of different types of information or of increasing amounts of material. Studies of self-help materials were carried out in a range of settings. Some studies provided the materials without face-to-face contact or any additional motivating strategy. Some studies tested the use of materials for people who had called quitlines (self-help materials were the main form of support offered) or the use of materials as an adjunct to counselling. In healthcare settings, studies more frequently provided self-help materials as an adjunct to brief advice to quit. Some studies described as testing self-help materials included relatively high levels of face-to-face support, although less than informal counselling programs. Most studies did not specify an interest in quitting as a selection criterion. The content and format of the self-help programs varied. The most frequently used materials were the American Lung Association (ALA) cessation manual: Freedom from Smoking in 20 days, and the maintenance manual: A Lifetime of Freedom from Smoking. Most other programs were not named or described fully. Materials have tended to become more complex over time and to incorporate more techniques from</td>
<td>rehabilitation centers</td>
<td>Studies of self-help materials were carried out in a range of settings</td>
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<tr>
<td>Matkin, 2019\textsuperscript{111}</td>
<td>Telephone counseling</td>
<td>104</td>
<td>40 – 7354</td>
<td>15 – 65+</td>
<td>10.6 – 28</td>
<td>Most of the studies were trials of proactive calls from a counsellor, or from an automated interactive voice response system (IVR). Only five assessed interventions that did not involve a counsellor contacting a participant. Some studies included participants who had called helplines that provide smoking counselling (quitlines). Other studies included people who had not called quitlines, but received calls from counsellors or other healthcare providers. Some studies provided telephone counselling alone, but many others provided telephone counselling along with minimal support such as self-help leaflets, or more active support such as face-to-face counselling, or with stop-smoking medication. The number of calls offered ranged from a single call to 12 calls. Some studies only recruited people trying to stop smoking, while others offered support even to those not actively trying to stop. The number, duration and content of the telephone calls was variable. The potential number of calls ranged from one to 12 and in some studies was flexible. The duration of the calls also varied; 10 to 20 minutes was common, although the initial call might be longer. The call schedule could be spaced over weeks or months. We grouped trials into three broad categories: trials of interventions for smokers who contacted a helpline; trials assessing the effect of providing access to a helpline; and trials that offered support proactively in other settings. There are 10 recruited participants in healthcare settings and referred them to services provided by quitlines, involving proactive counselling for those following through referral (k=16)</td>
<td>Recruited participants in healthcare settings and referred them to services provided by quitlines, involving proactive counselling for those following through referral (k=16)</td>
<td>Most of the studies were trials of proactive calls from a counsellor, or from an automated interactive voice response system (IVR)</td>
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<tr>
<td>Whittaker, 2019&lt;sup&gt;139&lt;/sup&gt;</td>
<td>Mobile phone-based support</td>
<td>26</td>
<td>49-8000</td>
<td>18.2-57</td>
<td>14.5</td>
<td>All studies tested automated text messaging interventions. Eighteen studies used text messaging (SMS) as a central component of the intervention. One study sent text messages containing links to theoretically driven video messages from ‘ordinary’ role models coping with quitting. Several studies paired text messages with in-person visits or assessments. The text message interventions varied in length from one week to five weeks, six weeks, eight weeks, three months, and six months, or were variable. Eight studies did not state that text messages were tailored to the individual. In other studies using text messages, the degree of individual tailoring varied. One study tailored messages to include first name, quit date, top three reasons for quitting, money saved by quitting, and use of quit-smoking medications. Two studies tailored messages to the stage of readiness to quit. Another study’s program could be interacted with by reporting changes in smoking behavior (e.g. a quit attempt, relapse), so that appropriate stage-specific messages could be sent. One study tailored their intervention text messages to contain advice and encouragement tailored to participants’ current quit status (preparing to quit, first week of the quit attempt, second week of attempt etc.). Two studies tailored the messages to information collected at baseline about the individual. One study individually tailored messages using 24 items from the iQuit questionnaire and information on smoking status at three and seven weeks. Another study matched participant characteristics to messages by keyword to create an individualized program. One study’s participants selected the role model from</td>
<td>Community</td>
<td>NR</td>
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<tr>
<td>Tzelepis, 2019&lt;sup&gt;115&lt;/sup&gt;</td>
<td>Real-time video counselling</td>
<td>2</td>
<td>49-566</td>
<td>47.4-51.12</td>
<td>17.0</td>
<td>whom they wished to receive messages. A number of text messaging interventions included interactive components such as the ability to text for more support in the instance of cravings or lapses, an optional Quit Buddy, a Quit support network, polls and quizzes, regular checking in on smoking status, and one study included some degree of choice. Participants received offers of support via a personalized tailored Internet program, a text message program, both programs, a choice of all three, or a minimal control.</td>
<td>Community, healthcare</td>
<td>NR</td>
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<tr>
<td>Taylor, 2017¹³⁰</td>
<td>Internet-based interventions</td>
<td>77</td>
<td>66 – 12,000</td>
<td>16 – 63</td>
<td>NR</td>
<td>Range of interventions provided, from a very low intensity intervention providing a list of websites for smoking cessation, to highly intensive interventions consisting of Internet-, email- and mobile phone-delivered components. Tailored Internet interventions differed in the amount of tailoring, from a bulletin board facility, a multimedia component, tailored and personalized access to very high depth tailored stories and highly personalized message sources. Some trials also included counselling or support from nurses, peer coaches or tobacco treatment specialists. Other trials also incorporated online social networks, such as Facebook, Twitter, and WeChat, and online forums, chat rooms, and support groups. Two interventions were very distinct from the rest.</td>
<td>Recruitred from primary care (k=7); most recruitment was web-based with participants finding the sites through search engines and browsing</td>
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<td>Notley, 2019†</td>
<td>Incentives</td>
<td>33</td>
<td>14 – 6006</td>
<td>19.7 – 55</td>
<td>8 – 26</td>
<td>In addition to brief smoking advice, one study used an Internet-based three-dimensional face age progression simulation software package to create a stream of aged images of faces from a standard digital photograph. The resulting aged image was adjusted to compare how the participant aged as a smoker versus as a non-smoker. In one study, the authors used an online version of the approach-avoidance task, where participants used the computer mouse to pull (i.e. approach, leading to an enlarged picture) or push (i.e. avoid, leading to a reduced picture) neutral or smoking-related pictures. We also identified nine trials of lifestyle interventions that included a smoking cessation component. These interventions included content on a range of topics, including diet and healthy eating, physical activity and fitness, alcohol and drug use, sexual behavior, unpleasant sexual experiences, bullying, mental health, patient-provider relationships, and medication management.</td>
</tr>
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Approximately half of studies offered cash for abstinence (contingent rewards), or monetary incentives in the form of vouchers. Four studies used entry into a prize draw alongside a guaranteed reward. Two studies used self-deposited money as the reward incentive and a further four studies used a combination of deposit arms with cash rewards or mixed-rewards arms for abstinence at fixed time points. Seven studies included more complex payment schedules, especially with a ‘reset’ option, meaning that a non-abstinent biochemically confirmed outcome at any time point would reset the escalating schedule of reinforcement to a lower level, thus reinforcing continued abstinence. | Community setting, clinics, substance misuse clinics, worksites | NR |
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<tr>
<td>Clair, 2019&lt;sup&gt;90&lt;/sup&gt;</td>
<td>Biomedical risk assessment</td>
<td>20</td>
<td>64 – 2110</td>
<td>31.7 – 53.0</td>
<td>11.9 – 29.2</td>
<td>One included study tested two interventions: the intervention was feedback about genetic susceptibility combined with CO measurement, which could either be compared to a control group of CO measurement alone, or to a control group without biomarker feedback, thereby testing the combination of the two interventions. Out of the 21 interventions, five tested feedback on smoking exposure, each measuring the effect of exhaled CO measurements. Five studies tested feedback on smoking-related disease risk; of these, four tested feedback about genetic susceptibility to cancer, and one tested feedback about genetic susceptibility to Crohn’s disease. Eleven studies assessed feedback on smoking-related harm: four tested the combination of exhaled CO measurement and spirometry; five tested the effect of spirometry alone, or with the addition of feedback on lung age; two tested the effect of undergoing an ultrasonography of carotid arteries (and femoral arteries for one study) with photographic demonstration of atherosclerotic plaques when present</td>
<td>Community (k=1), smoking cessation clinics (k=2), healthcare (k=1), research institutes (k=3)</td>
<td>Physician (k=5) Nurse (k=4) Specific study staff member (k=7) Trained health educator or research counsellor (k=2) Principal investigator with help from trained smoking cessation practitioners (k=1) Web-based (k=2)</td>
</tr>
<tr>
<td>Ussher, 2019&lt;sup&gt;136&lt;/sup&gt;</td>
<td>Exercise</td>
<td>24</td>
<td>20 - 2318</td>
<td>28 - 59</td>
<td>16.76 - 32</td>
<td>Most of the trials employed supervised, group-based cardiovascular-type exercise supplemented by a home-based exercise program and combined with a multi-session cognitive behavioral smoking cessation program. The comparator in most cases was a multi-session cognitive behavioral smoking cessation program alone.</td>
<td>Community, healthcare</td>
<td>NR</td>
</tr>
<tr>
<td>White, 2014&lt;sup&gt;138&lt;/sup&gt;</td>
<td>Acupuncture</td>
<td>38</td>
<td>18 - 651</td>
<td>NR</td>
<td>NR</td>
<td>All acupuncture studies used a traditional approach to acupuncture in choosing points nominated as specific for smoking cessation. Five studies used facial acupuncture and ten used auricular acupuncture alone. All but three of these used some form of continuous</td>
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<tr>
<td>Barnes, 2019</td>
<td>Hypnotherapy</td>
<td>14</td>
<td>20 – 360</td>
<td>30 – 40</td>
<td>20 – 24</td>
<td>stimulation, either needle or pressure device. Eight studies combined body and auricular acupuncture. Three used continuous stimulation with either indwelling needles or seeds. One study used facial, body, indwelling, and sham auricular acupuncture in different groups. Five studies used acupressure alone, three studies used laser; three studies investigated electrostimulation given over the mastoid bone; and four studies gave electrostimulation to the ear (one also used continuous acupressure stimulation).</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Boyle, 2014</td>
<td>Electronic health records support</td>
<td>16</td>
<td>NA</td>
<td>NA</td>
<td>NR</td>
<td>6 RCTs: In each of these studies treatment conditions tested an electronic health record (EHR) with enhancements intended to facilitate the provider interaction with a smoker patient. One study provided intervention clinics with additional tools within the EHR and clinical staff were reminded to use them. In one, the enhancement was based on information in an existing EHR. Clinical staff (physicians and medical assistants) in the intervention clinics received feedback reports on their use of the existing tools with smoking patients. Sherman 2008 also provided additional tools for clinical staff in the EHR system with some restrictions on use of the tools by the control clinics. The dental study created text boxes or scripts within the intervention clinic dental record. The scripts served as language the dental providers could use based on patient-specific</td>
<td>General practice/primary care medical clinics (k=14), dental clinic (k=1), hospital (k=1)</td>
<td>Variable</td>
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<td>information obtained during the dental encounter. In the other studies, the intervention clinics were able to link patients through the EHR to a telephone quitline, and the quitline proactively called the patient. Other studies: Of the other ten studies, three used a control condition or comparison clinic. In one study, the comparison clinic was a paper records-based clinic without an electronic health record. Another study used four control clinics, two were based on usual care and two had access to a new electronic health record vital sign screen but were provided no training or support on the use of the screen. One study randomly assigned patients in one clinic to either intervention or usual care based on their family medical record number. The seven additional studies measured outcomes before and after the introduction of an enhancement to an existing electronic health record, without any comparison group. One study was conducted in a family practice clinic and a pulmonary specialty clinic within the same health system. Another study was conducted in a single primary care clinic. One study studied the intervention in a single hospital. Two other studies each involved 3 clinics, and another study studied one large health system with 18 primary care clinics. Two studies involved retrospective cohorts. Followup: There was wide variation in the type and length of follow-up across the studies. For example, one study made telephone contact with dental patients a few days after a dental visit to measure intervention effects but no other follow-up was conducted. One study collected follow-up data through a patient survey about two weeks after a medical care visit during an eight month study period. One study collected</td>
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<tr>
<td>Thomas, 2017</td>
<td>System change interventions</td>
<td>7</td>
<td>1980 - 66516</td>
<td>30 - 64</td>
<td>NR</td>
<td>All studies included system-level interventions that involved identifying all smokers, training staff, and providing free evidence-based treatment (i.e., NRT or other pharmacotherapy). Five of the included studies also implemented organizational policies to improve access to cessation interventions (e.g., referrals). All included studies provided clinicians with training ranging from 30 minutes to 20 hours.</td>
<td>Primary care clinics (k=2), dental clinics (k=2), community pharmacy (k=1), VA medical center (k=1), pediatric practice (k=1)</td>
<td>All health professionals including pharmacists and dentists.</td>
</tr>
<tr>
<td>Lindson, 2019c</td>
<td>Reduction-to-quit interventions</td>
<td>51</td>
<td>24 - 3297</td>
<td>15.4 – 57.9</td>
<td>11 - 31</td>
<td>Reduction methods varied greatly: some studies simply asked participants to reduce the amount they smokers whereas others provided detailed instructions or suggestions on how to do so, including a goal number of cpd, gradually increasing time between cigarettes, increasing time in the morning before first cigarette, reducing scenario-specific smoking, or replacing cigarette smoking with a form of pharmacotherapy.</td>
<td>Primary care, smoking cessation clinics, worksite, and community</td>
<td>NR</td>
</tr>
<tr>
<td>Livingstone-Banks, 2019a</td>
<td>Relapse prevention</td>
<td>77</td>
<td>11 - 18010</td>
<td>19 - 60</td>
<td>10.2 - 29.9</td>
<td>Pharm interventions consisted of varenicline, rimonabant, NRT, and bupropion; behavioral interventions consisted of brief interventions (phone calls, mailings, written pamphlets), pharm in conjunction with behavioral support, a 50-minute in person training session, self-</td>
<td>Cessation clinic, participants’ own homes, Quitline, community, hospital, mobile applications.</td>
<td>NR</td>
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<td>Chamberlain, 2017 (^{182})</td>
<td>Any behavioral support</td>
<td>102</td>
<td>24 - 15,530</td>
<td>19.4 - 30.8</td>
<td>6 - 18</td>
<td>help materials, support groups, and group training sessions.</td>
<td>Naval training, hospitals, HMO health center, community mental health centers, antenatal clinics, maternity services, mail, Air Force, substance abuse outpatient facility, prenatal clinic, workplaces, Army Medical Center, Quit for Life employers/health plans, obstetric clinics, pediatric practices, narcotics treatment centers</td>
<td>Most trials of interventions to support pregnant women were conducted in public hospitals or community antenatal clinics</td>
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<td>intervention was coded as 'tailored' whereby different intervention components were offered and tailored to women’s needs. Of the 56 study arms coded as counselling, most involved face-to-face contact, using a variety of strategies either alone or in combination (such as motivational interviewing, cognitive behavioral therapy, stages of change). Four trials with the main intervention strategy coded as counselling included a lottery chance for women who reported quitting; nine included support from peers and/or partners with three of these including support for partners to quit. The duration and frequency of the intervention also varied considerably and has generally increased over time. Twenty of the interventions involved telephone counselling and in five of these studies all counselling was provided via telephone, and one had only brief additional face-to-face contact. Thirty-eight study arms included self-help manuals as part of the intervention, and in 27 study arms there was a brief introduction to the manuals (less than five minutes) and the intervention was therefore coded as counselling, with sensitivity analysis conducted to assess the independent effect of these studies. In 10 study arms the intervention involved use of a video; 11 study arms included use of computers in the intervention. Studies using tools or technology where there was no clear personal contact were coded as health education, including: self-help manuals; text messaging; audiotape; and computer. Three other studies that reported the intervention consisted of advice to quit only, either in person or by post were coded as health education. Among all 120 study arms with and without outcomes: six dissemination trials were identified, carried out in Australia, the</td>
<td></td>
<td>dedicated research project staff (coded as efficacy studies), with 11 coded as unclear or not applicable as dissemination trials or the intervention was automated (e.g. text messaging) or provided by use of other materials (e.g. mail-outs).</td>
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<td>US, and Europe. Three trials reported only dissemination outcomes, and not the primary outcomes of abstinence in late pregnancy, therefore outcomes not able to be included in the meta-analysis are reported in Table 1. Nine studies (with 12 study arms) were cluster-randomized at service level, providing an indication of implementation under routine care conditions; while four studies were cluster-randomized at provider level. Comparisons: Women in the control arms in 56 of 106 study arms with primary outcome data received ‘usual care’ in relation to smoking cessation, which generally included information about the risks of smoking and advice to quit. In 44 study arms the comparison group received some kind of ‘less intensive’ intervention, which included studies where a dedicated research team consistently provided what they considered to be ‘usual care’ for women in the comparison group. In six study arms the comparison group received an ‘alternative intervention’, which was categorized as having the same intensity (duration and frequency) as the intervention group, providing a comparison as close to a ‘placebo-controlled trial as is feasible for psychosocial interventions, to assess the independent effect of the intervention component). One was a counselling intervention using cognitive behavioral therapy compared with traditional health education, one compared two types of text messaging strategies, and four compared provision of incentives, contingent or not contingent on smoking status. As expected, the intensity of both interventions and controls has increased over time, as indicated by the change in frequency and duration of</td>
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<th>Author, Year</th>
<th>Specific intervention</th>
<th>Number of included studies</th>
<th>Sample size (Range)</th>
<th>Mean age (Range)</th>
<th>Mean CPD at BL (Range)</th>
<th>Intervention description</th>
<th>Setting</th>
<th>Providers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>contact during the interventions. In many cases the comparison/control group was described as receiving ‘usual care’ without specifying further what constituted usual practice (at a particular time and in a particular setting) with respect to advice and assistance.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 trial ~47% mean age <30; 1 trial ~62% fell between ages 20-39; 1 trial ~44% were >50
†Evidence for general (non-pregnant) adults only

**Abbreviations:** BL = Baseline; CBT = Cognitive behavioral therapy; CO = Carbon monoxide; CPD = Cigarettes per day; GP = General practitioner; HIV = Human immunodeficiency virus; HMO = Health maintenance organization; mg = milligram; MI = Motivational interviewing; NR = Not reported; NRT = Nicotine replacement therapy; RCT = Randomized controlled trial; SAMe = S-adenosyl-L-methionine; SMS = Short message service; TTFC = Time to first cigarette of the day; WIC = Women, infants, and children
<table>
<thead>
<tr>
<th>Author, Year</th>
<th>IG</th>
<th>CG</th>
<th># of RCTs</th>
<th>N analyzed</th>
<th>IG events</th>
<th>IG N</th>
<th>IG quit rate‡</th>
<th>CG events</th>
<th>CG N</th>
<th>CG quit rate‡</th>
<th>Risk ratio (95% CI)</th>
<th>I²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stead, 2016</td>
<td>Combined pharmacotherapy and behavioral support</td>
<td>Brief advice or usual care</td>
<td>52</td>
<td>19,488</td>
<td>1529</td>
<td>10,070</td>
<td>15.2%</td>
<td>808</td>
<td>9418</td>
<td>8.6%</td>
<td>1.83 (1.68, 1.98)</td>
<td>36%</td>
</tr>
<tr>
<td>Hartmann-Boyce, 2018</td>
<td>NRT, any form</td>
<td>Placebo or no drug</td>
<td>133</td>
<td>64,640</td>
<td>5574</td>
<td>32,918</td>
<td>16.9%</td>
<td>3315</td>
<td>31,722</td>
<td>10.5%</td>
<td>1.55 (1.49, 1.61)</td>
<td>39%</td>
</tr>
<tr>
<td></td>
<td>NRT, gum</td>
<td>Placebo or no drug</td>
<td>56</td>
<td>22,581</td>
<td>1732</td>
<td>10,596</td>
<td>16.3%</td>
<td>1196</td>
<td>11,985</td>
<td>10.0%</td>
<td>1.49 (1.40, 1.60)</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>NRT, patch</td>
<td>Placebo or no drug</td>
<td>51</td>
<td>25,754</td>
<td>2160</td>
<td>13,773</td>
<td>15.7%</td>
<td>1131</td>
<td>11,981</td>
<td>9.4%</td>
<td>1.64 (1.53, 1.75)</td>
<td>24%</td>
</tr>
<tr>
<td></td>
<td>NRT, inhaler</td>
<td>Placebo or no drug</td>
<td>4</td>
<td>976</td>
<td>84</td>
<td>490</td>
<td>17.1%</td>
<td>44</td>
<td>486</td>
<td>9.1%</td>
<td>1.90 (1.36, 2.67)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>NRT, intranasal spray</td>
<td>Placebo or no drug</td>
<td>4</td>
<td>887</td>
<td>107</td>
<td>448</td>
<td>23.9%</td>
<td>52</td>
<td>439</td>
<td>11.8%</td>
<td>2.02 (1.49, 2.73)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>NRT, tablets</td>
<td>Placebo or no drug</td>
<td>8</td>
<td>4439</td>
<td>488</td>
<td>2326</td>
<td>20.9%</td>
<td>273</td>
<td>2113</td>
<td>12.9%</td>
<td>1.52 (1.32, 1.74)</td>
<td>71%</td>
</tr>
<tr>
<td></td>
<td>NRT, participant's choice</td>
<td>Placebo or no drug</td>
<td>7</td>
<td>8288</td>
<td>793</td>
<td>4179</td>
<td>19.0%</td>
<td>569</td>
<td>4109</td>
<td>13.8%</td>
<td>1.37 (1.25, 1.52)</td>
<td>42%</td>
</tr>
<tr>
<td>Lindson, 2019</td>
<td>NRT combination</td>
<td>NRT single form</td>
<td>14</td>
<td>11,356</td>
<td>881</td>
<td>5218</td>
<td>16.9%</td>
<td>852</td>
<td>6138</td>
<td>13.9%</td>
<td>1.25 (1.15, 1.36)</td>
<td>4%</td>
</tr>
<tr>
<td>Hughes, 2014</td>
<td>Bupropion</td>
<td>Placebo or no drug</td>
<td>44</td>
<td>13,728</td>
<td>1507</td>
<td>7646</td>
<td>19.7%</td>
<td>701</td>
<td>6082</td>
<td>11.5%</td>
<td>1.62 (1.49, 1.76)</td>
<td>18%</td>
</tr>
<tr>
<td>Cahill, 2016</td>
<td>Varenicline</td>
<td>Placebo</td>
<td>27</td>
<td>12,625</td>
<td>1695</td>
<td>6632</td>
<td>25.6%</td>
<td>668</td>
<td>5993</td>
<td>11.1%</td>
<td>2.24 (2.06, 2.43)</td>
<td>60%</td>
</tr>
<tr>
<td>Hughes, 2014</td>
<td>Nortriptyline</td>
<td>Placebo</td>
<td>6</td>
<td>975</td>
<td>96</td>
<td>480</td>
<td>20.0%</td>
<td>49</td>
<td>495</td>
<td>9.9%</td>
<td>2.03 (1.48, 2.78)</td>
<td>16%</td>
</tr>
<tr>
<td>Hughes, 2014</td>
<td>Bupropion</td>
<td>NRT, any form</td>
<td>8</td>
<td>4086</td>
<td>342</td>
<td>1495</td>
<td>22.9%</td>
<td>658</td>
<td>2591</td>
<td>25.4%</td>
<td>0.96 (0.85, 1.09)</td>
<td>27%</td>
</tr>
<tr>
<td>Cahill, 2016</td>
<td>Varenicline</td>
<td>NRT, any form</td>
<td>8</td>
<td>6264</td>
<td>767</td>
<td>3227</td>
<td>23.8%</td>
<td>575</td>
<td>3037</td>
<td>18.9%</td>
<td>1.25 (1.14, 1.37)</td>
<td>39%</td>
</tr>
<tr>
<td>Cahill, 2016</td>
<td>Varenicline</td>
<td>Bupropion</td>
<td>5</td>
<td>5877</td>
<td>700</td>
<td>2944</td>
<td>23.8%</td>
<td>503</td>
<td>2933</td>
<td>17.1%</td>
<td>1.39 (1.35, 1.54)</td>
<td>0%</td>
</tr>
<tr>
<td>Hollands, 2019</td>
<td>Support for medication adherence</td>
<td>Usual care</td>
<td>5</td>
<td>3593</td>
<td>412</td>
<td>1816</td>
<td>22.7%</td>
<td>361</td>
<td>1777</td>
<td>20.3%</td>
<td>1.16 (0.96, 1.40)</td>
<td>48%</td>
</tr>
<tr>
<td>Hartmann-Boyce, 2019</td>
<td>Behavioral therapy as an adjunct to pharmacotherapy</td>
<td>Pharmacotherapy</td>
<td>65</td>
<td>23,331</td>
<td>2291</td>
<td>11,630</td>
<td>19.5%</td>
<td>2006</td>
<td>11,701</td>
<td>17.1%</td>
<td>1.15 (1.08, 1.22)</td>
<td>8%</td>
</tr>
<tr>
<td>Stead, 2013</td>
<td>Physician advice</td>
<td>Usual care</td>
<td>26</td>
<td>22,239</td>
<td>1008</td>
<td>12,583</td>
<td>8.0%</td>
<td>462</td>
<td>9656</td>
<td>4.8%</td>
<td>1.76 (1.58, 1.96)</td>
<td>40%</td>
</tr>
</tbody>
</table>
### Table 5. Smoking Cessation Results at 6 or More Months† (KQ 2) From Reviews of Tobacco Cessation Interventions Among Adults, by Type of Intervention

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>IG</th>
<th>CG</th>
<th># of RCTs</th>
<th>N analyzed</th>
<th>IG events</th>
<th>IG N</th>
<th>IG quit rate‡</th>
<th>CG events</th>
<th>CG N</th>
<th>CG quit rate‡</th>
<th>Risk ratio (95% CI)</th>
<th>( \phi )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice, 2017(^{120})</td>
<td>Nurse advice</td>
<td>Usual care</td>
<td>44</td>
<td>20,881</td>
<td>1607</td>
<td>11,319</td>
<td>14.2%</td>
<td>1165</td>
<td>9562</td>
<td>12.2%</td>
<td>1.29 (1.21, 1.38)</td>
<td>50%</td>
</tr>
<tr>
<td>Lancaster, 2017 (^{104})</td>
<td>Individual counselling with cessation specialist</td>
<td>Minimal contact control</td>
<td>33</td>
<td>13,762</td>
<td>765</td>
<td>6715</td>
<td>11.4%</td>
<td>546</td>
<td>7047</td>
<td>7.7%</td>
<td>1.48 (1.34, 1.64)</td>
<td>46%</td>
</tr>
<tr>
<td>Stead, 2017(^{127})</td>
<td>Group behavioral intervention</td>
<td>Self-help program</td>
<td>13</td>
<td>4395</td>
<td>249</td>
<td>2388</td>
<td>10.4%</td>
<td>116</td>
<td>2007</td>
<td>5.8%</td>
<td>1.88 (1.52, 2.33)</td>
<td>0%</td>
</tr>
<tr>
<td>Lindson, 2019(^{b}) (^{107})</td>
<td>Motivational interviewing + another smoking cessation intervention</td>
<td>Smoking cessation intervention alone</td>
<td>12</td>
<td>4167</td>
<td>399</td>
<td>2134</td>
<td>18.7%</td>
<td>306</td>
<td>2033</td>
<td>15.1%</td>
<td>1.07 (0.85, 1.36)</td>
<td>47%</td>
</tr>
<tr>
<td>Moyo, 2018(^{116})</td>
<td>Decision aid</td>
<td>Usual care without decision aid</td>
<td>7(^{§})</td>
<td>1772</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Livingstone-Banks, 2019(^{b}) (^{110})</td>
<td>Print-based, non-tailored self-help materials(|$</td>
<td>No self-help</td>
<td>32</td>
<td>28,451</td>
<td>983</td>
<td>11,114</td>
<td>8.8%</td>
<td>794</td>
<td>13,337</td>
<td>6.0%</td>
<td>1.06 (0.95, 1.19)</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>Print-based, non-tailored self-help materials with no face-to-face contact</td>
<td>No self-help</td>
<td>11</td>
<td>13,241</td>
<td>416</td>
<td>6723</td>
<td>6.2%</td>
<td>331</td>
<td>6518</td>
<td>5.1%</td>
<td>1.19 (1.03, 1.37)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Print-based, tailored self-help materials(|$</td>
<td>No self-help</td>
<td>10</td>
<td>14,359</td>
<td>501</td>
<td>6786</td>
<td>7.4%</td>
<td>455</td>
<td>7573</td>
<td>6.1%</td>
<td>1.34 (1.19, 1.51)</td>
<td>0%</td>
</tr>
<tr>
<td>Matkin, 2019(^{111})</td>
<td>Proactive telephone counseling (quitline callers)</td>
<td>Control (various)</td>
<td>14</td>
<td>32,484</td>
<td>2123</td>
<td>19,600</td>
<td>10.8%</td>
<td>1004</td>
<td>12,884</td>
<td>7.8%</td>
<td>1.38 (1.19, 1.61)</td>
<td>72%</td>
</tr>
<tr>
<td></td>
<td>Proactive telephone counseling (not initiated by quitline)</td>
<td>Control (various)</td>
<td>65</td>
<td>41,233</td>
<td>2924</td>
<td>21,001</td>
<td>13.9%</td>
<td>2229</td>
<td>20,232</td>
<td>11.0%</td>
<td>1.25 (1.15, 1.35)</td>
<td>52%</td>
</tr>
<tr>
<td>Whittaker, 2019(^{138})</td>
<td>Mobile phone-based interventions</td>
<td>Usual care of minimal intervention</td>
<td>13</td>
<td>14,133</td>
<td>694</td>
<td>7324</td>
<td>9.5%</td>
<td>382</td>
<td>6809</td>
<td>5.6%</td>
<td>1.54 (1.19, 2.00)</td>
<td>71%</td>
</tr>
</tbody>
</table>
Table 5. Smoking Cessation* Results at 6 or More Months† (KQ 2) From Reviews of Tobacco Cessation Interventions Among Adults, by Type of Intervention

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>IG</th>
<th>CG</th>
<th># of RCTs</th>
<th>N analyzed</th>
<th>IG events</th>
<th>IG N</th>
<th>IG quit rate‡</th>
<th>CG events</th>
<th>CG N</th>
<th>CG quit rate‡</th>
<th>Risk ratio (95% CI)</th>
<th>I²</th>
<th>χ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile phone-based interventions</td>
<td>No intervention</td>
<td>4</td>
<td>997</td>
<td>64</td>
<td>497</td>
<td>12.9%</td>
<td>39</td>
<td>500</td>
<td>7.8%</td>
<td>1.59 (1.09, 2.33)</td>
<td>0%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Tzelepis, 2019</td>
<td>Real-time video counselling</td>
<td>Telephone counselling</td>
<td>2</td>
<td>608</td>
<td>30</td>
<td>301</td>
<td>10.0%</td>
<td>22</td>
<td>307</td>
<td>7.2%</td>
<td>2.15 (0.38, 12.04)</td>
<td>66%</td>
<td>0%</td>
</tr>
<tr>
<td>Taylor, 2017</td>
<td>Internet (interactive and tailored)</td>
<td>Self-help or usual care</td>
<td>8</td>
<td>6786</td>
<td>516</td>
<td>4020</td>
<td>12.8%</td>
<td>356</td>
<td>2766</td>
<td>12.9%</td>
<td>1.15 (1.01, 1.30)</td>
<td>58%</td>
<td>0%</td>
</tr>
<tr>
<td>Notley, 2019</td>
<td>Incentives</td>
<td>Usual care or non-incentive-based intervention</td>
<td>30</td>
<td>20,060</td>
<td>1336</td>
<td>12,800</td>
<td>10.4%</td>
<td>516</td>
<td>7260</td>
<td>7.1%</td>
<td>1.49 (1.28, 1.73)</td>
<td>33%</td>
<td>0%</td>
</tr>
<tr>
<td>Feedback on smoking exposure</td>
<td>Usual care or minimal intervention</td>
<td>5</td>
<td>2368</td>
<td>183</td>
<td>1199</td>
<td>15.3%</td>
<td>179</td>
<td>1169</td>
<td>15.3%</td>
<td>1.00 (0.83, 1.21)</td>
<td>0%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Feedback on smoking-related disease risk</td>
<td>Usual care or minimal intervention</td>
<td>5</td>
<td>2064</td>
<td>106</td>
<td>1018</td>
<td>10.4%</td>
<td>136</td>
<td>1046</td>
<td>13.0%</td>
<td>0.80 (0.63, 1.01)</td>
<td>0%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Feedback on smoking-related harms</td>
<td>Usual care or minimal intervention</td>
<td>11</td>
<td>3314</td>
<td>239</td>
<td>1646</td>
<td>14.5%</td>
<td>195</td>
<td>1668</td>
<td>11.7%</td>
<td>1.26 (0.99, 1.61)</td>
<td>34%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Ussher, 2019</td>
<td>Exercise</td>
<td>No exercise</td>
<td>21</td>
<td>6607</td>
<td>457</td>
<td>3326</td>
<td>13.7%</td>
<td>407</td>
<td>3281</td>
<td>12.4%</td>
<td>1.08 (0.96, 1.22)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>White, 2014</td>
<td>Acupuncture</td>
<td>Sham acupuncture</td>
<td>9</td>
<td>1892</td>
<td>122</td>
<td>997</td>
<td>12.2%</td>
<td>97</td>
<td>895</td>
<td>10.8%</td>
<td>1.10 (0.86, 1.40)</td>
<td>23%</td>
<td>0%</td>
</tr>
<tr>
<td>Barnes, 2019</td>
<td>Hypnotherapy</td>
<td>No intervention or other cessation intervention</td>
<td>14</td>
<td>1926</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0%</td>
</tr>
<tr>
<td>Boyle, 2014</td>
<td>EHR-facilitated interventions</td>
<td>No change to EHR</td>
<td>16**</td>
<td>NA††</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0%</td>
</tr>
<tr>
<td>Thomas, 2017</td>
<td>System change interventions</td>
<td>No system changes</td>
<td>7</td>
<td>NA††</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0%</td>
</tr>
<tr>
<td>Lindson, 2019</td>
<td>Reduction-to-quit interventions</td>
<td>No cessation intervention</td>
<td>6</td>
<td>1599</td>
<td>87</td>
<td>915</td>
<td>9.5%</td>
<td>25</td>
<td>684</td>
<td>3.7%</td>
<td>1.74 (0.90, 3.38)</td>
<td>45%</td>
<td>0%</td>
</tr>
<tr>
<td>Reduction-to-quit interventions</td>
<td>Abrupt quitting interventions</td>
<td>22</td>
<td>9219</td>
<td>584</td>
<td>4922</td>
<td>11.9%</td>
<td>528</td>
<td>4297</td>
<td>12.3%</td>
<td>1.01 (0.87, 1.17)</td>
<td>29%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

*Used strictest available criteria to define abstinence (i.e., continuous, sustained, or prolonged abstinence was preferred over point prevalence abstinence and biochemically validated rates were used where available).
†Each review pooled data from the longest followup time point reported at 6 or more months followup
‡Weighted average quit rates
§Includes 3 RCTs and 4 quasi-experimental studies
Table 5. Smoking Cessation* Results at 6 or More Months† (KQ 2) From Reviews of Tobacco Cessation Interventions Among Adults, by Type of Intervention

† No meta-analysis performed. Six studies reported the effects of the intervention on smoking cessation. Only one study reported a statistically significant benefit of the use of a decision aid versus usual care on smoking cessation at 6 months.
‡ Irrespective of level of contact and support common to control group # No overall meta-analysis performed given variation in intensity of the hypnotherapy tested, little information on the hypnotherapy used, and large variation in control conditions
** Includes 7 RCTs and 9 non-randomized observational studies
†† Only one RCT (n=9589) reported effects on smoking cessation, as captured in the EHR, and found that more intervention vs. control clinic smokers quit (5.3% vs. 1.9%, p<0.001). The remaining studies focused on the impact of EHR changes on smoking support actions by clinicians, clinics, and health systems with most studies reporting improved processes following EHR-facilitated intervention implementation.
‡‡ Four trials (n=7142) reported the effects of the intervention on smoking cessation finding mixed results. Across all 7 trials, there was mixed evidence on secondary process outcomes such as documentation of smoking status and provision of counseling.

Abbreviations: CG = control group; CI = confidence interval; EHR = electronic health record; $I^2$ = percentage of the variability in effect estimates that is due to heterogeneity rather than sampling error; IG = intervention group; N = number; RCT = randomized controlled trial; RR = risk ratio
<table>
<thead>
<tr>
<th>Key questions</th>
<th>Author, Year Trial name Quality</th>
<th>Country</th>
<th>N rand</th>
<th>Brief population description</th>
<th>Intervention/ Exposure</th>
<th>Comparison</th>
<th>Outcomes of interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Included for KQ 2 and KQ 3</td>
<td>Bullen, 2013 ASCEND Fair</td>
<td>New Zealand</td>
<td>657</td>
<td>Age ≥18 years, had smoked &gt;10 CPD for at least the past year. Wanted to stop smoking</td>
<td>E-cig with 16 mg nicotine/ml plus behavioral support (voluntary quitline) for 13 weeks Device: E-liquid with nicotine solution cartridges</td>
<td>CG1: NRT patch (21 mg nicotine per 24 hours) plus behavioral support CG2: E-cig device with placebo (nicotine-free) cartridges plus behavioral support</td>
<td>• Tobacco abstinence at 6 months • Adverse events • Tobacco use outcomes at 6 months</td>
</tr>
<tr>
<td>Caponnetto, 2013 ECLAT Fair</td>
<td>Italy</td>
<td>300</td>
<td>Ages 18–70 years, had smoked &gt;10 CPD for at least the past 5 years. Not currently attempting to quit smoking or wishing to do so in the next 30 days</td>
<td>IG1: E-cig with 7.2 mg nicotine cartridges used at will for 12 weeks IG2: E-cig with 7.2 mg nicotine cartridges used at will for 6 weeks and E-cig with 5.4 mg nicotine cartridges for 6 weeks Followed for 1 year (8 visits total) Device: Categoría 401 e-cigarette</td>
<td>Nicotine-free E-cig cartridges</td>
<td>• Tobacco abstinence at 12 months • Adverse events</td>
<td></td>
</tr>
<tr>
<td>Hajek, 2019 TEC Fair</td>
<td>UK</td>
<td>886</td>
<td>Adult smokers attending NHS stop-smoking services. No strong preference to use or not to use nicotine replacement or e-cigarettes</td>
<td>E-cig starter pack with 30 ml bottle of tobacco-flavored e-liquid with 18 mg nicotine per ml (follow up use of any flavor or strength of e-liquid purchased by participant) for 1 year plus 4 weeks of behavioral support Device: One Kit (Aspire) and One Kit 2016 (Innokin)</td>
<td>NRT (any kind, any combination) plus 4 weeks behavioral support</td>
<td>• Tobacco abstinence at 6 and 12 months* • Adverse events • Tobacco use outcomes at 6 months</td>
<td></td>
</tr>
<tr>
<td>Walker, 2019 New Zealand Fair</td>
<td>New Zealand</td>
<td>1124</td>
<td>Ages ≥18 years, current tobacco smokers (any amount) Currently motivated to quit but no use of cessation products in the past year</td>
<td>21 mg, 24-hour nicotine patches + E-cigarette starter kit with a 14 - week supply of 18 mg/mL e-liquid plus 6 weeks of withdrawal-oriented behavioral support Device: eVOD (2nd gen)</td>
<td>CG1: 21 mg, 24-hour nicotine patches + E-cigarette starter kit with a 14 -week supply of no nicotine e-liquid plus 6 weeks of withdrawal-oriented behavioral support CG2: 21 mg, 24-hour nicotine patch for 14 weeks plus 6 weeks of behavioral support</td>
<td>• Tobacco abstinence at 6 and 12 months • Adverse events • Tobacco use outcomes at 6 months</td>
<td></td>
</tr>
</tbody>
</table>
Table 6. Study and Population Characteristics for Evidence on the Use of Electronic Cigarettes for Tobacco Cessation, Sorted by KQ

<table>
<thead>
<tr>
<th>Key questions</th>
<th>Author, Year</th>
<th>Trial name</th>
<th>Country</th>
<th>N rand</th>
<th>Brief population description</th>
<th>Intervention/ Exposure</th>
<th>Comparison</th>
<th>Outcomes of interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Included for KQ 3 only</td>
<td>Carpenter, 2017</td>
<td>149</td>
<td>Fair</td>
<td>US</td>
<td>Age ≥18 years, current smoker of ≥5 CPD for 1 year. At least some concern for health effects of smoking</td>
<td>IG1: E-cig with 16mg nicotine cartridges used at will for 3 weeks IG2: E-cig with 24mg nicotine cartridges used at will for 3 weeks After 3-week sampling period, both groups followed for 3 months (3 follow up visits)</td>
<td>No intervention (continued smoking with conventional cigarettes)</td>
<td>• Adverse events • Tobacco abstinence and use outcomes at 4 months (not abstracted)†</td>
</tr>
<tr>
<td>Cravo, 2016</td>
<td>150</td>
<td>Fair</td>
<td>UK</td>
<td>Cohort 1: 408 Cohort 2: 40</td>
<td>Age 21 - 65 years, 5-30 CPD for at least one year. Established smokers not trying to stop smoking or with quit intentions</td>
<td>Cohort 1: E-cig with 2.7 mg nicotine capsules (menthol or tobacco flavor) for 12 weeks Cohort 2: E-cig with 2.7 mg nicotine capsules (menthol or tobacco flavor) with 12 weeks plus 1-week inpatient confinement at onset Device: E-cig Prototype from Fontem Ventures B.V.</td>
<td>Cohort 1: No intervention (continued smoking with conventional cigarettes) Cohort 2: No intervention (continued smoking with conventional cigarettes) plus 1-week inpatient confinement at onset</td>
<td>• Adverse events</td>
</tr>
<tr>
<td>Masiero, 2017</td>
<td>153</td>
<td>Fair</td>
<td>Italy</td>
<td>210</td>
<td>Aged ≥55 years; smoked ≥10 CPD for the past 10 years. High motivation to stop smoking</td>
<td>IG1: E-cig with 8mg/mL nicotine concentration - no more than 1 mL of consumption per day – plus behavioral counseling for 3 months IG2: E-cig-like device with nicotine free capsules plus behavioral counseling for 3 months Device: VP5 electronic cigarette</td>
<td>Behavioral counseling</td>
<td>• Adverse events • Tobacco abstinence and use outcomes at 3 months (not abstracted)†</td>
</tr>
<tr>
<td>Tseng, 2016</td>
<td>155</td>
<td>Fair</td>
<td>US</td>
<td>99</td>
<td>Age 21–35 years, smoked ≥ 10 CPD. Interested in reducing cigarette consumption</td>
<td>E-cig (disposable, 4.5% nicotine) for 3 weeks plus behavioral counseling to reduce CPD Device: NJOY and King Bold</td>
<td>Placebo E-cig device plus behavioral counseling to reduce CPD</td>
<td>• Adverse events • Tobacco abstinence and use outcomes at 3 months (not abstracted)†</td>
</tr>
</tbody>
</table>
Table 6. Study and Population Characteristics for Evidence on the Use of Electronic Cigarettes for Tobacco Cessation, Sorted by KQ

<table>
<thead>
<tr>
<th>Key questions</th>
<th>Author, Year Trial name Quality</th>
<th>Country</th>
<th>N rand</th>
<th>Brief population description</th>
<th>Intervention/ Exposure</th>
<th>Comparison</th>
<th>Outcomes of interest</th>
</tr>
</thead>
</table>

†Defined as no more than 5 conventional cigarettes in the 2 weeks after a subject’s target quit date.
†Tobacco abstinence outcomes only included for followup ≥6 months

**Abbreviations:** ASCEND = A Study of Cessation using Electronic Nicotine Devices; CG = control group; CPD = cigarettes per day; ECLAT = EffiCiency and safety of an eLectronic cigAreTte; eCO = expired carbon monoxide; E-cig = electronic cigarette; KQ = key question; IG = intervention group; rand = randomized; TEC = Trial of Electronic Cigarettes
Table 7. Smoking Cessation Results at 6 or More Months (KQ 2) for Electronic Cigarettes for Tobacco Cessation, by Author

<table>
<thead>
<tr>
<th>Author, Year Quality</th>
<th>Population</th>
<th>IG</th>
<th>CG</th>
<th>FU (mo)</th>
<th>IG events</th>
<th>IG N</th>
<th>IG quit rate</th>
<th>CG events</th>
<th>CG N</th>
<th>CG quit rate</th>
<th>Effect estimate (95% CI)</th>
<th>Study product use after abstinence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bullen, 2013\textsuperscript{145, 154} ASCEND</td>
<td>All</td>
<td>E-cig (16mg)</td>
<td>NRT (21mg patch)</td>
<td>6</td>
<td>21</td>
<td>289</td>
<td>7.3%</td>
<td>17</td>
<td>295</td>
<td>5.8%</td>
<td>RR 1.26 (0.68, 2.34)</td>
<td>IG: 38% (8/21) CG: NR</td>
</tr>
<tr>
<td></td>
<td>E-cig (16mg)</td>
<td>Placebo (0mg E-cig)</td>
<td>6</td>
<td>21</td>
<td>289</td>
<td>7.3%</td>
<td>3</td>
<td>73</td>
<td>4.1%</td>
<td>RR 1.77 (0.54, 5.77)</td>
<td>IG: 38% (8/21) CG: NR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adults with mental illness</td>
<td>E-cig (16mg)</td>
<td>NRT (21mg patch)</td>
<td>6</td>
<td>2</td>
<td>39</td>
<td>5.1%</td>
<td>5</td>
<td>35</td>
<td>14.0%</td>
<td>p=0.245</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E-cig (16mg)</td>
<td>Placebo (0mg E-cig)</td>
<td>6</td>
<td>2</td>
<td>39</td>
<td>5.1%</td>
<td>0</td>
<td>12</td>
<td>NA*</td>
<td>NA*</td>
<td>NR</td>
</tr>
<tr>
<td>Caponnetto, 2013\textsuperscript{147} ECLAT</td>
<td>All</td>
<td>E-cig (both study groups)\textsuperscript{†}</td>
<td>Placebo (0mg E-cig)</td>
<td>12</td>
<td>22</td>
<td>200</td>
<td>11.0%</td>
<td>4</td>
<td>100</td>
<td>4.0%</td>
<td>RR 2.75 (0.97, 7.76), p=0.0561\textsuperscript{‡}</td>
<td>IG and CG (combined): 26.9% (7/26)</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Adjusted: p=0.04</td>
<td></td>
</tr>
<tr>
<td>Hajek, 2019\textsuperscript{151} TEC</td>
<td>All</td>
<td>E-cig (any)</td>
<td>NRT (any)</td>
<td>6</td>
<td>155</td>
<td>438</td>
<td>35.4%</td>
<td>112</td>
<td>446</td>
<td>25.1%</td>
<td>RR 1.40 (1.14, 1.72)</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E-cig (any)</td>
<td>NRT (any)</td>
<td>12</td>
<td>79</td>
<td>438</td>
<td>18.1%</td>
<td>44</td>
<td>446</td>
<td>9.9%</td>
<td>RR 1.83 (1.30, 2.58)</td>
<td>IG: 80% (63/79) CG: 9% (4/44)</td>
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<td></td>
<td></td>
<td></td>
<td>ARR\textsuperscript{§} 1.36 (1.15, 1.67)</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>IG and CG: 25.1% (11/44)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walker, 2019\textsuperscript{156}</td>
<td>All</td>
<td>E-cig (18 mg) + NRT (21mg patch)</td>
<td>Placebo (0mg E-cig) + NRT (21mg patch)</td>
<td>6</td>
<td>35</td>
<td>500</td>
<td>7.0%</td>
<td>20</td>
<td>499</td>
<td>4.0%</td>
<td>RR 1.75 (1.02, 2.98); p=0.038\textsuperscript{‖}</td>
<td>Use of both patch and e-cig at 6 months:#</td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>IG: 11% (36/317) CG: 13% (41/308)</td>
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<td></td>
<td></td>
<td>Use of e-cig only at 6 months:#</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>IG: 45% (143/317) CG: 36% (111/308)</td>
<td></td>
</tr>
</tbody>
</table>
Table 7. Smoking Cessation Results at 6 or More Months (KQ 2) for Electronic Cigarettes for Tobacco Cessation, by Author

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Population</th>
<th>IG</th>
<th>CG</th>
<th>FU (mo)</th>
<th>IG events</th>
<th>IG N</th>
<th>IG quit rate</th>
<th>CG events</th>
<th>CG N</th>
<th>CG quit rate</th>
<th>Effect estimate (95% CI)</th>
<th>Study product use after abstinence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E-cig (18 mg) + NRT (21mg patch)</td>
<td>NRT (21mg patch)</td>
<td>6</td>
<td>35</td>
<td>500</td>
<td>7.0%</td>
<td>3</td>
<td>125</td>
<td>2.0%</td>
<td>RR 2.92 (0.91, 9.33); p=0.05*</td>
<td>Use of e-cig only at 6 months:*</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>IG: 45% (143/317) CG: NR</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Use of patch only at 6 months:*</td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>IG: 22% (70/317) CG: 40% (21/52)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note(s): Abstinence measured as continuous abstinence and biochemically validated with expired carbon monoxide for all trials.

* Not applicable due to low (0) event rate.
† Group A=7.2 mg E-cig for 12 weeks; Group B=7.2 mg E-cig for 6 weeks and 5.4 mg E-cig for 6 weeks.
‡ Calculated
§ Adjusted for trial center, marital status, age at smoking initiation, and score on the Fagerström Test for Cigarette Dependence.
‖ Results based on self-reported quit rate were consistent with 18% of the patch plus nicotine e-cig group versus 11% of the patch plus nicotine-free e-cig group reporting abstinence at 6 months (RR 1.68 [95% CI, 1.22 to 2.30]; p=0.001). Per protocol sensitivity analyses also showed a statistically significant difference (p=0.020).
¶ In contrast, results based on self-reported quit rate showed statistically significantly greater abstinence at 6 months (RR 2.23 [95% CI, 1.19 to 4.15]; p=0.007) among patch plus nicotine e-cig group (18%) versus patches-only group (8%). The per protocol sensitivity analysis did not yield a statistically significant difference (p=0.11).
* Adherence was defined as having used the allocated product since last contact. Findings relate to allocated treatment only, in participants for whom adherence data were available. Data does not include adherence in those who crossed-over to an e-cig or those who changed their type of e-cig.

Abbreviations: ARR=adjusted relative risk; CG = control group; eCO=expired carbon monoxide; E-cig = electronic cigarette; IG = intervention group; mg = milligram(s); MI = mental illness; mo = months; NA = not applicable; NR = not reported; NRT = nicotine replacement therapy; RR = relative risk
Table 8. Adverse Event Results (KQ 3) From Systematic Reviews on Pharmacotherapy, by Comparison

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Author, Year</th>
<th>Adverse event</th>
<th>Subgroup</th>
<th>k</th>
<th>N</th>
<th>IG events</th>
<th>IG N</th>
<th>CG events</th>
<th>CG N</th>
<th>Pooled effect estimate (95% CI)</th>
<th>I2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRT vs. placebo</td>
<td>Mills, 2010\textsuperscript{115}</td>
<td>Mortality</td>
<td>-</td>
<td>8</td>
<td>2765</td>
<td>11</td>
<td>1387</td>
<td>16</td>
<td>1378</td>
<td>OR=0.74 (0.33, 1.67)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heart palpitations/</td>
<td>-</td>
<td>12</td>
<td>10,234</td>
<td>189</td>
<td>6249</td>
<td>64</td>
<td>3985</td>
<td>OR=2.06 (1.51, 2.82)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Hartmann-</td>
<td>Heart palpitations/</td>
<td>-</td>
<td>15</td>
<td>11,074</td>
<td>165</td>
<td>6673</td>
<td>62</td>
<td>4401</td>
<td>OR=1.88 (1.37, 2.57)</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Boyce, 2018\textsuperscript{86}</td>
<td>chest pains</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mills, 2014\textsuperscript{114}</td>
<td>CV AEs</td>
<td>-</td>
<td>21</td>
<td>11,647</td>
<td>202</td>
<td>6329</td>
<td>83</td>
<td>5318</td>
<td>RR=1.81 (1.35, 2.43)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Major CV AEs</td>
<td>-</td>
<td>21</td>
<td>11,647</td>
<td>12</td>
<td>6329</td>
<td>7</td>
<td>5318</td>
<td>RR=1.38 (0.58, 3.26)</td>
<td>0%</td>
</tr>
<tr>
<td>NRT: combo vs. single</td>
<td>Lindson, 2019\textsuperscript{105}</td>
<td>SAEs</td>
<td>-</td>
<td>6</td>
<td>2888</td>
<td>6</td>
<td>1475</td>
<td>1</td>
<td>1413</td>
<td>RR=4.44 (0.76, 25.85)</td>
<td>35%</td>
</tr>
<tr>
<td>NRT, patch: longer duration vs. shorter duration</td>
<td>Lindson, 2019\textsuperscript{105}</td>
<td>SAEs</td>
<td>-</td>
<td>3</td>
<td>1173</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NA\textsuperscript{*}</td>
<td>NA</td>
</tr>
<tr>
<td>NRT, patch: high vs. low dose</td>
<td>Lindson, 2019\textsuperscript{105}</td>
<td>SAEs</td>
<td>-</td>
<td>2</td>
<td>1023</td>
<td>7</td>
<td>511</td>
<td>1</td>
<td>512</td>
<td>RR=5.01 (0.87, 28.82)</td>
<td>0%</td>
</tr>
<tr>
<td>NRT: combo vs. single</td>
<td>Lindson, 2019\textsuperscript{105}</td>
<td>Withdrawals due to</td>
<td>-</td>
<td>7</td>
<td>3070</td>
<td>18</td>
<td>1169</td>
<td>23</td>
<td>1901</td>
<td>RR=1.12 (0.57, 2.20)</td>
<td>73%</td>
</tr>
<tr>
<td>NRT, fast-acting vs. NRT, patch</td>
<td>Lindson, 2019\textsuperscript{105}</td>
<td>Withdrawals due to</td>
<td>-</td>
<td>4</td>
<td>1482</td>
<td>18</td>
<td>740</td>
<td>4</td>
<td>742</td>
<td>RR=4.23 (1.54, 11.63)</td>
<td>0%</td>
</tr>
<tr>
<td>NRT, patch: high vs. low dose</td>
<td>Lindson, 2019\textsuperscript{105}</td>
<td>Withdrawals due to</td>
<td>-</td>
<td>2</td>
<td>554</td>
<td>17</td>
<td>277</td>
<td>3</td>
<td>277</td>
<td>RR=4.99 (1.60, 15.50)</td>
<td>0%</td>
</tr>
<tr>
<td>NRT, patch: longer duration vs. shorter duration</td>
<td>Lindson, 2019\textsuperscript{105}</td>
<td>Withdrawals due to</td>
<td>-</td>
<td>2</td>
<td>648</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NA\textsuperscript{†}</td>
<td>NA</td>
</tr>
<tr>
<td>Bupropion vs. placebo/no bupropion</td>
<td>Hughes, 2014\textsuperscript{74}</td>
<td>SAEs</td>
<td>-</td>
<td>33</td>
<td>9631</td>
<td>114</td>
<td>5328</td>
<td>80</td>
<td>4303</td>
<td>RR=1.30 (1.00, 1.69)</td>
<td>0%</td>
</tr>
<tr>
<td>Bupropion vs. placebo</td>
<td>Mills, 2014\textsuperscript{114}</td>
<td>CV AEs</td>
<td>-</td>
<td>27</td>
<td>10,402</td>
<td>50</td>
<td>5947</td>
<td>42</td>
<td>4455</td>
<td>RR=1.03 (0.71, 1.50)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Major CV AEs</td>
<td>-</td>
<td>27</td>
<td>10,402</td>
<td>15</td>
<td>5947</td>
<td>25</td>
<td>4455</td>
<td>RR=0.57 (0.31, 1.04)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Roberts, 2016\textsuperscript{121}</td>
<td>Discontinuation due to AEs</td>
<td>SMI</td>
<td>6</td>
<td>201</td>
<td>6</td>
<td>114</td>
<td>6</td>
<td>87</td>
<td>OR=0.93 (0.18, 4.74)</td>
<td>NR</td>
</tr>
<tr>
<td>Bupropion + NRT vs. placebo + NRT</td>
<td>Roberts, 2016\textsuperscript{121}</td>
<td>Discontinuation due to AEs</td>
<td>SMI</td>
<td>1</td>
<td>51</td>
<td>2</td>
<td>25</td>
<td>2</td>
<td>26</td>
<td>OR=1.04 (0.14, 8.04)</td>
<td>NR</td>
</tr>
<tr>
<td>Varenicline vs. placebo</td>
<td>Cahill, 2016\textsuperscript{87}</td>
<td>SAEs</td>
<td>-</td>
<td>29</td>
<td>15,370</td>
<td>269</td>
<td>8125</td>
<td>196</td>
<td>7245</td>
<td>RR=1.25 (1.04, 1.49)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CV SAEs</td>
<td>-</td>
<td>21</td>
<td>8587</td>
<td>57</td>
<td>4696</td>
<td>35</td>
<td>3891</td>
<td>RR=1.36 (0.91, 2.04)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neuropsychiatric SAEs (not deaths)</td>
<td>-</td>
<td>23</td>
<td>8955</td>
<td>41</td>
<td>4920</td>
<td>43</td>
<td>4035</td>
<td>RR=0.82 (0.57, 1.19)</td>
<td>0%</td>
</tr>
<tr>
<td>Mills, 2014\textsuperscript{114}</td>
<td></td>
<td>Major CV AEs</td>
<td>-</td>
<td>18</td>
<td>9072</td>
<td>22</td>
<td>5469</td>
<td>13</td>
<td>3603</td>
<td>RR=1.44 (0.73, 2.83)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CV AEs</td>
<td>-</td>
<td>18</td>
<td>9072</td>
<td>63</td>
<td>5469</td>
<td>41</td>
<td>3603</td>
<td>RR=1.24 (0.85, 1.81)</td>
<td>0%</td>
</tr>
<tr>
<td>Sterling, 2016\textsuperscript{129}</td>
<td></td>
<td>Mortality</td>
<td>-</td>
<td>38</td>
<td>12,706</td>
<td>11</td>
<td>7213</td>
<td>9</td>
<td>5493</td>
<td>RR=0.88 (0.50, 1.52)</td>
<td>0%</td>
</tr>
</tbody>
</table>
### Table 8. Adverse Event Results (KQ 3) From Systematic Reviews on Pharmacotherapy, by Comparison

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Author, Year</th>
<th>Adverse event</th>
<th>Subgroup</th>
<th>k</th>
<th>N</th>
<th>IG events</th>
<th>IG N</th>
<th>CG events</th>
<th>CG N</th>
<th>Pooled effect estimate (95% CI)</th>
<th>I2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV SAEs</td>
<td>Thomas, 2015</td>
<td>Suicide and attempted suicide</td>
<td>-</td>
<td>38</td>
<td>12,706</td>
<td>57</td>
<td>7213</td>
<td>43</td>
<td>5493</td>
<td>RR=1.03 (0.72, 1.49)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suicidal ideation</td>
<td>-</td>
<td>31</td>
<td>9830</td>
<td>4</td>
<td>5352</td>
<td>2</td>
<td>4478</td>
<td>OR=1.67 (0.33, 8.57)</td>
<td>10.3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Depression events</td>
<td>-</td>
<td>20</td>
<td>2990</td>
<td>15</td>
<td>799</td>
<td>18</td>
<td>2191</td>
<td>OR=0.58 (0.28, 1.20)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mortality</td>
<td>-</td>
<td>36</td>
<td>10,647</td>
<td>13</td>
<td>5760</td>
<td>11</td>
<td>4887</td>
<td>OR=0.96 (0.75, 1.22)</td>
<td>0%</td>
</tr>
<tr>
<td>Discontinuation due to AEs</td>
<td>Roberts, 2016</td>
<td>Discontinuation due to all causes</td>
<td>-</td>
<td>5</td>
<td>222</td>
<td>14</td>
<td>131</td>
<td>7</td>
<td>91</td>
<td>OR=1.29 (0.47, 3.56)</td>
<td>NR</td>
</tr>
<tr>
<td>Discontinuation due to side effects</td>
<td>Kishi, 2014</td>
<td>Discontinuation due to all causes</td>
<td>-</td>
<td>7</td>
<td>439</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>RR=0.92 (0.54, 1.56)</td>
<td>44%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discontinuation due to side effects</td>
<td>-</td>
<td>7</td>
<td>439</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>RR=1.29 (0.67, 2.48)</td>
<td>0%</td>
</tr>
<tr>
<td>Varenicline vs. placebo</td>
<td>Thomas, 2015</td>
<td>Suicidal ideation</td>
<td>Age 40 years and older</td>
<td>18</td>
<td>4782</td>
<td>14</td>
<td>2655</td>
<td>17</td>
<td>2127</td>
<td>OR=0.58 (0.28, 1.24)</td>
<td>0%</td>
</tr>
<tr>
<td>continued</td>
<td></td>
<td>Depression events</td>
<td>Age 40 years and older</td>
<td>27</td>
<td>9318</td>
<td>144</td>
<td>5050</td>
<td>129</td>
<td>4268</td>
<td>OR=0.99 (0.77, 1.27)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suicidal ideation</td>
<td>Age less than 40 years</td>
<td>2</td>
<td>208</td>
<td>1</td>
<td>144</td>
<td>1</td>
<td>64</td>
<td>OR=0.58 (0.28, 1.20)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Depression events</td>
<td>Age less than 40 years</td>
<td>4</td>
<td>525</td>
<td>19</td>
<td>306</td>
<td>10</td>
<td>219</td>
<td>OR=0.96 (0.75, 1.22)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suicidal ideation</td>
<td>50% male or greater</td>
<td>14</td>
<td>3660</td>
<td>12</td>
<td>2097</td>
<td>14</td>
<td>1563</td>
<td>OR=0.57 (0.25, 1.30)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Depression events</td>
<td>50% male or greater</td>
<td>24</td>
<td>8145</td>
<td>93</td>
<td>4406</td>
<td>89</td>
<td>3739</td>
<td>OR=0.89 (0.66, 1.21)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suicidal ideation</td>
<td>Less than 50% male</td>
<td>6</td>
<td>4990</td>
<td>3</td>
<td>702</td>
<td>4</td>
<td>628</td>
<td>OR=0.58 (0.28, 1.20)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Depression events</td>
<td>Less than 50% male</td>
<td>7</td>
<td>9843</td>
<td>163</td>
<td>5356</td>
<td>139</td>
<td>4487</td>
<td>OR=0.96 (0.75, 1.22)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suicidal ideation</td>
<td>50% White or greater</td>
<td>15</td>
<td>3498</td>
<td>11</td>
<td>1956</td>
<td>13</td>
<td>1542</td>
<td>OR=0.56 (0.24, 1.30)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Depression events</td>
<td>50% White or greater</td>
<td>24</td>
<td>8083</td>
<td>117</td>
<td>4378</td>
<td>95</td>
<td>3705</td>
<td>OR=0.95 (0.72, 1.27)</td>
<td>1.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suicidal ideation</td>
<td>Less than 50% White</td>
<td>3</td>
<td>681</td>
<td>4</td>
<td>436</td>
<td>2</td>
<td>245</td>
<td>OR=1.83 (0.29, 11.75)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Depression events</td>
<td>Less than 50% White</td>
<td>4</td>
<td>931</td>
<td>27</td>
<td>562</td>
<td>27</td>
<td>369</td>
<td>OR=0.82 (0.43, 1.58)</td>
<td>0%</td>
</tr>
</tbody>
</table>
Table 8. Adverse Event Results (KQ 3) From Systematic Reviews on Pharmacotherapy, by Comparison

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Author, Year</th>
<th>Adverse event</th>
<th>Subgroup</th>
<th>k</th>
<th>N</th>
<th>IG events</th>
<th>IG N</th>
<th>CG events</th>
<th>CG N</th>
<th>Pooled effect estimate (95% CI)</th>
<th>I2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suicidal ideation</td>
<td></td>
<td>100% with psychiatric illness</td>
<td>5</td>
<td>809</td>
<td>11</td>
<td>416</td>
<td>11</td>
<td>393</td>
<td>OR=0.79 (0.32, 1.93) 0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression events</td>
<td></td>
<td>100% with psychiatric illness</td>
<td>5</td>
<td>809</td>
<td>31</td>
<td>416</td>
<td>20</td>
<td>393</td>
<td>OR=1.49 (0.84, 2.65) 0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suicidal ideation</td>
<td></td>
<td>10%-20% psychiatric illness</td>
<td>1</td>
<td>192</td>
<td>0</td>
<td>86</td>
<td>1</td>
<td>106</td>
<td>OR=0.16 (0.00, 8.42) NA</td>
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<td></td>
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<tr>
<td>Depression events</td>
<td></td>
<td>10%-20% psychiatric illness</td>
<td>1</td>
<td>192</td>
<td>6</td>
<td>86</td>
<td>14</td>
<td>106</td>
<td>OR=0.51 (0.20, 1.30) NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suicidal ideation</td>
<td></td>
<td>No psychiatric illness</td>
<td>14</td>
<td>3989</td>
<td>4</td>
<td>2297</td>
<td>6</td>
<td>1692</td>
<td>OR=0.34 (0.09, 1.29) 0%</td>
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<td></td>
</tr>
<tr>
<td>Varenicline vs. placebo</td>
<td>Thomas, 2015</td>
<td>Depression events</td>
<td>No psychiatric illness</td>
<td>25</td>
<td>8842</td>
<td>126</td>
<td>4854</td>
<td>105</td>
<td>OR=0.91 (0.69, 1.21) 0%</td>
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<tr>
<td>Wu, 2016</td>
<td></td>
<td>Suicidal ideation</td>
<td>SMI</td>
<td>4</td>
<td>203</td>
<td>9</td>
<td>124</td>
<td>5</td>
<td>RR=1.06 (0.40, 2.82) 0%</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Depressed mood</td>
<td>SMI</td>
<td>3</td>
<td>198</td>
<td>13</td>
<td>121</td>
<td>6</td>
<td>RR=1.45 (0.45, 1.64) 28.6%</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Anxiety</td>
<td>SMI</td>
<td>4</td>
<td>267</td>
<td>13</td>
<td>155</td>
<td>14</td>
<td>RR=0.77 (0.28, 2.17) 33.7%</td>
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</tr>
<tr>
<td>Kishi, 2014</td>
<td></td>
<td>Discontinuation due to side effects</td>
<td>SMI</td>
<td>7</td>
<td>439</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>RR=1.29 (0.67, 2.48) 0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discontinuation due to all causes</td>
<td>SMI</td>
<td>7</td>
<td>439</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>RR=0.92 (0.54, 1.56) 44%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roberts, 2016</td>
<td></td>
<td>Discontinuation due to AEs</td>
<td>SMI</td>
<td>5</td>
<td>222</td>
<td>14</td>
<td>131</td>
<td>7</td>
<td>OR=1.29 (0.47, 3.56) NR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schwartz, 2015</td>
<td></td>
<td>Mood disorders</td>
<td>Smokeless tobacco users</td>
<td>3</td>
<td>744</td>
<td>6</td>
<td>370</td>
<td>9</td>
<td>RR=0.71 (0.26, 1.90) 0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* None of the comparisons based on duration of patch therapy showed a clinically or statistically significant difference for SAEs.
† Not pooled due to substantial heterogeneity; no significant differences in either study

**Abbreviations:** AE = Adverse event; CG = Control group; CI = Confidence interval; CV = Cardiovascular; IG = Intervention group; NA = Not applicable; NR = Not reported; NRT = Nicotine replacement therapy; OR = Odds ratio; RR = Risk ratio; SAE = Serious adverse event; SMI = Serious mental illness
Table 9. Adverse Event Results for Primary Evidence on the Use of Electronic Cigarettes for Tobacco Cessation

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Quality</th>
<th>System or organ class</th>
<th>Outcome</th>
<th>IG</th>
<th>CG</th>
<th>FU (mo)</th>
<th>IG events</th>
<th>IG N</th>
<th>IG AE rate</th>
<th>CG events</th>
<th>CG N</th>
<th>CG AE rate</th>
<th>Effect estimate (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bullen, 2013</td>
<td>ASCEND</td>
<td>General</td>
<td>AE Rate</td>
<td>E-cig (16mg)</td>
<td>NRT (21mg Patch)</td>
<td>6</td>
<td>137 events among 107 persons</td>
<td>NA</td>
<td>0.8 events per person month</td>
<td>119 events among 96 persons</td>
<td>NA</td>
<td>0.8 events per person month</td>
<td>IRR 1.05 (0.82, 1.34) p=0.7</td>
</tr>
<tr>
<td></td>
<td>Fair</td>
<td></td>
<td></td>
<td>E-cig (16mg)</td>
<td>Placebo (0mg E-cig)</td>
<td>6</td>
<td>137 events among 107 persons</td>
<td>NA</td>
<td>0.8 events per person month</td>
<td>36 events among 26 persons</td>
<td>NA</td>
<td>0.9 events per person month</td>
<td>NR</td>
</tr>
<tr>
<td>Participants with AEs</td>
<td></td>
<td></td>
<td></td>
<td>E-cig (16mg)</td>
<td>NRT (21mg Patch)</td>
<td>6</td>
<td>107</td>
<td>289</td>
<td>37.0%</td>
<td>96</td>
<td>295</td>
<td>32.5%</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E-cig (16mg)</td>
<td>Placebo (0mg E-cig)</td>
<td>6</td>
<td>107</td>
<td>289</td>
<td>37.0%</td>
<td>26</td>
<td>73</td>
<td>35.6%</td>
<td>NR</td>
</tr>
<tr>
<td>Caponnetto, 2013</td>
<td>ECLAT</td>
<td>General</td>
<td>AE Rate</td>
<td>E-cig (both study groups)²</td>
<td>Placebo (0mg E-cig)</td>
<td>3</td>
<td>NR</td>
<td>200</td>
<td>NR</td>
<td>100</td>
<td>NR</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fair</td>
<td></td>
<td></td>
<td>E-cig (both study groups)²</td>
<td>Placebo (0mg E-cig)</td>
<td>12</td>
<td>NR</td>
<td>200</td>
<td>NR</td>
<td>100</td>
<td>NR</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E-cig (both study groups)²</td>
<td>Placebo (0mg E-cig)</td>
<td>12</td>
<td>0</td>
<td>200</td>
<td>NA</td>
<td>0</td>
<td>100</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Serious AEs*</td>
<td></td>
<td></td>
<td></td>
<td>E-cig (both study groups)²</td>
<td>Placebo (0mg E-cig)</td>
<td>12</td>
<td>0</td>
<td>200</td>
<td>NA</td>
<td>0</td>
<td>100</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Carpenter, 2017</td>
<td>Fair</td>
<td>General</td>
<td>AE Rate</td>
<td>E-cig (16mg)</td>
<td>No Intv</td>
<td>4</td>
<td>17 events among 9 persons</td>
<td>25</td>
<td>NR</td>
<td>29 events among 8 persons</td>
<td>22</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E-cig (24mg)</td>
<td>No Intv</td>
<td>4</td>
<td>21 events among 11 persons</td>
<td>21</td>
<td>NR</td>
<td>29 events among 8 persons</td>
<td>22</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Participants with AEs</td>
<td></td>
<td></td>
<td></td>
<td>E-cig (16mg)</td>
<td>No Intv</td>
<td>4</td>
<td>9</td>
<td>25</td>
<td>36%</td>
<td>8</td>
<td>22</td>
<td>36%</td>
<td>NR</td>
</tr>
<tr>
<td>Author, Year Quality</td>
<td>System or organ class</td>
<td>Outcome</td>
<td>IG</td>
<td>CG</td>
<td>FU (mo)</td>
<td>IG events</td>
<td>IG N</td>
<td>IG AE rate</td>
<td>CG events</td>
<td>CG N</td>
<td>CG AE rate</td>
<td>Effect estimate (95% CI)</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------</td>
<td>---------</td>
<td>----</td>
<td>----</td>
<td>---------</td>
<td>-----------</td>
<td>------</td>
<td>------------</td>
<td>-----------</td>
<td>------</td>
<td>------------</td>
<td>--------------------------</td>
<td></td>
</tr>
<tr>
<td>Cravo, 2016¹⁵⁰</td>
<td>General</td>
<td>AE Rate</td>
<td>E-cig (2.7 mg)</td>
<td>No Intv</td>
<td>3</td>
<td>1515 events among 271 persons</td>
<td>306</td>
<td>NR</td>
<td>225 events among 80 persons</td>
<td>102</td>
<td>NR</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>General</td>
<td>Serious AEs</td>
<td>E-cig (2.7 mg)</td>
<td>No Intv</td>
<td>3</td>
<td>5 events among 5 persons</td>
<td>306</td>
<td>NR</td>
<td>0</td>
<td>102</td>
<td>0</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>Respiratory</td>
<td>Coughing</td>
<td>E-cig (2.7 mg)</td>
<td>No Intv</td>
<td>3</td>
<td>52</td>
<td>17.0%</td>
<td>8</td>
<td>102</td>
<td>7.8%</td>
<td>NR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sore Throat</td>
<td>E-cig (2.7 mg)</td>
<td>No Intv</td>
<td>3</td>
<td>85</td>
<td>27.8%</td>
<td>9</td>
<td>102</td>
<td>8.8%</td>
<td>NR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sinus Infection</td>
<td>E-cig (2.7 mg)</td>
<td>No Intv</td>
<td>3</td>
<td>34</td>
<td>11.1%</td>
<td>8</td>
<td>102</td>
<td>7.8%</td>
<td>NR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurologic</td>
<td>Headache</td>
<td>E-cig (2.7 mg)</td>
<td>No Intv</td>
<td>3</td>
<td>145</td>
<td>47.4%</td>
<td>34</td>
<td>102</td>
<td>33.3%</td>
<td>NR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hajek, 2019¹⁵¹</td>
<td>General</td>
<td>Serious AE incidence</td>
<td>E-cig (any)</td>
<td>NRT (any)</td>
<td>12</td>
<td>27</td>
<td>438</td>
<td>6.2%</td>
<td>22</td>
<td>446</td>
<td>4.9%</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Respiratory</td>
<td>Coughing</td>
<td>E-cig (any)</td>
<td>NRT (any)</td>
<td>12</td>
<td>97</td>
<td>314</td>
<td>30.8%</td>
<td>111</td>
<td>279</td>
<td>39.8%</td>
<td>RR 0.8 (0.6, 0.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shortness of breath</td>
<td>E-cig (any)</td>
<td>NRT (any)</td>
<td>12</td>
<td>66</td>
<td>314</td>
<td>21.0%</td>
<td>64</td>
<td>279</td>
<td>22.9%</td>
<td>RR 0.9 (0.7, 1.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wheezing</td>
<td>E-cig (any)</td>
<td>NRT (any)</td>
<td>12</td>
<td>74</td>
<td>314</td>
<td>23.5%</td>
<td>59</td>
<td>279</td>
<td>21.1%</td>
<td>RR 1.1 (0.8, 1.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Throat/mouth irritation</td>
<td>E-cig (any)</td>
<td>NRT (any)</td>
<td>12</td>
<td>286</td>
<td>438</td>
<td>65.3%</td>
<td>221</td>
<td>432</td>
<td>51.1%</td>
<td>RR 1.27 (1.13, 1.43)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phlegm</td>
<td>E-cig (any)</td>
<td>NRT (any)</td>
<td>12</td>
<td>79</td>
<td>314</td>
<td>25.1%</td>
<td>103</td>
<td>279</td>
<td>36.9%</td>
<td>RR 0.7 (0.6, 0.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gastro-intestinal</td>
<td>Nausea</td>
<td>E-cig (any)</td>
<td>NRT (any)</td>
<td>12</td>
<td>137</td>
<td>438</td>
<td>31.3%</td>
<td>169</td>
<td>446</td>
<td>37.9%</td>
<td>RR 0.83 (0.69, 0.99)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Psychiatric</td>
<td>Disturbed Sleep</td>
<td>E-cig (any)</td>
<td>NRT (any)</td>
<td>12</td>
<td>279</td>
<td>438</td>
<td>63.7%</td>
<td>303</td>
<td>446</td>
<td>67.9%</td>
<td>RR 0.94 (0.98, 1.04)</td>
<td></td>
</tr>
<tr>
<td>Masiero, 2017¹⁵³</td>
<td>Respiratory</td>
<td>Cough</td>
<td>E-cig (8mg)</td>
<td>Placebo (0mg E-cig)</td>
<td>3</td>
<td>7</td>
<td>70</td>
<td>10.0%</td>
<td>2</td>
<td>70</td>
<td>2.9%</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dyspnea</td>
<td>E-cig (8mg)</td>
<td>Placebo (0mg E-cig)</td>
<td>3</td>
<td>0</td>
<td>70</td>
<td>NA</td>
<td>1</td>
<td>70</td>
<td>1.4%</td>
<td>NR</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Burning throat</td>
<td>E-cig (8mg)</td>
<td>Placebo (0mg E-cig)</td>
<td>3</td>
<td>4</td>
<td>70</td>
<td>5.7%</td>
<td>2</td>
<td>70</td>
<td>2.9%</td>
<td>NR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 9. Adverse Event Results for Primary Evidence on the Use of Electronic Cigarettes for Tobacco Cessation

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>System or organ class</th>
<th>Outcome</th>
<th>IG (mg)</th>
<th>CG (mg)</th>
<th>FU (mo)</th>
<th>IG events</th>
<th>IG N</th>
<th>IG AE rate</th>
<th>CG events</th>
<th>CG N</th>
<th>CG AE rate</th>
<th>Effect estimate (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tseng, 2016</td>
<td>Neurologic</td>
<td>Headache</td>
<td>E-cig</td>
<td>Placebo</td>
<td>3</td>
<td>0</td>
<td>70</td>
<td>NA</td>
<td>0</td>
<td>70</td>
<td>NA</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td>Gastrointestinal</td>
<td>Nausea</td>
<td>E-cig</td>
<td>Placebo</td>
<td>3</td>
<td>1</td>
<td>70</td>
<td>1.4%</td>
<td>2</td>
<td>70</td>
<td>2.9%</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stomachache</td>
<td>E-cig</td>
<td>Placebo</td>
<td>3</td>
<td>0</td>
<td>70</td>
<td>NA</td>
<td>0</td>
<td>70</td>
<td>NA</td>
<td>NR</td>
</tr>
<tr>
<td>Walker, 2019</td>
<td>Psychiatric</td>
<td>Insomnia</td>
<td>E-cig</td>
<td>Placebo</td>
<td>3</td>
<td>1</td>
<td>70</td>
<td>1.4%</td>
<td>0</td>
<td>70</td>
<td>NA</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Confusion</td>
<td>E-cig</td>
<td>Placebo</td>
<td>3</td>
<td>1</td>
<td>70</td>
<td>1.4%</td>
<td>0</td>
<td>70</td>
<td>NA</td>
<td>NR</td>
</tr>
</tbody>
</table>

Note: No intervention control groups continued smoking with conventional cigarettes and received no behavioral intervention component.
* Defined as any event requiring unscheduled visits to a physician or hospitalization.
‡Group A=7.2 mg E-cig for 12 weeks; Group B=7.2 mg E-cig for 6 weeks and 5.4 mg E-cig for 6 weeks.

Abbreviations: AE = adverse event; E-cig = electronic cigarette; Intv = intervention; NA = not applicable; NR = not reported; NRT = nicotine replacement therapy; RR = relative risk
<table>
<thead>
<tr>
<th>Study design</th>
<th>Author, Year</th>
<th>Country</th>
<th>N rand</th>
<th>Brief population/cohort description</th>
<th>Intervention/Exposure</th>
<th>Comparison</th>
<th>Outcomes of interest</th>
</tr>
</thead>
</table>
| RCT | Berlin, 2014<sup>168</sup> SNIPP | France | 403 | Pregnant smokers aged 18 years or more with a gestational age of between 9 and 20 weeks of amenorrhea who smoked at least five cigarettes a day and were motivated to quit | NRT, patch (10-15 mg/day) plus behavioral support | Placebo patch plus behavioral support | • Low BW  
• Mean BW  
• Preterm birth  
• Stillbirth  
• Tobacco cessation |
| Coleman, 2012<sup>169</sup> SNAP | UK | 1051 | Pregnant smokers aged 16–50 years, between 12 and 24 weeks’ pregnant, smoked at least 10 cigarettes per day before pregnancy and continued to smoke at least five cigarettes per day | NRT, patch (15 mg/16 hrs) plus behavioral counseling | Placebo patch plus behavioral counseling | • Low BW  
• Mean BW  
• Preterm birth  
• Stillbirth  
• Tobacco cessation |
| Oncken, 2008<sup>174</sup> | US | 194 | Pregnant smokers, ≤26 weeks pregnant and smoked ≥ 1 cpd | NRT, gum (2 mg) plus behavioral counseling | Placebo gum plus behavioral counseling | • Low BW  
• Mean BW  
• Preterm birth  
• Stillbirth  
• Tobacco cessation |
| Wisborg, 2000<sup>177</sup> | Denmark | 250 | Pregnant smokers, who smoked ≥ 10 cigarettes after first trimester | Nicotine patch (15 mg/16 hrs for 8 weeks, 10 mg/16 hrs for 3 weeks) plus behavioral counseling | Placebo patch plus behavioral counseling | • Low BW  
• Mean BW  
• Preterm birth  
• Stillbirth  
• Tobacco cessation |
| Non-placebo control RCT | El-Mohandes, 2013<sup>172</sup> | US | 52 | Pregnant African American smokers ≥18 years, and <30 weeks pregnant with a desire to quit | Trans-dermal NRT, 14-21mg for 10 wks depending on cpd. Maximum of six clinical visits. | Behavioral counseling | • Low BW  
• Mean BW  
• Preterm birth  
• Tobacco cessation |
| Pollak, 2007<sup>175</sup> Baby Steps | US | 181 | Pregnant smokers between 13 and 25 weeks pregnant and smoked ≥ 5 CPD | Choice of NRT from patch (7-12mg/16hrs depending on cpd), gum (2mg/each cpd), or lozenge (2mg/each cpd) plus behavioral counseling | Behavioral counseling | • Low BW  
• Mean BW  
• Preterm birth  
• Tobacco cessation |
**Table 10. Primary Evidence on Pharmacotherapy Among Pregnant Individuals, Study and Population Characteristics, by Study Design**

<table>
<thead>
<tr>
<th>Study design</th>
<th>Author, Year Trial name</th>
<th>Country</th>
<th>N rand</th>
<th>Brief population/cohort description</th>
<th>Intervention/Exposure</th>
<th>Comparison</th>
<th>Outcomes of interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort</td>
<td>Berard, 2016178 Quebec Pregnancy Cohort Good</td>
<td>Canada</td>
<td>1288</td>
<td>Quebec Pregnancy Cohort data</td>
<td>IG1: Bupropion alone with or without smoking IG2: NRT alone w or without smoking</td>
<td>Smokers without Bupropion or NRT, patch exposure</td>
<td>• Preterm birth</td>
</tr>
<tr>
<td></td>
<td>Dhalwani, 2018179, 180 The Health Improvement Network (THIN) Fair</td>
<td>UK</td>
<td>220,630</td>
<td>Cohort of singleton pregnancies ending in live or stillbirth between 2001 and 2012 from The Health Improvement Network UK general practice database</td>
<td>NRT, any</td>
<td>Smokers and non-smokers</td>
<td>• Stillbirth • Major congenital anomalies</td>
</tr>
<tr>
<td></td>
<td>Zhu, 2014181 Danish National Birth Cohort (DNBC) Good</td>
<td>Denmark</td>
<td>84,803</td>
<td>Danish National Birth Cohort data</td>
<td>IG1: NRT (mother) plus smoker (father) IG2: NRT (mother) plus non-smoker (father)</td>
<td>Nonsmoker (mother) plus nonsmoker (father)</td>
<td>• ADHD (child)</td>
</tr>
</tbody>
</table>

**Abbreviations:** ADHD = attention deficit/hyperactivity disorder; BW = birth weight; CG = control group; CPD = cigarettes per day; hr = hour(s); IG = intervention group; NRT = nicotine replacement therapy; mg = milligram(s); RCT = randomized controlled trial; UK = United Kingdom; US = United States
Table 11. Summary of Perinatal Health Outcome Results (KQ 1) of Behavioral Tobacco Cessation Interventions Among Pregnant Women, Psychosocial Interventions vs. Any Control (Within Chamberlain, 2017 Review)\(^{182}\)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention</th>
<th>K</th>
<th>Total n analyzed</th>
<th>IG events</th>
<th>IG n</th>
<th>CG events</th>
<th>CG n</th>
<th>Risk Ratio (95% CI)</th>
<th>I^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean birthweight*</td>
<td>Any psychosocial intervention</td>
<td>26</td>
<td>11,338</td>
<td>3207.5</td>
<td>5756</td>
<td>3146.9</td>
<td>5582</td>
<td>MD=55.60 (29.82, 81.38)</td>
<td>31%</td>
</tr>
<tr>
<td></td>
<td>Counseling</td>
<td>14</td>
<td>5471</td>
<td>3080.7</td>
<td>2598</td>
<td>3744.9</td>
<td>2733</td>
<td>MD=42.17 (11.79, 72.55)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Health education</td>
<td>2</td>
<td>1172</td>
<td>3330.9</td>
<td>685</td>
<td>3255.1</td>
<td>487</td>
<td>MD=27.35 (-53.88, 108.58)</td>
<td>33%</td>
</tr>
<tr>
<td></td>
<td>Feedback</td>
<td>2</td>
<td>3006</td>
<td>3418.7</td>
<td>1501</td>
<td>3221.1</td>
<td>1505</td>
<td>MD=79.43 (-53.05, 211.91)</td>
<td>58%</td>
</tr>
<tr>
<td></td>
<td>Incentives</td>
<td>6</td>
<td>834</td>
<td>3150.5</td>
<td>451</td>
<td>3088.2</td>
<td>383</td>
<td>MD=114.01 (63.91, 164.11)</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td>Social support</td>
<td>1</td>
<td>142</td>
<td>3100</td>
<td>67</td>
<td>3072</td>
<td>75</td>
<td>MD=28.0 (-152.48, 208.48)</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Exercise</td>
<td>1</td>
<td>713</td>
<td>3132.4</td>
<td>354</td>
<td>3146.8</td>
<td>359</td>
<td>MD=-14.40 (-104.15, 75.35)</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Low birthweight</td>
<td>18</td>
<td>9402</td>
<td>355</td>
<td>4743</td>
<td>429</td>
<td>4659</td>
<td>0.83 (0.72, 0.94)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Counseling</td>
<td>8</td>
<td>7339</td>
<td>151</td>
<td>2090</td>
<td>200</td>
<td>2249</td>
<td>0.83 (0.68, 1.01)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Health education</td>
<td>2</td>
<td>1172</td>
<td>40</td>
<td>685</td>
<td>37</td>
<td>487</td>
<td>0.87 (0.49, 1.55)</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>Feedback</td>
<td>1</td>
<td>2848</td>
<td>99</td>
<td>1423</td>
<td>121</td>
<td>1425</td>
<td>0.82 (0.63, 1.06)</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Incentives</td>
<td>5</td>
<td>252</td>
<td>22</td>
<td>156</td>
<td>21</td>
<td>96</td>
<td>0.63 (0.37, 1.08)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Social support</td>
<td>1</td>
<td>79</td>
<td>5</td>
<td>36</td>
<td>6</td>
<td>43</td>
<td>1.00 (0.33, 2.99)</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Exercise</td>
<td>1</td>
<td>712</td>
<td>38</td>
<td>353</td>
<td>44</td>
<td>359</td>
<td>0.88 (0.58, 1.32)</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Preterm births</td>
<td>19</td>
<td>9222</td>
<td>337</td>
<td>4705</td>
<td>363</td>
<td>4517</td>
<td>0.93 (0.77, 1.11)</td>
<td>18%</td>
</tr>
<tr>
<td></td>
<td>Counseling</td>
<td>8</td>
<td>3447</td>
<td>99</td>
<td>1672</td>
<td>117</td>
<td>1775</td>
<td>0.93 (0.71, 1.20)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Health education</td>
<td>2</td>
<td>1170</td>
<td>29</td>
<td>684</td>
<td>25</td>
<td>486</td>
<td>0.92 (0.55, 1.56)</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>Feedback</td>
<td>2</td>
<td>3111</td>
<td>115</td>
<td>1572</td>
<td>150</td>
<td>1539</td>
<td>0.60 (0.28, 1.29)</td>
<td>63%</td>
</tr>
<tr>
<td></td>
<td>Exercise</td>
<td>1</td>
<td>704</td>
<td>35</td>
<td>356</td>
<td>26</td>
<td>348</td>
<td>1.32 (0.81, 2.14)</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Incentives</td>
<td>6</td>
<td>790</td>
<td>59</td>
<td>421</td>
<td>45</td>
<td>369</td>
<td>0.91 (0.52, 1.59)</td>
<td>33%</td>
</tr>
<tr>
<td></td>
<td>Stillbirths</td>
<td>8</td>
<td>6170</td>
<td>40</td>
<td>3053</td>
<td>33</td>
<td>3117</td>
<td>1.20 (0.76, 1.90)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Counseling</td>
<td>5</td>
<td>2454</td>
<td>16</td>
<td>1197</td>
<td>14</td>
<td>1257</td>
<td>1.14 (0.55, 2.33)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Feedback</td>
<td>2</td>
<td>2960</td>
<td>22</td>
<td>1479</td>
<td>17</td>
<td>1481</td>
<td>1.28 (0.69, 2.39)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Exercise</td>
<td>1</td>
<td>756</td>
<td>2</td>
<td>377</td>
<td>2</td>
<td>379</td>
<td>1.01 (0.14, 7.10)</td>
<td>NA</td>
</tr>
</tbody>
</table>

*Presented as mean in grams; weighted means (g) calculated.

**Abbreviations:** CG = control group; CI = confidence intervals; IG = intervention group; MD = mean difference; NA = not applicable.
Table 12. Summary of Tobacco Cessation Outcomes (KQ 2) of Behavioral Tobacco Cessation Interventions Among Pregnant Women (Within Chamberlain, 2017 Review)

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Control</th>
<th>K</th>
<th>N analyzed</th>
<th>IG</th>
<th>IG N</th>
<th>IG quit rate</th>
<th>CG</th>
<th>CG N</th>
<th>CG quit rate</th>
<th>Risk ratio (95% CI)</th>
<th>I²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any psychosocial intervention</td>
<td>Any control</td>
<td>97</td>
<td>26,637</td>
<td>2332</td>
<td>14,192</td>
<td>16.4%</td>
<td>1518</td>
<td>12,445</td>
<td>12.2%</td>
<td>1.35 (1.23, 1.48)</td>
<td>44%</td>
</tr>
<tr>
<td>Counseling</td>
<td>Any control</td>
<td>51</td>
<td>18,276</td>
<td>1376</td>
<td>9510</td>
<td>14.5%</td>
<td>950</td>
<td>8766</td>
<td>10.8%</td>
<td>1.31 (1.16, 1.47)</td>
<td>40%</td>
</tr>
<tr>
<td>Health education</td>
<td>Any control</td>
<td>11</td>
<td>2142</td>
<td>195</td>
<td>1275</td>
<td>15.3%</td>
<td>107</td>
<td>867</td>
<td>12.3%</td>
<td>1.22 (0.97, 1.55)</td>
<td>7%</td>
</tr>
<tr>
<td>Feedback</td>
<td>Any control</td>
<td>6</td>
<td>859</td>
<td>94</td>
<td>513</td>
<td>18.3%</td>
<td>31</td>
<td>346</td>
<td>9.0%</td>
<td>1.92 (1.16, 3.17)</td>
<td>7%</td>
</tr>
<tr>
<td>Incentives</td>
<td>Any control</td>
<td>13</td>
<td>1752</td>
<td>222</td>
<td>995</td>
<td>22.3%</td>
<td>89</td>
<td>757</td>
<td>11.8%</td>
<td>1.88 (1.12, 3.14)</td>
<td>66%</td>
</tr>
<tr>
<td>Social support</td>
<td>Any control</td>
<td>14</td>
<td>2629</td>
<td>405</td>
<td>1409</td>
<td>28.7%</td>
<td>310</td>
<td>1220</td>
<td>25.4%</td>
<td>1.16 (0.96, 1.40)</td>
<td>23%</td>
</tr>
<tr>
<td>Exercise</td>
<td>Any control</td>
<td>1</td>
<td>785</td>
<td>30</td>
<td>392</td>
<td>7.7%</td>
<td>25</td>
<td>393</td>
<td>6.4%</td>
<td>1.20 (0.72, 2.01)</td>
<td>NA</td>
</tr>
<tr>
<td>Other (behavioral)</td>
<td>Any control</td>
<td>1</td>
<td>194</td>
<td>10</td>
<td>98</td>
<td>10.2%</td>
<td>6</td>
<td>96</td>
<td>6.3%</td>
<td>1.63 (0.62, 4.32)</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Usual care</td>
<td>30</td>
<td>12,432</td>
<td>771</td>
<td>6350</td>
<td>12.1%</td>
<td>546</td>
<td>6082</td>
<td>9.0%</td>
<td>1.44 (1.19, 1.73)</td>
<td>49%</td>
</tr>
<tr>
<td></td>
<td>Less intensive intervention</td>
<td>18</td>
<td>5657</td>
<td>494</td>
<td>2897</td>
<td>17.1%</td>
<td>368</td>
<td>2760</td>
<td>13.3%</td>
<td>1.25 (1.07, 1.47)</td>
<td>28%</td>
</tr>
<tr>
<td></td>
<td>Alternative intervention</td>
<td>1</td>
<td>257</td>
<td>58</td>
<td>128</td>
<td>4.5%</td>
<td>51</td>
<td>129</td>
<td>4.0%</td>
<td>1.15 (0.86, 1.53)</td>
<td>NA</td>
</tr>
<tr>
<td>Health education</td>
<td>Usual care</td>
<td>5</td>
<td>629</td>
<td>41</td>
<td>310</td>
<td>13.2%</td>
<td>25</td>
<td>319</td>
<td>7.8%</td>
<td>1.59 (0.99, 2.55)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Less intensive intervention</td>
<td>4</td>
<td>1282</td>
<td>116</td>
<td>759</td>
<td>15.3%</td>
<td>72</td>
<td>523</td>
<td>13.8%</td>
<td>1.20 (0.85, 1.70)</td>
<td>33%</td>
</tr>
<tr>
<td></td>
<td>Alternative intervention</td>
<td>1</td>
<td>31</td>
<td>2</td>
<td>16</td>
<td>12.5%</td>
<td>1</td>
<td>15</td>
<td>6.7%</td>
<td>1.88 (0.19, 18.60)</td>
<td>NA</td>
</tr>
<tr>
<td>Feedback</td>
<td>Usual care</td>
<td>2</td>
<td>355</td>
<td>33</td>
<td>198</td>
<td>16.7%</td>
<td>6</td>
<td>157</td>
<td>3.80%</td>
<td>4.39 (1.89, 10.21)</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Less intensive intervention</td>
<td>3</td>
<td>439</td>
<td>42</td>
<td>276</td>
<td>15.2%</td>
<td>19</td>
<td>163</td>
<td>11.7%</td>
<td>1.29 (0.75, 2.20)</td>
<td>0%</td>
</tr>
<tr>
<td>Incentives</td>
<td>Usual care</td>
<td>5</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Social support</td>
<td>Less intensive intervention</td>
<td>7</td>
<td>781</td>
<td>102</td>
<td>405</td>
<td>25.2%</td>
<td>73</td>
<td>376</td>
<td>19.4%</td>
<td>1.21 (0.93, 1.58)</td>
<td>0%</td>
</tr>
<tr>
<td>Exercise</td>
<td>Usual care</td>
<td>1</td>
<td>785</td>
<td>30</td>
<td>392</td>
<td>7.7%</td>
<td>25</td>
<td>393</td>
<td>6.4%</td>
<td>1.21 (0.72, 2.01)</td>
<td>NA</td>
</tr>
</tbody>
</table>

Abbreviations: CG = control group; CI = confidence intervals; IG = intervention group; NA = not applicable; NR = not reported
Table 13. Summary of Evidence for the General Adult Population

<table>
<thead>
<tr>
<th>Key question</th>
<th>Intervention</th>
<th>Number of included studies and participants</th>
<th>Summary of findings</th>
<th>Consistency and precision</th>
<th>Other limitations</th>
<th>Strength of evidence</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Health outcomes</td>
<td>Combined pharm and behavioral</td>
<td>0</td>
<td>NA------------------------------------------------------------------------------------------------------</td>
<td>NA</td>
<td>NA</td>
<td>Insufficient</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Pharm</td>
<td>0</td>
<td>NA------------------------------------------------------------------------------------------------------</td>
<td>NA</td>
<td>NA</td>
<td>Insufficient</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Behavioral</td>
<td>1 review (1 RCT, n=1445)</td>
<td>One trial found favorable effects on all-cause and coronary disease mortality and lung cancer incidence and mortality 20 years following an intensive behavioral intervention, although results were not statistically significant.</td>
<td>NA</td>
<td>Only one review reported the results of one intervention in men. Within that trial, the rate of smoking among control group participants declined steadily over the followup period, narrowing the intervention effect.</td>
<td>Low evidence of potential benefit</td>
<td>One trial conducted among civil servant men aged 40-59 years in the UK with high risk of cardiorespiratory disease. Intervention took place in the 1970's.</td>
</tr>
<tr>
<td></td>
<td>Electronic cigarettes</td>
<td>0 RCTs</td>
<td>NA------------------------------------------------------------------------------------------------------</td>
<td>NA</td>
<td>NA</td>
<td>Insufficient</td>
<td>NA</td>
</tr>
<tr>
<td>2: Cessation outcomes</td>
<td>Combined pharm and behavioral</td>
<td>1 review (53 RCTs, n=25,375)</td>
<td>Combined pharmacotherapy and behavioral interventions increased smoking quit rates by 68-98% compared with no or minimal treatment (RR 1.83 [95% CI, 1.68 to 1.98]) at 6 months or more followup.</td>
<td>Reasonably consistent</td>
<td>May be risk of bias due to lack of blinding of participants.</td>
<td>High evidence of benefit²</td>
<td>Treatment effects appear to be comparable in a range of populations, settings and types of interventions and in smokers with and without other co-morbidities. The literature almost exclusively addressed treatment for cigarette smoking, as opposed to the use of other forms of tobacco, so results may not be generalizable to...</td>
</tr>
</tbody>
</table>
Table 13. Summary of Evidence for the General Adult Population

<table>
<thead>
<tr>
<th>Key question</th>
<th>Intervention</th>
<th>Number of included studies and participants</th>
<th>Summary of findings</th>
<th>Consistency and precision</th>
<th>Other limitations</th>
<th>Strength of evidence†</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharm</td>
<td>NRT, bupropion, and varenicline significantly improved the chances of quitting smoking compared with placebo or no medication. Reviews suggested that NRT might increase smoking abstinence at 6 months or longer by 49-61% (RR 1.55 [95% CI, 1.49 to 1.61]); bupropion by 49-76% (RR 1.62 [95% CI, 1.49 to 1.76]); and varenicline by 106-143% (RR 2.24 [95% CI, 2.06 to 2.43]). Absolute quit differences averaged 6.4% for NRT; 8.2% for bupropion, and 14.5% for varenicline. Using a combination of NRT products increased quitting more than the use of a single NRT product (RR 1.25 [95% CI, 1.15 to 1.36]). Direct comparisons between drugs suggested that varenicline may be superior to NRT and bupropion in achieving smoking abstinence at 6 months or longer.³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reasonably consistent</td>
<td>Reasonably precise</td>
<td>Possibility of publication bias but unlikely that the presence of additional studies with lower relative risks would alter the findings given large number of studies and consistency in findings for each type of drug.</td>
<td>High evidence of benefit§</td>
<td>Treatment effects appear to be comparable in a range of populations, settings and types of interventions and in smokers with and without other co-morbidities. The literature almost exclusively addressed treatment for cigarette smoking, as opposed to the use of other forms of tobacco, so results may not be generalizable to all forms of tobacco.</td>
<td>all forms of tobacco.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 13. Summary of Evidence for the General Adult Population

<table>
<thead>
<tr>
<th>Key question</th>
<th>Intervention</th>
<th>Number of included studies and participants</th>
<th>Summary of findings</th>
<th>Consistency and precision</th>
<th>Other limitations</th>
<th>Strength of evidence</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral</td>
<td>20 reviews (830 RCTs, n&gt;500,000)</td>
<td>Health provider advice and counseling, individual counseling, group-based interventions, telephone counseling, mobile phone-based interventions, tailored and interactive internet-based interventions, and incentives showed significant increased smoking cessation at 6 or more months relative to controls (15% to 88%). For example, for physician advice versus minimal controls or usual care: RR 1.76 (95% CI, 1.58 to 1.96). Providing more intense adjunctive behavioral support to smokers receiving pharmacotherapy may increase cessation by 8-22% (RR 1.15 [95% CI, 1.08 to 1.22]). Evidence on the use of motivational interviewing, decision aids, print-based, nontailored self-help materials, real-time video counseling, biomedical risk assessment, exercise, complementary and alternative therapies, and system-level interventions was limited and not definitive in the effects on cessation.</td>
<td>Reasonably consistent Reasonably precise</td>
<td>Individual trials may be represented in more than one review and/or meta-analysis. Indication of possible publication bias for evidence related to motivational interviewing and acupuncture. Fixed-effects models were used in nearly all meta-analyses.</td>
<td>Moderate to High evidence of benefit</td>
<td>Treatment effects appear to be comparable in a range of populations, settings and types of interventions and in smokers with and without other co-morbidities. The literature almost exclusively addressed treatment for cigarette smoking, as opposed to the use of other forms of tobacco, so results may not be generalizable to all forms of tobacco.</td>
<td></td>
</tr>
</tbody>
</table>
Table 13. Summary of Evidence for the General Adult Population

<table>
<thead>
<tr>
<th>Key question</th>
<th>Intervention</th>
<th>Number of included studies and participants</th>
<th>Summary of findings</th>
<th>Consistency and precision</th>
<th>Other limitations</th>
<th>Strength of evidence</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relapse prevention</td>
<td>1 review (77 RCTs, n=67,285)</td>
<td>Analyses of behavioral interventions among abstainers did not detect an effect in both studies of assisted abstainers (RR 0.99 [95% CI, 0.87 to 1.13]; I²=56%; k=10; n=5408) and unaided abstainers (RR 1.06 [95% CI, 0.96 to 1.16]; I²=1%; k=5; n=3561) from the general population. There was some evidence that extending varenicline could be beneficial in preventing relapse, but it was only reported by two studies. NRT was found to help in unassisted abstainers, but no difference was seen among those who achieved abstinence with NRT. None of the six studies that examined the use of bupropion to prevent relapse found a statistically significant effect.</td>
<td>Inconsistent</td>
<td>Highly variable study designs and included interventions.</td>
<td>Moderate evidence of no benefit of behavioral interventions on relapse prevention</td>
<td>Studies were highly heterogenous and may not be applicable to the general adult population.</td>
<td></td>
</tr>
<tr>
<td>Key question</td>
<td>Intervention</td>
<td>Number of included studies and participants</td>
<td>Summary of findings</td>
<td>Consistency and precision</td>
<td>Other limitations</td>
<td>Strength of evidence</td>
<td>Applicability</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------</td>
<td>---------------------------------------------</td>
<td>--------------------</td>
<td>--------------------------</td>
<td>------------------</td>
<td>---------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>3: Harms</td>
<td>Combined pharm and behavioral</td>
<td>0 reviews</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Moderate evidence of no harms*</td>
<td>NA</td>
</tr>
<tr>
<td>Pharm</td>
<td>15 reviews*</td>
<td>NRT, bupropion, and varenicline were not associated with an increased risk in major CV or neuropsychiatric adverse events. NRT was associated with a higher rate of any CV adverse events largely driven by low-risk events, typically bradycardia and arrhythmia. There was no evidence of a difference in harms</td>
<td>Reasonably consistent</td>
<td>Reasonably precise</td>
<td>Many trials that report cessation effectiveness do no report AEs, particularly CV- or neuropsychiatric-specific AEs. AEs typically measured through passive reporting and</td>
<td>Moderate evidence of no serious harms</td>
<td>Findings appear applicable across populations and settings, including among patients with severe mental illness.</td>
</tr>
</tbody>
</table>

**Table 13. Summary of Evidence for the General Adult Population**
Table 13. Summary of Evidence for the General Adult Population

<table>
<thead>
<tr>
<th>Key question</th>
<th>Intervention</th>
<th>Number of included studies and participants</th>
<th>Summary of findings</th>
<th>Consistency and precision</th>
<th>Other limitations</th>
<th>Strength of evidence‡</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Behavioral</td>
<td>3 reviews*</td>
<td>There was no evidence that behavioral tobacco cessation interventions are associated with serious adverse events.</td>
<td>NA</td>
<td>Very few reviews assessed AEs related to behavioral interventions.</td>
<td>Moderate evidence of no harms**</td>
<td>Limited evidence on harms limits applicability.</td>
</tr>
<tr>
<td></td>
<td>Electronic cigarettes</td>
<td>8 RCTs (n=3792)</td>
<td>No trials reported serious AEs in either the intervention or control groups related to product use and no significant differences in the frequency of AEs among study groups. Coughing, nausea, throat irritation and sleep disruption were the most commonly reported side effects of e-cig use.</td>
<td>Reasonably consistent</td>
<td>Limited statistical power to detect differences and differential loss to followup in all three trials (22-39%).</td>
<td>Insufficient</td>
<td>The two US trials had the lowest enrollment (&lt;100 participants). Two trials used older models of e-cigs, one of which is no longer available, one trial used an e-cig that is not available in US markets, and one trial used a prototype.</td>
</tr>
</tbody>
</table>

* Number of included studies reflects the number of systematic reviews designated as primary evidence for that body of evidence as well as the summed total number of included studies and observations from each review.
† For our review-of-reviews method, we adopted the strength of the overall body of evidence assigned within the primary systematic review. In most cases, these grades were based on the Grading of Recommendations Assessment, Development and Evaluation (GRADE) working group definitions which consider study limitations, consistency of effect, imprecision, indirectness and publication bias. Where strength of evidence grades were not available, we adapted the EPC approach to assign an overall strength of evidence grade based on consensus discussions involving at least two reviewers.80
‡ Some evidence of asymmetry in a funnel plot; excess of small trials detecting larger effects. However, in a sensitivity analysis, removing smaller studies did not markedly decrease the pooled estimate.
§ Sensitivity analysis including only those studies judged to be a low risk of bias did not impact the pooled results for any comparison; for NRT and bupropion, the funnel plots showed some evidence of asymmetry. However, given the large number of trials in these reviews, this does not suggest the results would be altered significantly were smaller studies with lower RRs included.
¶ Evidence from existing systematic reviews as well as the EAGLES trial indicate that adult smokers randomized to varenicline have a statistically significant higher likelihood of quitting smoking at 6 months compared with those randomized to NRT or bupropion. In the EAGLES trial (n=8144) 21.8% of smokers randomized to varenicline quit smoking at 6 months compared with 15.7% randomized to NRT (OR 1.52 [95% CI 1.29 to 1.78]) and 16.2% randomized to bupropion (OR 1.45 [95% CI, 1.24 to 1.70]).800
‖ Evidence for the specific type of intervention, but generally reflects moderate to high certainty grades. Most common reasons for downgraded the quality of evidence were unexplained statistical heterogeneity, several studies with high or unclear risk of bias, or inconsistency in the evidence base.
Table 13. Summary of Evidence for the General Adult Population

# Total number of studies and observations not estimated
** Despite the relatively limited number of reviews that reported harms related to interventions, we are moderately confident that there are no serious harms related to combined pharmacotherapy and behavioral counseling interventions or behavioral counseling alone for tobacco cessation.

Abbreviations: AE = adverse event; CI = confidence interval; CV = cardiovascular; e-cig = electronic cigarette; mg = milligrams; NA = not applicable; NRT = nicotine replacement therapy; pharm = pharmacotherapy; RCT = randomized controlled trial; RR = risk ratio; UK = United Kingdom; US = United States
<table>
<thead>
<tr>
<th>Key Question</th>
<th>Intervention</th>
<th>Number of included studies*</th>
<th>Summary of findings</th>
<th>Consistency and precision</th>
<th>Other limitations</th>
<th>Strength of evidence†</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Health outcomes</td>
<td>Pharm</td>
<td>6 RCTs (n=2131)</td>
<td>Limited evidence of NRT on perinatal and child health benefits. Four placebo controlled NRT trials reported preterm births with the three largest trials reporting effects close to null and one reporting reduced risk with NRT. These four trials also reported birthweight; the two largest placebo-controlled trials reported no difference with NRT, and two trials reported higher mean birthweights associated with NRT. The risk for low birthweight was lower in the smallest trial, and results were mixed but null for the others. Followup data from the largest NRT trial found higher rate of 'survival with no impairment' at 2 years among children of women assigned to NRT intervention vs placebo (73% vs 65%; OR 1.40 [95% CI 1.05 to 1.86]). No trials of bupropion or varenicline among pregnant women.</td>
<td>Inconsistent</td>
<td>Rare health outcomes and few trials of NRT limited statistical precision and ability to draw conclusions. Limited information on the women approached for participation that declined, and low participation rates. Timing of the final antenatal assessment varied considerably among trials which may affect the amount of time women were exposed to the intervention as well as those lost to followup and measurement of perinatal outcomes.</td>
<td>Insufficient evidence for birth outcomes and child health outcomes</td>
<td>Trials mainly conducted in high-income countries including the US, relevant and applicable. Pharmacotherapy trials were mostly placebo controlled and outcomes based on well-established measures used in routine health care settings, likely applicable results. Given stigma of smoking during pregnancy, challenging to recruit pregnant smokers. Those who disclose smoking status and willing to participate in trials may differ from general population (e.g., motivation to quit).</td>
</tr>
<tr>
<td>Behavioral</td>
<td>1 review (26 RCTs, n=12,338)</td>
<td>Suggestive benefit of behavioral interventions on mean birthweight (mean difference, 55.60 [95% CI. 29.82 to 81.38])</td>
<td>Reasonably consistent</td>
<td>High evidence of potential benefit on mean birthweight and...</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 14. Summary of Evidence for Pregnant Women

<table>
<thead>
<tr>
<th>Key Question</th>
<th>Intervention</th>
<th>Number of included studies*</th>
<th>Summary of findings</th>
<th>Consistency and precision</th>
<th>Other limitations</th>
<th>Strength of evidence†</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electronic cigarettes</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Insufficient</td>
<td>NA</td>
</tr>
<tr>
<td>2: Cessation outcomes</td>
<td>Pharm</td>
<td>No statistical evidence of NRT efficacy for validated smoking cessation in late pregnancy (RR 1.17, 95% CI 0.78 to 1.76) in pooled analysis of four placebo-controlled trials. Limited power, and all trials in the direction of benefit including two trials with no NRT control conditions. No trials of bupropion or varenicline among pregnant women. The pooled estimate from 97 trials suggested an increased risk and low birthweight (RR 0.83 [95% CI 0.72 to 0.94]), vs. usual care or control. Uncertain evidence on the effect of behavioral interventions on preterm birth (RR 0.93 [95% CI, 0.77 to 1.11]) and stillbirths (RR 1.20 [95% CI, 0.76 to 1.90]).</td>
<td>Reasonably consistent Imprecise</td>
<td>Limited information on the women approached for participation that declined, and low participation rates.</td>
<td>Low evidence of no benefit</td>
<td>Low evidence of no benefit</td>
<td>Trials mainly conducted in high-income countries including the US, relevant and applicable. Pharmacotherapy trials were mostly placebo controlled and outcomes based on well-established measures used in routine health care settings, likely applicable results. Given stigma of smoking during pregnancy, challenging to recruit pregnant smokers. Those</td>
</tr>
<tr>
<td></td>
<td>Behavioral</td>
<td>Reasonably consistent Reasonably precise</td>
<td>Minimal information on the number of women who</td>
<td>Moderate evidence of benefit</td>
<td>Moderate evidence of benefit</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 14. Summary of Evidence for Pregnant Women

<table>
<thead>
<tr>
<th>Key Question</th>
<th>Intervention</th>
<th>Number of included studies*</th>
<th>Summary of findings</th>
<th>Consistency and precision</th>
<th>Other limitations</th>
<th>Strength of evidence†</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>of quitting smoking in late pregnancy for psychosocial interventions compared with controls (RR 1.35 [95% CI, 1.23 to 1.48]), with a similar benefit when limited to the most common intervention (counseling) versus usual care (RR 1.44 [95% CI 1.19 to 1.73])</td>
<td></td>
<td></td>
<td>Consistency and precision were eligible for inclusion or were approached to take place in the trials.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Timing of the final antenatal assessment of smoking status varied considerably among trials which may affect the amount of time women were exposed to the intervention as well as those lost to followup.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity was moderate for the pooled effect (44%), but there was no definitive evidence of subgroup effects by study, population, or intervention characteristics.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relapse prevention</td>
<td>Relapse prevention</td>
<td>Inconsistent Imprecise</td>
<td>Variable interventions tested</td>
<td>Low evidence of no benefit of behavioral interventions</td>
<td>Low evidence of no benefit of behavioral interventions</td>
<td></td>
<td>who disclose smoking status and willing to participate in trials may differ from general population (e.g., motivation to quit).</td>
</tr>
<tr>
<td>Key Question</td>
<td>Intervention</td>
<td>Number of included studies*</td>
<td>Summary of findings</td>
<td>Consistency and precision</td>
<td>Other limitations</td>
<td>Strength of evidence†</td>
<td>Applicability</td>
</tr>
<tr>
<td>--------------</td>
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<td>---------------------</td>
<td>--------------------------</td>
<td>------------------</td>
<td>----------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Electronic cigarettes</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>N/A</td>
<td>Insufficient</td>
<td>NA</td>
</tr>
<tr>
<td>KQ3: Harms</td>
<td>Pharm</td>
<td>6 RCTs (n=2131) 3 cohort studies (n=306,721)</td>
<td>Limited evidence of perinatal harms from NRT; mixed findings on birth outcomes from trials, but most in direction of benefit rather than harm (KQ 1). Two-year followup from one NRT trial did not suggest harms (KQ 1). Observational evidence did not indicate harms of stillbirth or low birthweight associated with NRT; one study with limited precision and multiple comparison groups suggested a possible association of NRT with attention deficit hyperactivity disorder. No trials of bupropion or varenicline among pregnant women.</td>
<td>Inconsistent Imprecise</td>
<td>Few trials of NRT and not all reported consistently on health outcomes and adverse events. Observational studies may not be able to fully account for confounding, substantial differences across a range of population characteristics among comparison groups.</td>
<td>Low evidence of no harm</td>
<td>Trials mainly conducted in high-income countries including the US, relevant and applicable.</td>
</tr>
<tr>
<td>Behavioral</td>
<td>1 review (13 RCTs, n=5831)</td>
<td>There did not appear to be any adverse effects from the psychosocial interventions. Five of 13 trials evaluating psychological impact reported an improvement in women's psychological well-being and none reported a negative impact.</td>
<td>Reasonably consistent Reasonably precise</td>
<td>Measures of adverse events rarely reported; most reliant on passive reporting.</td>
<td>Moderate evidence of no harm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic cigarettes</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>N/A</td>
<td>Insufficient</td>
<td>NA</td>
</tr>
</tbody>
</table>
Table 14. Summary of Evidence for Pregnant Women

* Number of included studies reflects the number of systematic reviews designated as primary evidence for that body of evidence as well as the summed total number of included studies and observations from each review.
† For our review-of-reviews method, we adopted the strength of the overall body of evidence assigned within the primary systematic review. In most cases, these grades were based on the Grading of Recommendations Assessment, Development and Evaluation (GRADE) working group definitions which consider study limitations, consistency of effect, imprecision, indirectness and publication bias. Where strength of evidence grades were not available, we adapted the EPC approach to assign an overall strength of evidence grade based on consensus discussions involving at least two reviewers.80

**Abbreviations:** NA = not applicable; NRT = nicotine replacement therapy; pharm = pharmacotherapy; US = United States; vs = versus.
Appendix A. Detailed Methods

Literature Search Strategies for Review of Reviews: Tobacco Cessation in Adults

Sources searched (2014-present):
Agency for Healthcare Research and Quality
Canadian Agency for Drugs and Technologies in Health
Cochrane Database of Systematic Reviews
Community Guide
Database of Abstracts of Reviews of Effects
Health Technology Assessment
Health and Medicine Division (HMD) of the National Academies of Sciences, Engineering, and Medicine (formerly Institute of Medicine)
NHS Health Technology Assessment Programme
PsycINFO
PubMed
Surgeon General

Canadian Agency for Drugs and Technologies in Health
Pharmacological based strategies for Smoking Cessation (2016)
https://cadth.ca/pharmacologic-based-strategies-smoking-cessation

Integrated cessation program for adults who smoke cannabis and tobacco: Clinical effectiveness and guidelines (2017)

Smoking cessation interventions for patients with severe mental illnesses: A review of clinical effectiveness and guidelines (2017)

Cochrane Database of Systematic Reviews
Issue 5 of 12, May 2019

#1 tobacco:ti 1800
#2 smoking:ti 8736
#3 smoker*:ti 3237
#4 smokeless:ti 167
#5 nicotine:ti 2830
#6 cigar*:ti 1822
#7 (vape or vaping or vapour):ti 148
#8 #1 or #2 or #3 or #4 or #5 or #6 or #7 with Cochrane Library publication date Between Jan 2014 and Dec 2019, in Cochrane Reviews, Cochrane Protocols 67

NHS HTA Programme
Pharmacological interventions for promoting smoking cessation during pregnancy 2018 [in progress]
https://www.journalslibrary.nihr.ac.uk/programmes/sr/NIHR128783/#/
Appendix A. Detailed Methods

Relapse prevention interventions for smoking cessation (2019) [waiting to start]
https://www.journalslibrary.nihr.ac.uk/programmes/sr/NIHR128787/#/

https://www.journalslibrary.nihr.ac.uk/programmes/phr/134202/#/

A multi-centred Trial of physical Activity assisted Reduction of Smoking (TARS) (2017)
https://www.journalslibrary.nihr.ac.uk/programmes/hta/1511101/#/

https://www.journalslibrary.nihr.ac.uk/programmes/hta/0916101/#/

Helping pregnant smokers quit: Multi-centre RCT of electronic cigarettes vs usual care. (2017)[in progress]
https://www.journalslibrary.nihr.ac.uk/programmes/hta/155785/#/

A randomised controlled trial to examine the efficacy of e-cigarettes compared with nicotine replacement therapy, when used within the UK stop smoking service (2014) [waiting to publish]
https://www.journalslibrary.nihr.ac.uk/programmes/hta/12167135/#/

A randomised trial to increase the uptake of smoking cessation services using Personal Targeted risk information and Taster Sessions (2017)
https://www.journalslibrary.nihr.ac.uk/programmes/hta/085802/#/

Barriers and facilitators to smoking cessation in pregnancy and following childbirth: literature review and qualitative study (2017)
https://www.journalslibrary.nihr.ac.uk/programmes/hta/119301/#/

Exploring the uptake and use of electronic cigarettes provided to smokers accessing homeless centres: a feasibility study (2018) [in progress]
https://www.journalslibrary.nihr.ac.uk/programmes/phr/174429/#/

A pragmatic randomised controlled trial of physical activity as an aid to smoking cessation during pregnancy. (2015)
https://www.journalslibrary.nihr.ac.uk/programmes/hta/070114/#/

Feasibility randomised controlled trial of a smoking cessation smartphone app that delivers ’context aware’ behavioural support in real time (2019)
https://www.journalslibrary.nihr.ac.uk/programmes/phr/179231/#/

The London Exercise And Pregnant smokers (LEAP) trial: a randomised controlled trial of physical activity for smoking cessation in pregnancy with an economic evaluation (2015)
https://www.journalslibrary.nihr.ac.uk/hta/hta19840/#/abstract

Nicotine preloading for smoking cessation: the Preloading RCT (2018)
https://www.journalslibrary.nihr.ac.uk/hta/hta22410/#/abstract
Appendix A. Detailed Methods

Smoking Cessation Intervention for Severe Mental Ill Health Trial (SCIMITAR): a definitive randomised evaluation of a bespoke smoking cessation service (2015)
https://www.journalslibrary.nihr.ac.uk/programmes/hta/1113652/#/

Mixed methods systematic review to identify the determinants of nicotine replacement therapy use and of vaping in pregnancy (2018)
https://www.journalslibrary.nihr.ac.uk/programmes/sr/NIHR128785/#/

PubMed search strategy

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<tr>
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<th>Query</th>
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<tr>
<td>#11</td>
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<td>963</td>
</tr>
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<td>#10</td>
<td>Search #7 AND #9 AND (&quot;2014&quot;[Date - Publication] : &quot;3000&quot;[Date - Publication]) AND English[Language]</td>
<td>963</td>
</tr>
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<td>436</td>
</tr>
<tr>
<td>#7</td>
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<td>67420</td>
</tr>
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</tr>
<tr>
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</tr>
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</tr>
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Appendix A. Detailed Methods

<table>
<thead>
<tr>
<th>Search</th>
<th>Query</th>
<th>Items found</th>
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</table>

**PsycINFO <1806 to April Week 4 2019>**

1. exp Tobacco Smoking/ (29913)
2. exp Smoking Cessation/ (12420)
3. exp Smokeless Tobacco/ (792)
4. exp Electronic Cigarettes/ (909)
5. (smoking or smoker* or tobacco or nicotine or cigar* or vape or vaping or vapour or smokeless).ti. (34380)
6. 1 or 2 or 3 or 4 or 5 (39898)
7. limit 6 to "300 adulthood <age 18 yrs and older>" (22887)
8. limit 7 to ("0830 systematic review" or 1200 meta analysis) (95)
9. limit 8 to (english language and yr="2014-Current") (46)

**Literature Search Strategies for Primary Literature: Tobacco Cessation in Adults: Electronic Cigarettes**

Sources searched:
Cochrane Central Register of Controlled Clinical Trials, via Wiley
PsycInfo, via Ovid
PubMed
Scopus

Key:
* = truncation
ab = word in abstract
id = keyword
kf = keyword heading [word not phrase indexed]
kw = keyword
ti = word in title

**CENTRAL**
Issue 5 of 12, May 2019

#1 (electronic next cigarette*):ti,ab,kw 207
#2 (e next cigarette*):ti,ab,kw 177
#3 "electronic nicotine":ti,ab,kw 74
#4 (e next liquid):ti,ab,kw 16
#5 (vape or vaping):ti,ab,kw 34
#6 (vaporizer* or vapourizer*):ti,ab,kw 2023
#7 (nicotine or tobacco or cigar*):ti,ab,kw 11896
Appendix A. Detailed Methods

#8  #6 and #7  42
#9  #1 or #2 or #3 or #4 or #5 or #8 Publication Year from 2013 to 2018  261

PsycINFO
<1806 to May Week 3 2019>

<table>
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<th>Query</th>
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</tr>
<tr>
<td>#8</td>
<td>Search #6 NOT #7</td>
</tr>
<tr>
<td>#7</td>
<td>Search &quot;Animals&quot;[Mesh] NOT (&quot;Animals&quot;[Mesh] AND &quot;Humans&quot;[Mesh])</td>
</tr>
<tr>
<td>#6</td>
<td>Search #1 OR #2 OR #3 OR #4 OR #5</td>
</tr>
<tr>
<td>#5</td>
<td>Search (vaporizer*[tiab] OR vapourizer*[tiab]) AND (nicotine[tiab] OR tobacco[tiab] OR cigar*[tiab])</td>
</tr>
<tr>
<td>#4</td>
<td>Search vape[tiab] OR vaping[tiab]</td>
</tr>
<tr>
<td>#3</td>
<td>Search e-liquid[tiab]</td>
</tr>
<tr>
<td>#1</td>
<td>Search (&quot;Electronic Nicotine Delivery Systems&quot;[Mesh:NoExp]) OR &quot;Vaping&quot;[Mesh:NoExp]</td>
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</table>

Scopus
6 #1 OR #2 OR #3 OR #4 OR #5 AND ( LIMIT-TO ( PUBYEAR , 2018 ) OR LIMIT-TO ( PUBYEAR , 2017 ) OR LIMIT-TO ( PUBYEAR , 2016 ) OR LIMIT-TO ( PUBYEAR , 2015 ) OR LIMIT-TO ( PUBYEAR , 2014 ) OR LIMIT-TO ( PUBYEAR , 2013 ) ) AND LIMIT-TO ( LANGUAGE , "English" )

5 ( TITLE-ABS-KEY ( vaporizer* OR vapourizer* ) AND TITLE-ABS-KEY ( nicotine OR tobacco OR cigar* ) )

4 TITLE-ABS-KEY (( vape OR vaping )
Appendix A. Detailed Methods

3 TITLE-ABS-KEY ( "electronic nicotine" )

2 TITLE-ABS-KEY ( "electronic cigarette*" )

1 TITLE-ABS-KEY ( "e cigarette*" )

Literature Search Strategies for Primary Literature: Tobacco Cessation in Adults: Pharmacologic Interventions in Pregnant Women

Sources searched:
Cochrane Central Register of Controlled Clinical Trials, via Wiley
MEDLINE, via Ovid
PsycInfo, via Ovid
PubMed, publisher-supplied

Key:
* = truncation
$ = truncation
ab = word in abstract
exp = explode
id = keyword
kf = keyword heading [word not phrase indexed]
kw = keyword
sb=sbset
ti = word in title

CENTRAL
Issue 3 of 12, May 2019

#1 (pregnan* or prenatal or "pre natal" or perinatal or "peri natal" or antenatal or "ante natal" or antepartum or "ante partum" or postnatal or "post natal" or postpartum or "post partum" or puerperal):ti,ab,kw 43587
#2 nicotine:ti,ab,kw next replacement*:ti,ab,kw 1050
#3 nicotine:ti,ab,kw near/3 (transdermal or intravenous* or patch* or gum* or spray* or inhaler* or lozenge*):ti,ab,kw 1728
#4 (Nicotrol or Nicoderm or Habitrol or Prostep or Nicorette):ti,ab,kw 72
#5 (Bupropion or Wellbutrin or Zyban or Varenicline or Chantix or Champix):ti,ab,kw 1685
#6 pharm*:ti and (smoking or smoker* or tobacco or nicotine or cigarette*):ti,ab,kw 475
#7 #2 or #3 or #4 or #5 or #6 4066
#8 #1 and #7 Publication Year from 2014 to 2019 39
Appendix A. Detailed Methods

Medline
Database: Ovid MEDLINE(R) <1946 to April Week 4 2019>, Ovid MEDLINE(R) Epub Ahead of Print <April 30, 2019>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <April 30, 2019>, Ovid MEDLINE(R) Daily Update <April 30, 2019>

1. Pregnancy/
2. Pregnant women/
3. Prenatal care/
4. Perinatal care/
5. Postnatal care/
6. Postpartum period/
7. Puerperal period/
8. Maternal Health Services/
9. Pregnancy complications/
10. Puerperal Disorders/
11. pregnancy.ti,ab,kf.
12. prenatal.ti,ab,kf.
13. perinatal.ti,ab,kf.
14. prenatal.ti,ab,kf.
15. perinatal.ti,ab,kf.
16. antenatal.ti,ab,kf.
17. ante natal.ti,ab,kf.
18. antepartum.ti,ab,kf.
19. antepartum.ti,ab,kf.
20. postnatal.ti,ab,kf.
21. post natal.ti,ab,kf.
22. postpartum.ti,ab,kf.
23. post partum.ti,ab,kf.
24. new mother.ti,ab,kf.
25. puerperal.ti,ab,kf.
26. or/1-25
27. "Tobacco Use Cessation Products"/
28. Nicotinic Agonists/
29. Bupropion/
30. Varenicline/
31. nicotine replacement$.ti,ab,kf.
32. (nicotine adj3 (transdermal or intravenous$ or patch$ or gum$ or nasal spray$ or inhaler$ or lozenge$)).ti,ab,kf.
33. (Nicotrol or Nicoderm or Habitrol or Prostep or Nicorette).ti,ab,kf.
34. (Bupropion or Wellbutrin).ti,ab,kf.
35. Zyban.ti,ab,kf.
36. Varenicline.ti,ab,kf.
37. Chantix.ti,ab,kf.
38. Champix.ti,ab,kf.
39. pharm$.ti. and (smoking or smoker$ or tobacco or nicotine or cigarette$).ti,ab,kf.
40. stop smoking med$.ti,ab,kf.
41. "Tobacco Use Disorder"/dt or smoking/dt or cigarette smoking/dt or "tobacco use"/dt
42. or/27-41
43. 26 and 42
44. Animals/ not (Humans/ and Animals/)
Appendix A. Detailed Methods

45. 43 not 44
46. limit 45 to (english language and yr="2014 -Current")
47. remove duplicates from 46

PsycInfo
Database: PsycINFO <1806 to April Week 4 2019>

1 Pregnancy/ (20369)
2 Expectant Mothers/ (607)
3 Prenatal Care/ (1666)
4 Perinatal Period/ (2376)
5 Postnatal Period/ (4119)
6 pregnan$.ti,ab,id. (42745)
7 prenatal.ti,ab,id. (17646)
8 pre natal.ti,ab,id. (239)
9 perinatal.ti,ab,id. (9399)
10 peri natal.ti,ab,id. (66)
11 antenatal.ti,ab,id. (3071)
12 ante natal.ti,ab,id. (51)
13 antepartum.ti,ab,id. (299)
14 ante partum.ti,ab,id. (10)
15 postnatal.ti,ab,id. (18433)
16 post natal.ti,ab,id. (1010)
17 postpartum.ti,ab,id. (10569)
18 post partum.ti,ab,id. (1113)
19 puerperal.ti,ab,id. (488)
20 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19
(77809)
21 tobacco smoking/ (28653)
22 smoking cessation/ (11949)
23 Smokeless tobacco/ (754)
24 Nicotine.ti,ab,id. (15159)
25 (smoking or smoker$ or tobacco or nicotine or cigarette$).ti,ab,id. (62558)
26 21 or 22 or 23 or 24 or 25 (62757)
27 Drug Therapy/ or pharm$.ti. (137803)
28 26 and 27 (3136)
29 Bupropion/ (907)
30 nicotine replacement$.ti,ab,id. (1558)
31 (nicotine adj3 (transdermal or intravenous$ or patch$ or gum$ or nasal spray$ or inhaler$ or lozenge$)).ti,ab,id. (1689)
32 (Nicotrol or Nicoderm or Habitrol or Prostep or Nicorette).ti,ab,id. (46)
33 (Bupropion or Wellbutrin).ti,ab,id. (2037)
34 Zyban.ti,ab,id. (44)
35 Varenicline.ti,ab,id. (707)
36 Chantix.ti,ab,id. (39)
37 Champix.ti,ab,id. (16)
38 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 (6953)
39 20 and 38 (226)
40 limit 39 to (english language and yr="2014 -Current") (62)
Appendix A. Detailed Methods

**PubMed, publisher-supplied records**

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<tr>
<th>Search</th>
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<td>Search #1 AND #7</td>
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<tr>
<td>#2</td>
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<td>3015</td>
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## Appendix A Table 1. Inclusion and Exclusion Criteria

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<thead>
<tr>
<th>Category</th>
<th>Include</th>
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<tbody>
<tr>
<td><strong>Aim</strong></td>
<td>Tobacco cessation in adults who currently use tobacco, regardless of readiness to quit, including relapse prevention</td>
<td>• Primary prevention of tobacco use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tobacco harm–reduction strategies</td>
</tr>
<tr>
<td><strong>Condition</strong></td>
<td>Current use of any tobacco product, including but not limited to: cigarettes, e-cigarettes and other electronic nicotine delivery systems (ENDS), cigars, cigarillos and filtered cigars, smokeless tobacco (including snus pouches), pipe tobacco, dissolvable tobacco in the form of strips, sticks, or lozenges, or smoking tobacco through a hookah or waterpipe</td>
<td></td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td>Adults (age ≥18 years), including pregnant women who currently use tobacco</td>
<td>Reviews limited to:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Children and adolescents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Persons with other comorbid health conditions (e.g., chronic obstructive pulmonary disease, cardiovascular conditions, cancer, HIV)</td>
</tr>
<tr>
<td><strong>Interventions</strong></td>
<td>Primary care–relevant tobacco cessation interventions that can be provided in primary care or are feasible to refer to from primary care, including pharmacotherapy, behavioral interventions, and e-cigarettes or ENDS, alone or in combination.</td>
<td>Broad public health initiatives (e.g., mass media, communitywide campaigns)</td>
</tr>
<tr>
<td><strong>Setting</strong></td>
<td>Any setting applicable to primary care, including interventions that take place in settings that can be referred to from primary care</td>
<td>Reviews limited to studies that take place in worksites, churches, or other settings where participants have existing social connections</td>
</tr>
<tr>
<td><strong>Comparators</strong></td>
<td>• No intervention</td>
<td>Population-based smoking rates (i.e., not based on study sample but on underlying population)</td>
</tr>
<tr>
<td></td>
<td>• Usual care</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Waitlist</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Attention control (e.g., intervention is similar in format and intensity but on a different content area)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Minimal intervention (no more than a single brief contact [i.e., &lt;5 minutes] per year, brief written materials, such as pamphlets, or self-help materials)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Active intervention (i.e., more than a single brief contact per year or brief written materials)</td>
<td></td>
</tr>
<tr>
<td><strong>Outcome assessment</strong></td>
<td>Based on self-report or biochemically validated reports (e.g., expired carbon monoxide; cotinine measured in saliva, urine, or blood; cotinine–creatinine ratio; thiocyanate)</td>
<td></td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
<td>KQ 1 (health and other outcomes):</td>
<td>Reviews that only report:</td>
</tr>
<tr>
<td></td>
<td>Health outcomes:</td>
<td>• Reduction in smoking/tobacco (based on frequency/quantity only)</td>
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<tr>
<td></td>
<td>• All-cause mortality</td>
<td>• Reduction in withdrawal symptoms</td>
</tr>
<tr>
<td></td>
<td>• Tobacco-related mortality</td>
<td>• Attitudes, knowledge, or beliefs related to tobacco use</td>
</tr>
<tr>
<td></td>
<td>• Tobacco-related morbidity (including, but not limited to: cancer, asthma, cardiovascular disease, chronic bronchitis, or other respiratory disorders)</td>
<td>• Intentions to change behavior</td>
</tr>
<tr>
<td></td>
<td>• Maternal and perinatal morbidity/mortality</td>
<td>• Intervention participation/compliance</td>
</tr>
<tr>
<td></td>
<td>• Dental/oral health</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Quality of life</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other outcomes:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Health care utilization</td>
<td></td>
</tr>
<tr>
<td><strong>KQ 2 (behavioral outcomes):</strong> Tobacco cessation/tobacco abstinence (continuous or point prevalence abstinence)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>KQ 3 (harms):</strong> Serious treatment-related harms at any time point after the intervention began</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Appendix A Table 1. Inclusion and Exclusion Criteria

<table>
<thead>
<tr>
<th>Category</th>
<th>Include</th>
<th>Exclude</th>
</tr>
</thead>
</table>
| Outcome assessment timing | **KQs 1, 2**: ≥6-month followup after quit date/start of intervention  
**KQ 3**: Harms reported at any point after quit date                                                                                                                                                                                                                                                                                                                                                     | <6-month followup after quit date or start of intervention                                      |
| Study design              | **Pharmacotherapy and behavioral interventions in adults and behavioral interventions in pregnant women (review-of-reviews)**:  
**All KQs**: Systematic reviews, including review-of-reviews, with or without meta-analysis. A review will be considered "systematic" if it: 1) includes a clear statement of the purpose of the review; 2) describes the search strategy; 3) indicates the criteria used to select studies for inclusion; and 4) presents the findings relevant to the main purpose of the review, including those that did not favor the intervention. Systematic reviews that include experimental and/or observational study designs will be included.  
**Pharmacotherapy in pregnant women; e-cigarette or ENDS interventions**  
**All KQs**: Randomized and nonrandomized controlled trials  
**KQ 3**: The above, plus observational cohort studies (n≥1,000)                                                                                                                                                                                                                                                                                      |                                                                                                                                                        |
| Study geography           | Reviews and primary studies that primarily take place in countries categorized as "Very High" on the Human Development Index (as defined by the United Nations Development Programme)                                                                                                                                                                                                                   | Reviews in which >50% of included studies take place in countries not categorized as "Very High" on the Human Development Index |
| Publication language      | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Any language other than English                                                                |
| Quality rating            | Fair- or good-quality studies                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Poor-quality studies                                                                          |
### Appendix A Table 2. Study-Design Quality Rating Criteria

<table>
<thead>
<tr>
<th>Study Design</th>
<th>Adapted Quality Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort studies*, adapted from Newcastle-Ottawa Scale&lt;sup&gt;184&lt;/sup&gt;</td>
<td><strong>Bias arising in randomization process or due to confounding</strong>&lt;br&gt;• Balance in baseline characteristics&lt;br&gt;• No baseline confounding&lt;br&gt;• No time-varying confounding&lt;br&gt;<strong>Bias in selecting participants into the study</strong>&lt;br&gt;• No evidence of biased selection of sample&lt;br&gt;• Start of followup and start of intervention coincide&lt;br&gt;<strong>Bias due to departures from intended interventions</strong>&lt;br&gt;• Participant intervention status is clearly and explicitly defined and measured&lt;br&gt;• Classification of intervention status is unaffected by knowledge of the outcome or risk of the outcome&lt;br&gt;<strong>Bias in classifying interventions</strong>&lt;br&gt;• Fidelity to intervention protocol&lt;br&gt;• Participants were analyzed as originally allocated&lt;br&gt;<strong>Bias from missing data</strong>&lt;br&gt;• Outcome data are reasonably complete and comparable between groups&lt;br&gt;• Confounding variables that are controlled for in analysis are reasonably complete&lt;br&gt;• Reasons for missing data are similar across groups&lt;br&gt;• Missing data are unlikely to bias results&lt;br&gt;<strong>Bias in measurement of outcomes</strong>&lt;br&gt;• Blinding of outcome assessors&lt;br&gt;• Outcomes are measured using consistent and appropriate procedures and instruments across treatment groups&lt;br&gt;• No evidence of biased use of inferential statistics&lt;br&gt;<strong>Bias in reporting results selectively</strong>&lt;br&gt;No evidence that the measures, analyses, or subgroup analyses are selectively reported</td>
</tr>
<tr>
<td>Randomized clinical trials*, adapted from U.S. Preventive Services Task Force Manual&lt;sup&gt;77&lt;/sup&gt;</td>
<td><strong>Bias arising in the randomization process or due to confounding</strong>&lt;br&gt;• Valid random assignment/random sequence generation method used&lt;br&gt;• Allocation concealed&lt;br&gt;• Balance in baseline characteristics&lt;br&gt;<strong>Bias in selecting participants into the study</strong>&lt;br&gt;• CCT only: No evidence of biased selection of sample&lt;br&gt;<strong>Bias due to departures from intended interventions</strong>&lt;br&gt;• Fidelity to the intervention protocol&lt;br&gt;• Low risk of contamination between groups&lt;br&gt;• Participants were analyzed as originally allocated</td>
</tr>
</tbody>
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## Appendix A Table 2. Study-Design Quality Rating Criteria

<table>
<thead>
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</table>
| **Bias from missing data** | - No, or minimal, post-randomization exclusions  
- Outcome data are reasonably complete and comparable between groups  
- Reasons for missing data are similar across groups  
- Missing data are unlikely to bias results |
| **Bias in measurement of outcomes** | - Blinding of outcome assessors  
- Outcomes are measured using consistent and appropriate procedures and instruments across treatment groups  
- No evidence of biased use of inferential statistics |
| **Bias in reporting results selectively** | - No evidence that the measures, analyses, or subgroup analyses are selectively reported |
| **Systematic review†, AMSTAR 2** | - Research questions and inclusion criteria for the review included components of PICO  
- Report of the review contained an explicit statement that the review methods were established prior to the conduct of the review and the report justified any significant deviations from the protocol  
- The selection of the study designs for inclusion in the review was explained  
- A comprehensive literature search strategy was used  
- Study selection was performed in duplicate  
- Data extraction in was performed duplicate  
- A list of excluded studies and justifications for the exclusions were provided  
- The included studies were described in adequate detail  
- A satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review was used  
- Sources of funding for the studies included were reported  
- If meta-analysis was performed, appropriate methods for statistical combination of results were performed  
- If meta-analysis was performed, the potential impact of RoB in the individual studies on the results of the MA or other evidence synthesis were assessed  
- RoB in individual studies were accounted for when interpreting/discussing the results of the review  
- A satisfactory explanation for, and discussion of, any heterogeneity observed in the results to the review was provided  
- If a quantitative synthesis was performed, an adequate investigation of publication bias (small study bias) was performed and its likely impact on the results of the review was discussed  
- Any potential sources of conflict of interest, included any funding authors received for conducting the review was reported |

*Good quality studies generally meet all quality criteria. Fair quality studies do not meet all the criteria but do not have critical limitations that could invalidate study findings. Poor quality studies have a single fatal flaw or multiple important limitations that could invalidate study findings. Critical appraisal of studies using *a priori* quality criteria are conducted independently by at least two reviewers. Disagreements in final quality assessment are resolved by consensus, and, if needed, consultation with a third independent reviewer.  
† Overall confidence in the results of each review was rated according to published guidance: a rating of “high” reflects that the review had zero or one noncritical weakness; “moderate” indicates the review was judged to have more than one noncritical weakness; “low” means the review was judged to have one critical flaw with or without noncritical weaknesses or multiple noncritical weaknesses; and “critically low” signifies that more than one critical flaw was present.
Appendix B Figure 1. Literature Flow Diagram, Tobacco Cessation in Adults: Review of Reviews

Articles may appear under more than one Key Question.
† Additional primary evidence for Bupropion included in review but not shown here, 2 trials (4 articles).

Abbreviations: ESRs = existing systematic reviews.
Appendix B Figure 2. Literature Flow Diagram, Tobacco Cessation in Adults: Electronic Cigarettes

Number of citations identified through 2015 USPSTF Review: 3

Number of unique citations identified through literature database searching after the exclusion of duplicates: 4822

Number of citations identified through other sources (e.g., reference lists, peer reviewers): 8

Number of citations screened: 4833

Number of citations excluded at title and abstract stage: 4768

Number of full-text articles assessed for eligibility*: 65

Articles excluded for Key Question 1: 65
  - Relevance: 9
  - Design: 20
  - Setting: 0
  - Population: 1
  - Outcomes: 33
  - Quality: 0
  - Publication Type: 2

Articles excluded for Key Question 2: 57
  - Relevance: 10
  - Design: 27
  - Setting: 0
  - Population: 1
  - Outcomes: 15
  - Quality: 2
  - Publication Type: 2

Articles excluded for Key Question 3: 52
  - Relevance: 7
  - Design: 15
  - Setting: 0
  - Population: 1
  - Outcomes: 27
  - Quality: 0
  - Publication Type: 2

Articles included for Key Question 1: 0 studies

Articles included for Key Question 2: 4 studies (8 articles)

Articles included for Key Question 3: 8 studies (13 articles)

* Articles may appear under more than one Key Question.
Appendix B Figure 3. Literature Flow Diagram, Tobacco Cessation in Adults: Pharmacotherapy Interventions Among Pregnant Women

Number of citations identified through 2015 USPSTF Review: 11

Number of unique citations identified through literature database searching after the exclusion of duplicates: 293

Number of citations identified through other sources (e.g., reference lists, peer reviewers): 14

Number of citations screened: 203

Number of citations excluded at title and abstract stage: 259

Number of full-text articles assessed for eligibility*: 99

Articles excluded for Key Question 1: 49
- Relevance: 1
- Design: 39
- Setting: 0
- Population: 0
- Outcomes: 2
- Quality: 2
- Publication Type: 4
- Intervention Type: 1

Articles excluded for Key Question 2: 49
- Relevance: 1
- Design: 39
- Setting: 0
- Population: 0
- Outcomes: 3
- Quality: 1
- Publication Type: 4
- Intervention Type: 1

Articles excluded for Key Question 3: 45
- Relevance: 1
- Design: 32
- Setting: 0
- Population: 1
- Outcomes: 3
- Quality: 3
- Publication Type: 4
- Intervention Type: 1

Articles included for Key Question 1: 6 studies (19 articles)

Articles included for Key Question 2: 6 studies (10 articles)

Articles included for Key Question 3: 9 studies (14 articles)

* Articles may appear under more than one Key Question.
### Appendix C Table 1. Inclusion Criteria of Ancillary Systematic Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions Among Adults, by Author

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Last search date</th>
<th>Population</th>
<th>Specific Intervention</th>
<th>Intervention criteria</th>
<th>Comparison</th>
<th>Outcomes</th>
<th>Setting</th>
<th>Followup</th>
<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agboola, 2015&lt;sup&gt;51&lt;/sup&gt;</td>
<td>Sept-2013</td>
<td>Adult smokers</td>
<td>Varenicline</td>
<td>Varenicline</td>
<td>NR</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥3 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Ahmed, 2018&lt;sup&gt;[Ahmed, 2018 #21604]&lt;/sup&gt;</td>
<td>July-2018</td>
<td>Smokers with schizophrenia, schizophreniform, schizoaffective, or delusional disorder</td>
<td>Varenicline</td>
<td>Varenicline</td>
<td>Placebo</td>
<td>Smoking abstinence, AEs</td>
<td>NR</td>
<td>NR</td>
<td>RCTs</td>
</tr>
<tr>
<td>Appolonio, 2016&lt;sup&gt;62&lt;/sup&gt;</td>
<td>Aug-2016</td>
<td>Adult smokers aged 15 years or older with alcohol or other drug dependence</td>
<td>Any tobacco cessation intervention</td>
<td>Any pharmacologic, behavioral, or combination tobacco cessation intervention</td>
<td>Usual tobacco cessation therapies provided in alcohol and drug treatment; delayed treatment; lower treatment level; no tobacco-related cessation therapy</td>
<td>Smoking abstinence</td>
<td>Inpatient or outpatient treatment</td>
<td>Any followup</td>
<td>RCTs</td>
</tr>
<tr>
<td>Boland, 2016&lt;sup&gt;64&lt;/sup&gt;</td>
<td>May-2016</td>
<td>Smokers (excluding smokeless tobacco or e-cig users) of any age, of low-socioeconomic status, disadvantaged groups (e.g. homeless persons, Indigenous and native persons, prisoners, at-risk-youth, persons with a mental illness, persons</td>
<td>Mobile phone- or internet-based support</td>
<td>Technology-based intervention, including those delivered via mobile phone or internet</td>
<td>NR</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>Any followup</td>
<td>RCTs or quasi-RCTs</td>
</tr>
</tbody>
</table>
### Appendix C Table 1. Inclusion Criteria of Ancillary Systematic Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions Among Adults, by Author

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<th>Setting</th>
<th>Followup</th>
<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carson, 2012&lt;sup&gt;88&lt;/sup&gt;</td>
<td>April-2011</td>
<td>Indigenous smokers of any age</td>
<td>Any tobacco cessation intervention</td>
<td>Any pharmacologic, behavioral, or combination tobacco cessation intervention</td>
<td>Usual care, minimal or no intervention, placebo</td>
<td>Smoking abstinence</td>
<td>Any</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>Danielsson, 2014&lt;sup&gt;92&lt;/sup&gt;</td>
<td>May-2013</td>
<td>Adult smokers, excluding pregnant persons</td>
<td>Telephone- or internet-based support</td>
<td>Telephone or web-based interventions, focused on pure telephone or internet-based self-help</td>
<td>NR</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥3 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>Denison, 2017&lt;sup&gt;93&lt;/sup&gt;</td>
<td>Nov-2016</td>
<td>Adults smokers</td>
<td>Cognitive therapy</td>
<td>Cognitive therapies promoting smoking cessation</td>
<td>No intervention; usual care; other behavioral intervention</td>
<td>Smoking abstinence; physiological or clinical outcomes related to smoking</td>
<td>NR</td>
<td>NR</td>
<td>RCTs or systematic reviews</td>
</tr>
<tr>
<td>Do, 2018(Do, 2018 #21597)</td>
<td>Mar-2017</td>
<td>Smokers of any age, excluding smokeless tobacco users</td>
<td>eHealth smoking cessation intervention</td>
<td>Web-based intervention, computer-generated programs, mobile-based interventions,</td>
<td>Usual practice or other smoking cessation methods</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥1 month</td>
<td>RCTs, quasi-RCTs, interrupted time series, and</td>
</tr>
</tbody>
</table>
### Appendix C Table 1. Inclusion Criteria of Ancillary Systematic Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions Among Adults, by Author

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<th>Followup</th>
<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ebbert, 2015</td>
<td>June-2015</td>
<td>Users of any age of any tobacco product that is placed in the mouth and not burned</td>
<td>Any tobacco cessation intervention</td>
<td>Any pharmacologic, behavioral, or combination tobacco cessation intervention</td>
<td>Placebo; less intensive intervention; usual care</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>Giles, 2014</td>
<td>Apr-2012</td>
<td>Non-clinical, adult (at least 50% of the sample aged 18 years or above) populations, living in high-income economies</td>
<td>Financial-based incentives</td>
<td>Financial incentives: cash, cash-like rewards, or penalties contingent on behavior change</td>
<td>Usual care; no intervention</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Graham, 2016</td>
<td>Apr-2015</td>
<td>Adult smokers</td>
<td>Internet-based interventions</td>
<td>Internet-based interventions</td>
<td>NR</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥1 month</td>
<td>RCTs</td>
</tr>
<tr>
<td>Griffiths, 2018</td>
<td>May-2017</td>
<td>Pregnant smokers aged 16 years and older</td>
<td>Digital interventions</td>
<td>Any intervention delivered through computer, video or DVD, mobile phone or handheld device</td>
<td>Usual care; other intervention</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>End of pregnancy</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>Johnston, 2013</td>
<td>May-2012</td>
<td>Nonindigenous and indigenous smokers of any age from Australia, New Zealand, United States, or Canada</td>
<td>Any tobacco cessation intervention</td>
<td>Any tailored or nontailored pharmacologic, behavioral, or combination tobacco cessation intervention</td>
<td>Nontailored tobacco control intervention or usual care</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>NR</td>
<td>RCTs, CCTs</td>
</tr>
<tr>
<td>Khanna, 2016</td>
<td>Apr-2015</td>
<td>Smokers aged 18 to 65 years and suffering from</td>
<td>Advice</td>
<td>Tobacco cessation advice, defined</td>
<td>Usual care</td>
<td>Smoking abstinence; AEs; quality</td>
<td>NR</td>
<td>Any followup</td>
<td>RCTs</td>
</tr>
</tbody>
</table>
Appendix C Table 1. Inclusion Criteria of Ancillary Systematic Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions Among Adults, by Author

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<th>Setting</th>
<th>Followup</th>
<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kishi, 2014&lt;sup&gt;101&lt;/sup&gt;</td>
<td>Aug-2014</td>
<td>Smokers of any age, including pregnant women, with schizophrenia, schizoaffective disorder, schizophreniform disorder, or delusional disorder</td>
<td>Varenicline (Harms only)</td>
<td>as &quot;preventive information or counsel that leaves the recipient to make the final decision&quot;.</td>
<td>Varenicline Placebo</td>
<td>AEs</td>
<td>NR</td>
<td>≥8 weeks</td>
<td>RCTs</td>
</tr>
<tr>
<td>Klinsophon, 2017&lt;sup&gt;102&lt;/sup&gt;</td>
<td>Nov-2016</td>
<td>Smokers of any age who wished to quit or who were recent quitters, excluding pregnant persons</td>
<td>Exercise</td>
<td>Exercise alone or as an adjunct program to smoking cessation</td>
<td>Any control, including another smoking cessation intervention that did not include exercise</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Lindson-Hawley, 2015&lt;sup&gt;105&lt;/sup&gt;</td>
<td>Aug-2014</td>
<td>Adult tobacco users, excluding pregnant persons</td>
<td>Motivational interviewing</td>
<td>Behavioral intervention using motivational interviewing</td>
<td>Brief advice; low-intensity intervention; routine care</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Liu, 2013&lt;sup&gt;106&lt;/sup&gt;</td>
<td>Apr-2013</td>
<td>Children and adults of African-, Chinese- or South Asian-origin</td>
<td>Adapted interventions for ethnic minorities</td>
<td>Adapted behavioral tobacco cessation interventions for ethnic minorities</td>
<td>Usual care or nonadapted intervention</td>
<td>Smoking abstinence</td>
<td>Any</td>
<td>NR</td>
<td>Any</td>
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</tbody>
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</tr>
</thead>
<tbody>
<tr>
<td>McCabb. 2019 (McCrabb, 2019 #21658)</td>
<td>Sept-2018</td>
<td>Adult smokers, excluding pregnant persons and smokeless tobacco users</td>
<td>Internet-based interventions</td>
<td>Internet-based intervention with or without additional support such as medication or other behavioral support</td>
<td>No treatment or other smoking cessation intervention</td>
<td>Smoking abstinence</td>
<td>Any</td>
<td>Any</td>
<td>RCTs</td>
</tr>
<tr>
<td>McKee, 2016</td>
<td>Dec-2014</td>
<td>Tobacco users of any age</td>
<td>Varenicline</td>
<td>Varenicline</td>
<td>Placebo</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥3 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Notley, 2019 (Notley, 2019 #23046)</td>
<td>July-2018</td>
<td>Pregnant smokers</td>
<td>Incentives</td>
<td>Incentive schemes, lotteries, raffles, and contingent or non-contingent payments, to reward cessation and abstinence in smoking cessation programs</td>
<td>Usual care, other smoking cessation intervention without incentives, another incentive-based intervention differing by incentive type or amount</td>
<td>Smoking abstinence, AEs</td>
<td>Any</td>
<td>End of pregnancy</td>
<td>RCTs</td>
</tr>
<tr>
<td>Palmer, 2018</td>
<td>Jan-2016</td>
<td>Smokers of any age</td>
<td>Mobile phone-based support</td>
<td>Mobile phone-based support</td>
<td>NR</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>Any followup</td>
<td>RCTs</td>
</tr>
<tr>
<td>Peckham, 2017</td>
<td>Sept-2016</td>
<td>Adults smokers with severe mental illness</td>
<td>Any tobacco cessation intervention</td>
<td>Any pharmacologic, behavioral, or combination tobacco cessation intervention or the use of e-cigarettes as a smoking cessation aid</td>
<td>Placebo; comparative effectiveness; usual care; no intervention</td>
<td>Smoking abstinence; AEs; change in psychiatric symptoms; change in body weight</td>
<td>Either inpatient or outpatient settings</td>
<td>Any followup</td>
<td>RCTs</td>
</tr>
<tr>
<td>Roberts, 2016</td>
<td>Dec-2014</td>
<td>Adult smokers with severe mental illness</td>
<td>NRT, bupropion, varenicline</td>
<td>Placebo; alternative pharm</td>
<td>Smoking abstinence; AEs</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
<td></td>
</tr>
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# Appendix C Table 1. Inclusion Criteria of Ancillary Systematic Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions Among Adults, by Author

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<th>Setting</th>
<th>Followup</th>
<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rosen, 2018[17]</td>
<td>Dec-11, July-12, July-13 (used 3 Cochrane reviews)</td>
<td>Adult smokers, excluding pregnant persons</td>
<td>NRT, bupropion, varenicline</td>
<td>NRT, bupropion, varenicline</td>
<td>No active medication</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>6 months and 12 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Schuit, 2018[18]</td>
<td>Aug-2016</td>
<td>Adult smokers</td>
<td>NRT, bupropion, varenicline</td>
<td>NRT, bupropion, varenicline</td>
<td>Placebo; usual care; alternative pharm; non-pharm intervention; no-intervention control; different doses or durations of pharm; different NRT formats; combinations of pharm; different types or intensities of behavioral support as adjunct to pharm</td>
<td>Smoking abstinence</td>
<td>Any</td>
<td>Any followup</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>Schwartz, 2015[19]</td>
<td>Feb-2014</td>
<td>Smokeless tobacco users of any age</td>
<td>Varenicline</td>
<td>Varenicline</td>
<td>Placebo</td>
<td>Smoking abstinence; AEs</td>
<td>NR</td>
<td>12 weeks; 6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Smith, 2016[20]</td>
<td>Dec-2015</td>
<td>Adult smokers</td>
<td>NRT, bupropion, varenicline</td>
<td>NRT, bupropion, varenicline</td>
<td>Placebo</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Thurgood, 2016[29]</td>
<td>Aug-2014</td>
<td>Adult smokers in substance abuse treatment or recovery</td>
<td>Any tobacco cessation intervention</td>
<td>Any pharmacologic, behavioral, or combination tobacco</td>
<td>Placebo; usual care</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
</tbody>
</table>
Appendix C Table 1. Inclusion Criteria of Ancillary Systematic Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions Among Adults, by Author

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Last search date</th>
<th>Population</th>
<th>Specific Intervention</th>
<th>Intervention criteria</th>
<th>Comparison</th>
<th>Outcomes</th>
<th>Setting</th>
<th>Followup</th>
<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tsoi, 2013(^{130})</td>
<td>Oct-2012</td>
<td>Adult smokers with schizophrenia or schizoaffective disorder</td>
<td>Any tobacco cessation intervention</td>
<td>Any pharmacologic, behavioral, or combination tobacco cessation intervention</td>
<td>Another intervention, placebo or usual care</td>
<td>Smoking abstinence; AEs; change in mental state</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs or quasi-RCTs</td>
</tr>
<tr>
<td>van der Meer, 2013(^{131})</td>
<td>Apr-2013</td>
<td>Adult smokers with current or past depression</td>
<td>Any tobacco cessation intervention</td>
<td>Any pharmacologic, behavioral, or combination tobacco cessation intervention</td>
<td>Usual care or placebo</td>
<td>Smoking abstinence</td>
<td>Any</td>
<td>≥6 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Wilson, 2017(^{134})</td>
<td>Jan-2017</td>
<td>Smokers in selected disadvantaged groups (e.g. homeless, prisoners, indigenous populations, at-risk youth, people on low income, those with mental illness)</td>
<td>Any behavioral support</td>
<td>Any behavioral tobacco cessation intervention</td>
<td>Another behavioral intervention; usual care</td>
<td>Smoking abstinence</td>
<td>Only studies conducted in full OECD countries (US, Canada, Australia, New Zealand, United Kingdom, and Western Europe)</td>
<td>≥3 months</td>
<td>RCTs</td>
</tr>
<tr>
<td>Wilson, 2018(Wilson, 2018 #21629)</td>
<td>July-2017</td>
<td>Pregnant smokers of any age</td>
<td>Psychotherapy or incentive-based interventions</td>
<td>Psychotherapy delivered in at least 2 sessions or incentives to be earned</td>
<td>Usual care or any smoking cessation intervention not including incentives</td>
<td>Smoking abstinence</td>
<td>NR</td>
<td>≥3 months</td>
<td>RCTs</td>
</tr>
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### Appendix C Table 1. Inclusion Criteria of Ancillary Systematic Reviews on the Effectiveness and Adverse Events of Tobacco Cessation Interventions Among Adults, by Author

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<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windle, 2016&lt;sup&gt;135&lt;/sup&gt;</td>
<td>July-2015</td>
<td>Cigarette smokers of any age motivated to quit</td>
<td>NRT, bupropion, varenicline</td>
<td>Placebo or alternative pharm</td>
<td>Smoking abstinence; AEs; SAEs</td>
<td>NR</td>
<td>≥12 months</td>
<td>RCTs</td>
<td></td>
</tr>
<tr>
<td>Wu, 2015&lt;sup&gt;136&lt;/sup&gt;</td>
<td>Apr-2015</td>
<td>Adults smokers not motivated to quit</td>
<td>Any tobacco cessation intervention</td>
<td>Placebo; no intervention; other behavioral support except for reduction support</td>
<td>Smoking abstinence; AEs</td>
<td>NR</td>
<td>≥6 months</td>
<td>RCTs</td>
<td></td>
</tr>
<tr>
<td>Wu, 2016&lt;sup&gt;137&lt;/sup&gt;</td>
<td>Sept-2015</td>
<td>Adult smokers with a severe mental illness</td>
<td>Varenicline (Harms only)</td>
<td>Varenicline</td>
<td>Placebo; alternative pharm</td>
<td>Psychiatric AEs</td>
<td>In- and outpatient settings in any country</td>
<td>NR</td>
<td>RCTs or quasi-RCT</td>
</tr>
</tbody>
</table>

**Abbreviations:** AE = Adverse event; CCT = Controlled clinical trial; NR = Not reported; NRT = Nicotine replacement therapy; OECD = Organization for Economic Cooperation and Development; RCT = Randomized controlled trial; SAE = Serious adverse event
### Appendix D. Included Studies

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Intervention</th>
<th>Total # of included studies</th>
<th>Sample size (range)</th>
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<th>Average CPD at BL (range)</th>
<th>Intervention description</th>
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<th>Providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agboola, 2015</td>
<td>Varenicline</td>
<td>19</td>
<td>32 - 1210</td>
<td>39 - 57</td>
<td>NR</td>
<td>All trials used a regimen of 0.5 mg for the first week of treatment followed by 1-mg tablets of varenicline administered twice daily for an additional 11 weeks except three; one in which varenicline was administered for 7 weeks, another in which participants received varenicline for 52 weeks, and a third study in which varenicline was administered for an additional 12 weeks as maintenance treatment following a 12 week treatment period. All trials provided brief support (behavioral counseling delivered face-to-face or via telephone) throughout the treatment phase, except one study in which participants received a personalized quit message and a printed information sheet at baseline only. All trials continued brief counseling during the non-treatment follow-up phase, either face-to-face or via telephone, except two studies in which participants received a quit message at baseline only and supplies of varenicline at follow-up visits and access to quitline counseling during the treatment phase only. Only two studies documented the use of specific relapse prevention counseling indicating that, in most of the included studies, relapse prevention may not have been a major feature of support provided.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ahmed, 2018(Ahmed, 2018 #21604)</td>
<td>Varenicline</td>
<td>4</td>
<td>9 – 127</td>
<td>41 – 42</td>
<td>NR</td>
<td>Varenicline treatment for 12 weeks</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Appolonio, 2016</td>
<td>Any tobacco cessation intervention</td>
<td>34</td>
<td>36 - 575</td>
<td>NR</td>
<td>NR</td>
<td>Counseling (k=11) included one-time or multi-session individual counseling or motivational interviewing sessions, cognitive behavioral therapy, and group counseling sessions. Pharmacotherapy (k=11) included naltrexone or topiramate, nicotine gum, nicotine patches + gum, bupropion, and varenicline. Combination therapy (k=12) included combined counseling</td>
<td>Inpatient and outpatient</td>
<td>NR</td>
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<tbody>
<tr>
<td>Boland, 2016&lt;sup&gt;84&lt;/sup&gt;</td>
<td>Mobile phone- or internet-based support</td>
<td>13</td>
<td>100 - 2142</td>
<td>22 - 47.4</td>
<td>Average, 16.9 (range NR)</td>
<td>Websites to deliver cessation support targeted at low-income smokers and HIV positive smokers (k=5) Computer program to deliver cessation advice and support to substance dependent smokers, smokers with a mental illness, and predominantly African American pregnant smokers (k=5) 60-minute culturally specific cessation DVD for African American smokers (k=1) Integrated video-telephony for rural low-SES smokers (k=1) Mobile phone text-message cessation support for Indigenous smokers (k=1) Tailored intervention and study materials to respective disadvantaged group with the aim of reducing health inequalities (k=9)</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Carson, 2012&lt;sup&gt;88&lt;/sup&gt;</td>
<td>Any tobacco cessation intervention</td>
<td>4</td>
<td>111 - 601</td>
<td>24.5 - 39.9</td>
<td>NR</td>
<td>Intervention durations ranged from seven weeks to six months. One study had two days of training for doctors and clinical staff with no data provided on intervention duration received by patients.</td>
<td>Remote locations; health clinics</td>
<td>NR</td>
</tr>
<tr>
<td>Danielsson, 2014&lt;sup&gt;82&lt;/sup&gt;</td>
<td>Telephone- or internet-based support</td>
<td>74</td>
<td>38 - 73,000</td>
<td>20.1 - 57.4</td>
<td>NR</td>
<td>Internet intervention vs. control (k=21) Helpline intervention vs. control (k=12) Remaining studies focused on alcohol use or gambling</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Denison, 2017&lt;sup&gt;93&lt;/sup&gt;</td>
<td>Cognitive therapy</td>
<td>21</td>
<td>25 - 677</td>
<td>21 - 60</td>
<td>NR</td>
<td>Most interventions included one or more of the following cognitive or cognitive-behavioral content, in order of frequency: relapse prevention, coping skills, self-management, self-efficacy, social support, cognitive restructuring, problem solving, motivational interview, stress management, and rearrangement of environment-person interaction. One study</td>
<td>NR</td>
<td>NR</td>
</tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Do, 2018(#21597)</td>
<td>eHealth smoking cessation intervention</td>
<td>108</td>
<td>2 – 23,213</td>
<td>NR</td>
<td>NR</td>
<td>Majority of studies used web-based programs followed by wireless and mobile phone-based programs, and computer-assisted interventions. Few studies investigated social media, virtual chat rooms, or other electronic aids.</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Ebbert, 2015</td>
<td>Any tobacco cessation intervention</td>
<td>34</td>
<td>42 - 2523</td>
<td>17 - 44</td>
<td></td>
<td>Two studies reported the average number of dips per day, ranging from 7.9 to 11 dips per day at baseline. One study only enrolled participants consuming 3 cans or pouches of smokeless tobacco per week. All other studies required participant Pharmacologic: Bupropion SR was sustained release; NRT included patches, lozenges, and gum. In all cases, both the treatment and control groups received the same behavioral interventions. Behavioral: stratified on the basis of whether the intervention targeted individuals or organizations and included oral screening, counseling (telephone or group (peer-led or nursing-led)), mailings, posters, videos, in-person feedback, manuals, informational websites, and quit lines.</td>
<td>Any setting, including dental offices, community settings, school, military</td>
<td>NR</td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td>Giles, 2014&lt;sup&gt;35&lt;/sup&gt;</td>
<td>Financial-based incentives</td>
<td>141 - 11,281</td>
<td>NR</td>
<td>Most interventions offered cash rewards and/or vouchers exchangeable for a specific range of goods or services; two studies used deposit contracts where participants made cash deposits at the start of the intervention which were only returned in the event of successful behavior change - resulting in potential financial penalties. Two studies also included additional uncertain rewards contingent on behavior change in addition to certain rewards. The total value of incentives, over and above any payments for study participants, ranged from $5.16 to $786 (in 2011 US$). Intervention periods ranged from two weeks to 24 months.</td>
</tr>
<tr>
<td>Graham, 2016&lt;sup&gt;36&lt;/sup&gt;</td>
<td>Internet-based interventions</td>
<td>122 - 23,213</td>
<td>19.8 - 49.5</td>
<td>Static web interventions: Ten trials included stand-alone static web components as part of the intervention condition. Static content was generally informational and non-tailored and contained content comparable to a printed cessation guide. Included in this category are static interventions in which the intervention is fully available and those that deliver intervention components over time. In some studies, static content was paired with additional features such as tailored feedback reports, text messaging, and/or social support. Tailored feedback: Tailored feedback consists of advice or information provided to users based on responses to one or more assessments. Eight studies examined interventions consisting largely of a feedback report. Tailoring was often performed on the basis of participants’ responses to an initial assessment and/or on the basis of participants’ stage of</td>
</tr>
</tbody>
</table>
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<tr>
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</table>

- quitting. The form of tailored messages, however, varied greatly. In one study, participants could receive up to 150 tailored emails over 6–12 months with tailoring on multiple factors. In contrast, another study provided participants with a single tailored letter, six to nine pages in length, based on a 62-item questionnaire.

- Interactive/tailored web intervention: The majority of studies evaluated the effectiveness of interactive web interventions. Interactivity was defined as any part of a web intervention that solicited/required user input and included features such as exercises, quizzes, cost calculators, tailored messages, quit planning tools, training in coping strategies, and self-monitoring. A minority of the interactive interventions offered tailored content and/or guided users through the intervention based on information provided by the participant. Coaching analogs and social support: A number of trials included social support resources such as peers, coaches, or counselors. The most common form of social support was the provision of an asynchronous discussion forum. Eight trials included a discussion forum, either moderated by a peer or an expert, in at least some of the study arms. Seven trials included access to live coaching or counseling either via telephone, face-to-face counseling, or SMS text or email. Two studies evaluated other methods of accessing social support. Other adjunctive components: Four trials described the use of SMS text messaging as part of the intervention. Two trials also included interactive voice response calls. Two other studies included an online eight module cognitive-behavioral mood management component in some arms. Another study included videos and the ability to create

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</thead>
<tbody>
<tr>
<td>Griffiths, 2018 (Griffiths, 2018 #21644)</td>
<td>Digital interventions</td>
<td>12</td>
<td>17 – 918</td>
<td>23 – 30.5</td>
<td>NR</td>
<td>Four studies delivered digital content through text messages. Three studies used videotapes, and one study used telephone Interactive Voice Response Technology (IVR). Two trials used websites, including a contingency management program, and an interactive and personalized website. The remaining two trials were computer programs.</td>
<td>Home, clinical setting</td>
<td>NR</td>
</tr>
<tr>
<td>Johnston, 2013</td>
<td>Any tobacco cessation intervention</td>
<td>5</td>
<td>226 - 1705</td>
<td>NR</td>
<td>NR</td>
<td>Three studies were pragmatic trials that recruited participants through New Zealand’s Quitline service with the aim of testing the effectiveness of enhanced protocols, specifically (a) precessation nicotine replacement therapy (NRT), (b) familiarization and choice of NRT product, and (c) very low nicotine content cigarettes (VLNC) compared with usual care. The other two studies trialed a smoking cessation counseling intervention using mobile phone technology.</td>
<td>Recruited from Quitline service (k=3)</td>
<td>NR</td>
</tr>
<tr>
<td>Khanna, 2016</td>
<td>Advice</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Kishi, 2015</td>
<td>Varenicline (Harms only)</td>
<td>7</td>
<td>9 - 128</td>
<td>39.9 - 51.4</td>
<td>NR</td>
<td>All trials provided varenicline at 1-2mg/day plus psychotherapy</td>
<td>Outpatient</td>
<td>NR</td>
</tr>
<tr>
<td>Klinsophon, 2017</td>
<td>Exercise</td>
<td>19</td>
<td>20 - 2318</td>
<td>NR</td>
<td>NR</td>
<td>Details of interventions not synthesized. Aerobic exercise (k=14) Resistance training (k=1) Yoga (k=1)</td>
<td>NR</td>
<td>NR</td>
</tr>
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<tbody>
<tr>
<td>Liu, 2013</td>
<td>Adapted interventions for ethnic minorities</td>
<td>28</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>Combined aerobic and resistance exercise program (k=1) Did not specify the precise type of exercise and were classified as &quot;physical activity&quot; (k=2) Supervised, group-based exercise at the research setting plus home-based exercise (k=8) Supervised, group-based exercise at the research setting (k=7) Home-based exercise (k=3) Remaining provided home-based exercise or supervised, group-based exercise in each group.</td>
<td>NR</td>
<td>Physicians, lay health educators, lay counselors, neighborhood health advocates, nurses</td>
</tr>
<tr>
<td>McCrabb, 2019(Mccrabb, 2019 #21658)</td>
<td>Internet-based interventions</td>
<td>45</td>
<td>35-16,430</td>
<td>20-50</td>
<td>NR</td>
<td>Internet-based interventions with or without additional interventions components such as phone calls, medication, group support.</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>McKee, 2016</td>
<td>Varenicline</td>
<td>16</td>
<td>79 - 703</td>
<td>NR</td>
<td>NR</td>
<td>Majority of studies delivered 1mg bid. Varenicline duration was mostly 12 weeks (14/16 trial) with 1 study at 6weeks and 1 lasting 52wks. Study duration ranged from 24 to 52; majority 52 wks (9/16 trials) while 7 were 24 or 26wks in duration.</td>
<td>Hospitalized adults (k=1)</td>
<td>NR</td>
</tr>
<tr>
<td>Notley, 2019*</td>
<td>Incentives</td>
<td>10</td>
<td>17-1014</td>
<td>24-30.7</td>
<td>NR</td>
<td>Largest trial provided cash payments as the incentive. In all other cases the rewards were vouchers for goods or services. All the trials offered a program of practical cessation support, in addition to usual care.</td>
<td>Antenatal programs, substance misuse</td>
<td>NR</td>
</tr>
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</thead>
<tbody>
<tr>
<td>Palmer, 2018</td>
<td>Mobile phone-based support</td>
<td>18</td>
<td>31 - 5800</td>
<td>19 - 43</td>
<td>NR</td>
<td>Twelve interventions were delivered by SMS, three were delivered by voice calls, one by interactive voice response, one by a combination of SMS and video messages, and one by a mobile application with voice calls.</td>
<td>Recruited from internet, quit line, lung cancer screening, local newspaper, cancer network membership, mail, emergency department, electronic health record, and phone recruitment</td>
<td>NR</td>
</tr>
<tr>
<td>Peckham, 2017</td>
<td>Any tobacco cessation intervention</td>
<td>26</td>
<td>5 - 298</td>
<td>NR</td>
<td>NR</td>
<td>The varenicline studies all followed a standard dosing schedule whereas the dose in the Bupropion SR studies ranged from 150 mg once per day to 150 mg twice per day. Smoking cessation counselling, whether part of the intervention being tested or part of the control arm, consisted of a range of behavior change techniques delivered in a variety of formats e.g. face-to-face one-to-one sessions, face-to-face group sessions or one-to-one sessions delivered via telephone. It is important to note that in the trials of varenicline and bupropion, where smoking cessation counselling was delivered, the same program was delivered in both the medication (varenicline or bupropion) arm of the trial as in the usual care arm of the trial. In the majority of the trials the exact content, in terms of the behavior change techniques employed in</td>
<td>Outpatients (k=20), inpatient (k=1)</td>
<td>NR</td>
</tr>
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</thead>
<tbody>
<tr>
<td>Roberts, 2016(^{116})</td>
<td>NRT, bupropion, varenicline</td>
<td>14</td>
<td>5 - 128</td>
<td>NR</td>
<td>NR</td>
<td>Number of CBT sessions varied by study</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Rosen, 2018(^{117})</td>
<td>NRT, bupropion, varenicline</td>
<td>61</td>
<td>36 - 3575</td>
<td>NR</td>
<td>NR</td>
<td>For comparators: “Some studies included more than two treatment groups. For 2 × 2 factorial designs that included a medical and a non-medical (behavioral/psychological) intervention, two separate comparisons were performed: one for the active non-medical intervention and one for the inactive non-medical intervention. In cases where high- and low-dependent smoker subgroups were randomized separately to intervention and control arms, each subgroup was treated in the meta-analysis as a separate study. In studies with multiple doses and a single control, participants assigned any non-zero dose were combined into a single intervention group. For trials with multiple intervention arms which did not have a clear 2 × 2 design, we compared the two groups that were identical on all aspects of the intervention except for provision of medication.</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Schuit, 2017(^{118})</td>
<td>NRT, bupropion, varenicline</td>
<td>18</td>
<td>61 - 1686</td>
<td>41 - 46</td>
<td>NR</td>
<td>NRT vs. placebo (k=4) Bupropion SR vs. placebo (k=6) NRT vs. bupropion SR vs. NRT + Bupropion SR (k=1) NRT vs. varenicline (k=1) Bupropion SR vs. NRT + Bupropion SR (k=1) Basic support + NRT vs. weekly support + NRT (k=1) No intervention vs. extended NRT vs. extended NRT + CBT vs. extended NRT vs. extended counselling (k=1) NRT, patch vs. NRT, nasal spray with group counseling provided to all participants (k=1)</td>
<td>Community and healthcare</td>
<td>NR</td>
</tr>
</tbody>
</table>
### Appendix D. Included Studies

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Intervention</th>
<th>Total # of included studies</th>
<th>Sample size (range)</th>
<th>Average age (range)</th>
<th>Average CPD at BL (range)</th>
<th>Intervention description</th>
<th>Setting</th>
<th>Providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schwartz, 2016&lt;sup&gt;119&lt;/sup&gt;</td>
<td>Varenicline</td>
<td>3</td>
<td>76 - 431</td>
<td>34.2 - 43.9</td>
<td>NR</td>
<td>All trials included behavioral counseling (details not specified)</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>2 trials assessed at both timepoints: Varenicline at a dose of 0.5mg once daily on Days 1–3, increased to 0.5mg twice daily on Days 4–7, and further increased to a target dose of 1mg twice daily for 11 weeks; for a total of 12 weeks of treatment.</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td>The 3rd trial with only 12wk FU: Varenicline at a dose of 0.5mg once daily on Days 1–3, increased to 0.5mg twice daily on Days 4–7, and further increased to a target dose of 1mg once daily for 11 weeks in participants weighing &lt;55kg, and a target dose of 1mg twice daily in participants weighing ≥55kg; for a total of 12 weeks of treatment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smith, 2016&lt;sup&gt;126&lt;/sup&gt;</td>
<td>NRT, bupropion, varenicline</td>
<td>28</td>
<td>56 - 842</td>
<td>NR</td>
<td>NR</td>
<td>All NRT trials included transdermal nicotine patches ranging from 14mg to 42mg per day for 6 to 18 weeks with varying levels of counseling. All Bupropion SR trials provided 150mg 2/day for 6 to 10 weeks with varying levels of counseling. Varenicline doses ranges from 0.3 mg 1/day to 1mg 2/day for 12 weeks with varying levels of counseling.</td>
<td>Primary care (k=4), community volunteers (k=26), smoking cessation clinic (k=2), community health center (k=1)</td>
<td>NR</td>
</tr>
</tbody>
</table>
## Appendix D. Included Studies

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Intervention</th>
<th>Total # of included studies</th>
<th>Sample size (range)</th>
<th>Averag.e age (range)</th>
<th>Average CPD at BL (range)</th>
<th>Intervention description</th>
<th>Setting</th>
<th>Providers</th>
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</thead>
<tbody>
<tr>
<td>Thurgood, 2016&lt;sup&gt;129&lt;/sup&gt;</td>
<td>Any tobacco cessation intervention</td>
<td>17</td>
<td>64 - 383</td>
<td>34 - 50</td>
<td>16 - 32</td>
<td>The main intervention categories included counseling only; counseling and NRT; NRT only; CBT only; CBT and NRT; motivational interviewing; contingency management; bupropion; and varenicline.</td>
<td>Inpatient substance abuse treatment (k=4) 21-day inpatient alcohol detox (k=1) Outpatient substance abuse treatment (k=1) Outpatient methadone treatment (k=1)</td>
<td>Masters and doctoral level clinicians, trained therapists, counselors, graduate students, psychologists trained in CBT, research physicians, first author provided counseling, interventionists</td>
</tr>
<tr>
<td>Tsoi, 2013&lt;sup&gt;130&lt;/sup&gt;</td>
<td>Any tobacco cessation intervention</td>
<td>34</td>
<td>9 - 298</td>
<td>34 - 48.7</td>
<td>7 – 41</td>
<td>The duration of drug treatment varied from 7 hours to 6 months.</td>
<td>“Most trials recruited participants from the community”; inpatient units, the community, or outpatient psychiatric treatment sites</td>
<td>NR</td>
</tr>
<tr>
<td>van der Meer, 2013&lt;sup&gt;131&lt;/sup&gt;</td>
<td>Any tobacco cessation intervention</td>
<td>49</td>
<td>14 - 5046</td>
<td>24 - 57</td>
<td>7.9 – 32.3</td>
<td>In most trials, the psychosocial mood management component of the experimental intervention consisted of a format of (cognitive) behavioral therapy for depression. In one trial the psychosocial mood management component consisted of a cognitive behavioral analysis system of psychotherapy, in one trial of hypnosis</td>
<td>Trials conducted in community, university, and clinical settings</td>
<td>NR</td>
</tr>
</tbody>
</table>
## Appendix D. Included Studies

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Intervention</th>
<th>Total # of included studies</th>
<th>Sample size (range)</th>
<th>Average age (range)</th>
<th>Average CPD at BL (range)</th>
<th>Intervention description</th>
<th>Setting</th>
<th>Providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilson, 2017</td>
<td>Any behavioral support</td>
<td>24</td>
<td>30 - 4613</td>
<td>21.9 - 54.8</td>
<td>NR</td>
<td>NRT (k=9), Bupropion SR (k=2), nortriptyline (k=1), behavioral therapy varied, included motivational interviewing, smoking cessation counselling, group therapy, CBT, weekly classes, financial incentives, exercise, computer-delivered programs, phone counselling, contingency management, motivational enhancement, and educational videos</td>
<td>Community or health centers</td>
<td>NR</td>
</tr>
<tr>
<td>Wilson, 2018</td>
<td>Incentives</td>
<td>22</td>
<td>54 – 941</td>
<td>23 – 31</td>
<td>Mean: 10</td>
<td>Sixteen trials provided psychotherapy to smokers with total session time ranging from 50 min to 480 min over 2 or more sessions. Six trials provided incentive-based interventions ranging from a maximum of $250 to $1180 contingent upon abstinence.</td>
<td>Public prenatal clinic, WIC clinic, community, prenatal clinic, HMO, army medical center, women's hospital, MIC clinic, maternity hospital,</td>
<td>NR</td>
</tr>
</tbody>
</table>
### Appendix D. Included Studies

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Intervention</th>
<th>Total # of included studies</th>
<th>Sample size (range)</th>
<th>Average age (range)</th>
<th>Average CPD at BL (range)</th>
<th>Intervention description</th>
<th>Setting</th>
<th>Providers</th>
</tr>
</thead>
</table>
| Windle, 2016<sup>135</sup> | NRT, bupropion, varenicline | 123 | 51 - 3684 | 16 - 63 | 7 - 38 | NRT patch + BT vs. BT (k=15)  
Short-acting NRT + BT vs. BT (k=29)  
NRT + BT vs. BT (k=44)  
Bupropion SR + BT vs. BT (k=20)  
Varenicline + BT vs. BT (k=14)  
Nicotine patch + BT vs. Nicotine Patch (k=4)  
NRT + BT vs. NRT (k=6)  
Pharmacotherapy + BT vs. Pharmacotherapy (k=7)  
Pharmacotherapy + Intensive BT vs. Pharmacotherapy + Minimal BT (k=5)  
Pharmacotherapy combinations NRT + NRT vs. NRT monotherapy (k=7)  
Nicotine patch + Short-acting NRT vs. Nicotine Patch (k=5)  
Bupropion SR + NRT vs. Monotherapy (k=4)  
Pharmacotherapy + Pharmacotherapy vs. Pharmacotherapy (k=12) | NR | NR |
| Wu, 2015<sup>136</sup> | Any tobacco cessation intervention | 14 | 67 - 1410 | 38.5 - 55.4 | NR | Reduction support + medication vs. reduction support + placebo (k=9)  
Reduction support + medication vs. no intervention (k=5)  
Reduction support + medication vs. reduction support vs. no intervention (k=1) | NR | NR |
| Wu, 2016<sup>137</sup> | Varenicline (Harms only) | 8 | 5 - 127 | NR | NR | The selected randomized trials all compared varenicline with placebo. Three studies explored the effectiveness of varenicline alone, and the remaining studies evaluated varenicline in combination with individual behavioral interventions. The duration of the varenicline treatment varied between 8 and 12 weeks; 81% of participants treated with varenicline completed the treatment, compared with 82% in placebo groups. | NR | NR |

*Evidence for pregnant persons only.*
Appendix D. Included Studies

**Abbreviations:** bid = Two times a day; BL = Baseline; BT = Behavioral therapy; CBT = Cognitive behavioral therapy; CPD = Cigarettes per day; DNA = Deoxyribonucleic acid; DVD = Digital versatile disc; FU = Followup; HIV = Human immunodeficiency virus; kg = kilogram; mg = milligram; NA = Not applicable; NR = Not reported; NRT = Nicotine replacement therapy; SES = Socioeconomic status; SMS = Short message service; ST = Smokeless tobacco; wks = weeks; US = United States; VLNC = Very low nicotine content cigarettes.
Appendix D. Included Studies

List 1. Included ESRs, by author

*Ancillary publication(s) indented under primary article*


Apollonio D, Philipps R, Bero L. Interventions for tobacco use cessation in people in treatment for or recovery from substance use disorders. Cochrane Database of Systematic Reviews. 2016(11). PMID: 27878808. [https://doi.org/10.1002/14651858.CD010274.pub2](https://doi.org/10.1002/14651858.CD010274.pub2)


Danielsson AK, Eriksson AK, Allebeck P. Technology-based support via telephone or web: a systematic review of the effects on smoking, alcohol use and gambling. Addict Behav. 2014;39(12):1846-68. PMID: 25128637. [https://doi.org/10.1016/j.addbeh.2014.06.007](https://doi.org/10.1016/j.addbeh.2014.06.007)

Appendix D. Included Studies


Ebbert JO, Elrashidi MY, Stead LF. Interventions for smokeless tobacco use cessation. Cochrane Database of Systematic Reviews. 2015(10). PMID: 26501380. [https://doi.org/10.1002/14651858.CD004306.pub5]


Lancaster T, Stead LF. Individual behavioural counselling for smoking cessation. Cochrane Database of Systematic Reviews. 2017(3). PMID: 28361496. [https://doi.org/10.1002/14651858.CD001292.pub3]


Palmer M, Sutherland J, Barnard S, et al. The effectiveness of smoking cessation, physical activity/diet and alcohol reduction interventions delivered by mobile phones for the prevention of non-communicable
Appendix D. Included Studies


Appendix D. Included Studies


Appendix D. Included Studies


Additional included primary evidence for bupropion

Ancillary articles indented under primary article


List 2. Included trials for electronic cigarettes, by author

Ancillary publication(s) indented under primary article


Appendix D. Included Studies


List 3. Included studies for pharmacotherapy interventions among pregnant women, by author

Ancillary publication(s) indented under primary article


Appendix D. Included Studies


### Appendix E. Excluded Studies

#### List 1. Excluded studies list, Tobacco cessation in adults: Review of Reviews

<table>
<thead>
<tr>
<th>Exclusion Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>ESR aim not relevant</td>
</tr>
<tr>
<td>E2a</td>
<td>Not a systematic review</td>
</tr>
<tr>
<td>E2b</td>
<td>Does not describe search dates AND search databases AND search string</td>
</tr>
<tr>
<td>E2c</td>
<td>Does not indicate criteria used to select studies for inclusion</td>
</tr>
<tr>
<td>E2d</td>
<td>ESR among pharmacotherapy interventions among pregnant women (not included study design)</td>
</tr>
<tr>
<td>E3a</td>
<td>Population: ≥50% of studies included focus on children and adolescents, and stratified results not presented</td>
</tr>
<tr>
<td>E3b</td>
<td>Population: &gt; 50% of the included studies focus on groups not generalizable to primary care (e.g., COPD), and stratified results not presented</td>
</tr>
<tr>
<td>E4</td>
<td>Intervention: Not a relevant intervention (e.g., systems-level, broad public health intervention, harm reduction, second-line or off-label medications, relapse prevention)</td>
</tr>
<tr>
<td>E5</td>
<td>Setting: &gt; 50% of the included studies take place in settings not applicable to primary care (e.g., worksites, specialty care), and stratified results not presented</td>
</tr>
<tr>
<td>E6</td>
<td>Outcomes: No relevant outcomes (exclude reviews that only report tobacco reduction; reduction in withdrawal symptoms; attitudes, knowledge, beliefs, intentions; etc.)</td>
</tr>
<tr>
<td>E7</td>
<td>Outcome Assessment: &gt; 50% of the included studies report outcomes at &lt; 6 months follow up, and stratified results not presented (does not apply for KQ3/harms data)</td>
</tr>
<tr>
<td>E8</td>
<td>Country: &gt; 50% of included studies take place in countries not on the &quot;Very High&quot; list for Human Development</td>
</tr>
<tr>
<td>E9</td>
<td>Review published in language other than English</td>
</tr>
<tr>
<td>E10</td>
<td>Previous Review: Primary ESR that has been updated</td>
</tr>
<tr>
<td>E11</td>
<td>Previous Review: Non-primary ESR that will not move forward</td>
</tr>
<tr>
<td>E12</td>
<td>Poor Quality</td>
</tr>
</tbody>
</table>

Appendix E. Excluded Studies

713fd8fa-d1c4-4cd9-925b-196fb29f4d44%40sessionmgr101&vid=3&bdata
=JnNpdGU9ZHuYW1ZC1saXZJnNjI3B1PXNp


17. Canadian Agency for Drugs and Technologies in Health. Smoking Cessation Aids for Patients in Treatment for Substance Abuse: Clinical Effectiveness, Cost-Effectiveness and Guidelines. Ottawa, ON Canada: Canadian
Appendix E. Excluded Studies

23. Canadian Agency for Drugs and Technologies in Health. Telehealth Delivery of Group Smoking Cessation Programs for Adolescents and Young Adults: Clinical Effectiveness. Ottawa, ON Canada: Canadian Agency for Drugs and Technologies in Health; 2015. KQ1E2a, KQ2E2a, KQ3E2a.

24. Canadian Agency for Drugs and Technologies in Health. Nicotine Replacement Therapy, Bupropion and Varenicline for Tobacco Cessation: A Review of Clinical Effectiveness. Ottawa, ON Canada: Canadian Agency for Drugs and Technologies in Health; 2016. KQ1E2a, KQ2E2a, KQ3E2a.

25. Canadian Agency for Drugs and Technologies in Health. Smoking Cessation Interventions for Patients with Severe Mental Illnesses: Clinical Effectiveness and Guidelines. Ottawa, ON Canada: Canadian Agency for Drugs and Technologies in Health; 2016. KQ1E2a, KQ2E2a, KQ3E2a.


27. Canadian Agency for Drugs and Technologies in Health. Cytisine for smoking cessation: clinical effectiveness and cost-effectiveness. Ottawa, ON Canada: Canadian Agency for Drugs and Technologies in Health; 2017. KQ1E2a, KQ2E2a, KQ3E2a.


Appendix E. Excluded Studies


Appendix E. Excluded Studies


65. Hurst D. Nicotine lozenges and behavioural interventions may help smokeless tobacco users to quit. Evidence-based dentistry. 2015;16(4):104-5. PMID: 26680516. 10.1038/sj. ebd.6401129 KQ1E2a, KQ2E2a, KQ3E2a.

Appendix E. Excluded Studies

38. PMID: 21350042. KQ1E6, KQ2E11, KQ3E6.

67. Jahagirdar D, Kaunelis D. Smoking Cessation Interventions for Patients with Severe Mental Illnesses: A Review of Clinical Effectiveness and Guidelines. Ottawa: Canadian Agency for Drugs and Technologies in Health; 2017. PMID: KQ1E2a, KQ2E2a, KQ3E2a.


Appendix E. Excluded Studies

https://doi.org/10.1002/14651858.CD005549.pub3 KQ1E8, KQ2E8, KQ3E8.


Appendix E. Excluded Studies


111. Shahab L, McEwen A. Online support for smoking cessation: a systematic review of the
Appendix E. Excluded Studies


Appendix E. Excluded Studies

https://doi.org/10.1111/add.14721 KQ1E6, KQ2E12, KQ3E12.


10.3109/00952990.2015.1117480 KQ1E6, KQ2E12, KQ3E12.


Appendix E. Excluded Studies

List 2. Excluded studies list, Tobacco cessation in adults: Electronic Cigarettes

<table>
<thead>
<tr>
<th>Exclusion Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Study aim not relevant</td>
</tr>
<tr>
<td>E2</td>
<td>Study design</td>
</tr>
<tr>
<td>E3</td>
<td>Population</td>
</tr>
<tr>
<td>E4</td>
<td><strong>Outcomes</strong>: No relevant outcomes (exclude trials that only report tobacco reduction; reduction in withdrawal symptoms; attitudes, knowledge, beliefs; intentions; etc.)</td>
</tr>
<tr>
<td>E5</td>
<td>Setting</td>
</tr>
<tr>
<td>E6</td>
<td>Poor Quality</td>
</tr>
<tr>
<td>E7</td>
<td>Publication Type</td>
</tr>
</tbody>
</table>


Appendix E. Excluded Studies

https://dx.doi.org/10.3310/hta19950 KQ1E1, KQ2E1, KQ3E1

https://dx.doi.org/10.1016/j.drugalcdep.2015.07.1091 KQ1E7, KQ2E7, KQ3E7


https://dx.doi.org/10.1001/jamanetworkopen.2018.5937 KQ1E1, KQ2E1, KQ3E4

https://dx.doi.org/10.1093/ntr/nzt025 KQ1E4, KQ2E2, KQ3E4

https://dx.doi.org/10.1016/j.addbeh.2018.07.003 KQ1E2, KQ2E2, KQ3E4


https://dx.doi.org/10.4137/cmemento.s40364 KQ1E2, KQ2E2, KQ3E2

https://dx.doi.org/10.1093/ntr/ntw160 KQ1E2, KQ2E2, KQ3E2

https://dx.doi.org/10.1056/NEJMsa1715757 KQ1E4, KQ2E1, KQ3E4

https://dx.doi.org/10.1161/circulationaha.117.029153 KQ1E2, KQ2E2, KQ3E4

Appendix E. Excluded Studies

https://dx.doi.org/10.1093/ntr/nty211
KQ1E4, KQ2E2, KQ3E4

https://dx.doi.org/http://dx.doi.org/10.1016/j.addbeh.2017.09.012 KQ1E1, KQ2E1, KQ3E1

https://dx.doi.org/10.1016/j.drugalcdep.2018.11.030 KQ1E4, KQ2E4, KQ3E2

https://dx.doi.org/10.1007/s12630-017-1003-0 KQ1E7, KQ2E7, KQ3E7

https://dx.doi.org/10.1136/tobaccocontrol-2015-052822 KQ1E2, KQ2E2, KQ3E2

https://dx.doi.org/10.1093/ntr/ntz043 KQ1E4, KQ2E2, KQ3E4

https://dx.doi.org/10.1093/ntr/ntw157 KQ1E4, KQ2E4, KQ3E4

https://dx.doi.org/10.1177/2050312118777953 KQ1E1, KQ2E1, KQ3E2

https://dx.doi.org/10.1093/ntr/ntw003 KQ1E4, KQ2E4, KQ3E4

https://dx.doi.org/http://dx.doi.org/10.1016/j.addbeh.2017.09.023 KQ1E2, KQ2E2, KQ3E4

https://dx.doi.org/10.1016/j.amjmed.2019.02.016 KQ1E2, KQ2E2, KQ3E4

https://dx.doi.org/10.1111/bcpt.12300 KQ1E2, KQ2E2, KQ3E2

https://dx.doi.org/10.1371/journal.pone.0173625 KQ1E1, KQ2E1, KQ3E1

37. Pepper, JK, Gilkey, MB, et al. Physicians' Counseling of Adolescents Regarding E-
Appendix E. Excluded Studies


45. Soneji, S. Errors in Data Input in Meta-analysis on Association Between Initial Use of e-Cigarettes and Subsequent Cigarette Smoking Among Adolescents and Young Adults. JAMA Pediatr. 2017. PMID: 29131876. https://dx.doi.org/10.1001/jamapediatrics.2017.4200 KQ1E1, KQ2E1, KQ3E1


50. Walele, T, Sharma, G, et al. A randomised, crossover study on an electronic vapour product, a nicotine inhalator and a conventional cigarette. Part B: Safety and


Appendix E. Excluded Studies

List 3. Excluded studies list, Tobacco cessation in adults: pharmacotherapy in pregnant women

<table>
<thead>
<tr>
<th>Exclusion Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Study aim not relevant</td>
</tr>
<tr>
<td>E2</td>
<td>Study design</td>
</tr>
<tr>
<td>E3</td>
<td>Population</td>
</tr>
<tr>
<td>E4</td>
<td>Outcomes: No relevant outcomes (exclude trials that only report tobacco reduction; reduction in withdrawal symptoms; attitudes, knowledge, beliefs; intentions; etc.)</td>
</tr>
<tr>
<td>E5</td>
<td>Setting</td>
</tr>
<tr>
<td>E6</td>
<td>Poor Quality</td>
</tr>
<tr>
<td>E7</td>
<td>Publication Type</td>
</tr>
<tr>
<td>E8</td>
<td>Intervention Type</td>
</tr>
</tbody>
</table>


6. Brose, LS. Helping pregnant smokers to quit. BMJ. 348: g1808. 2014. PMID: 24620362. https://dx.doi.org/10.1136/bmj.g1808 KQ1E2, KQ2E2, KQ3E2


Appendix E. Excluded Studies


Appendix E. Excluded Studies


33. O'Dowd, A. Only a tenth of pregnant smokers are prescribed nicotine replacement therapy. BMJ. 349: g5405. 2014. PMID: 25183700. https://dx.doi.org/10.1136/bmj.g5405 KQ1E2, KQ2E2, KQ3E2


Appendix E. Excluded Studies


43. Tappin, D, Bauld, L, et al. Financial incentives for smoking cessation in pregnancy: randomised controlled trial. BMJ. 350: h134. 2015. PMID: 25627664. https://dx.doi.org/10.1136/bmj.h134 KQ1E1, KQ2E1, KQ3E1


### Appendix F Table 1. Population Details From Trials of Electronic Cigarettes for Tobacco Cessation

<table>
<thead>
<tr>
<th>Author, Year Trial name Quality</th>
<th>Mean age</th>
<th>SES</th>
<th>Race</th>
<th>% Female</th>
<th>Median CPD</th>
<th>Nicotine dependence</th>
<th>Other smoking history</th>
<th>Readiness to quit</th>
<th>Quit history</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bullen, 2013 ASCEND Fair</td>
<td>42.4</td>
<td>Marital status: NR</td>
<td>Maori: 32.4%</td>
<td>61.6</td>
<td>17.9</td>
<td>FTND* (0 to 10), Median: 5.5</td>
<td>Age of smoking initiation, mean: 15.5 years</td>
<td>Confidence in ability to sustain abstinence (1-5 scale), mean: 3.7</td>
<td>Past year quit attempt: 55.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Education: 47.3% less than high school</td>
<td>Non Maori: 67.6%</td>
<td></td>
<td></td>
<td>FTND &gt;5: 54.6%</td>
<td># years smoking, mean: 24.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Employment: NR</td>
<td>Other SES: NR</td>
<td></td>
<td></td>
<td>Lives with smokers: 52.1%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caponnetto, 2013 ECLAT Fair</td>
<td>44.0</td>
<td>Marital status: NR</td>
<td>NR</td>
<td>36.7</td>
<td>20.0</td>
<td>FTND*, mean: 5.8</td>
<td>Age of smoking initiation, mean: 16.8 years</td>
<td>NR</td>
<td>Ever attempted to quit: 51%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Education: Low: 31% Intermediate: 53% High: 16%</td>
<td>Employment: NR</td>
<td></td>
<td></td>
<td>Packs per year, mean: 24.9</td>
<td></td>
<td></td>
<td># Lifetime quit attempts, mean: 0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other SES: NR</td>
<td>Other SES: NR</td>
<td></td>
<td></td>
<td>eCO, mean: 20 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hajek, 2019 TEC Fair</td>
<td>41.0</td>
<td>Marital Status: 73.1% Single or divorced/ separated 24.9% married 1.8% widowed</td>
<td>NR</td>
<td>48.0</td>
<td>15.0</td>
<td>FTND*, mean: 4.6</td>
<td>Age of smoking initiation, median: 16 years</td>
<td>NR</td>
<td>Past use for cessation NRT: 74.9%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Education: 35.3% high school education or less</td>
<td>Employment: 69.6% employed</td>
<td></td>
<td></td>
<td>eCO, mean: 20 ppm</td>
<td></td>
<td></td>
<td>E-cig: 41.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other SES: NR</td>
<td>Other SES: NR</td>
<td></td>
<td></td>
<td>Has significant other who smokes: 39.1%</td>
<td></td>
<td></td>
<td>Varenicline: 33.9%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bupropion: 7.8%</td>
</tr>
</tbody>
</table>
### Appendix F Table 1. Population Details From Trials of Electronic Cigarettes for Tobacco Cessation

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Trial name</th>
<th>Quality</th>
<th>Mean age</th>
<th>SES</th>
<th>Race</th>
<th>% Female</th>
<th>Median CPD</th>
<th>Nicotine dependence</th>
<th>Other smoking history</th>
<th>Readiness to quit</th>
<th>Quit history</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walker, 2019 [Walker, 2019 #23051]</td>
<td>Fair</td>
<td>41.6</td>
<td>Marital status: NR</td>
<td>Education: 35.7% with less than 12 years of education</td>
<td>Employment: NR</td>
<td>Other SES: NR</td>
<td>Maori: 40.1%</td>
<td>Non Maori: 59.9%</td>
<td>68.3%</td>
<td>17.3</td>
<td>FTND*: mean: 5.2</td>
</tr>
<tr>
<td>Carpenter, 2017 [143]</td>
<td>Fair</td>
<td>42.2</td>
<td>Marital status: NR</td>
<td>Education: 37.1% HS education or less</td>
<td>Employment: 54.2% employed (full- or part-time)</td>
<td>Other SES: NR</td>
<td>White: 54.5%</td>
<td>African American: 44.0%</td>
<td>60.5</td>
<td>15.3</td>
<td>NR</td>
</tr>
<tr>
<td>Cravo, 2016 [144]</td>
<td>Fair</td>
<td>34.6</td>
<td>Marital status: NR</td>
<td>Education: NR</td>
<td>Employment: NR</td>
<td>Other SES: NR</td>
<td>NR</td>
<td>44.6</td>
<td>5-10 CPD: 34.6%</td>
<td>11-20 CPD: 57.6%</td>
<td>21-30 CPD: 7.8%</td>
</tr>
</tbody>
</table>
## Appendix F Table 1. Population Details From Trials of Electronic Cigarettes for Tobacco Cessation

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Mean age</th>
<th>SES</th>
<th>Race</th>
<th>% Female</th>
<th>Median CPD</th>
<th>Nicotine dependence</th>
<th>Other smoking history</th>
<th>Readiness to quit</th>
<th>Quit history</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masiero, 2017[^1][^2]</td>
<td>62.8</td>
<td>Marital status: NR</td>
<td>NR</td>
<td>37.1</td>
<td>19.4</td>
<td>FTND[^3], mean: 4.3</td>
<td>Age of smoking initiation, mean: 17.4 years</td>
<td>Motivation to quit, mean score (scale 4-19[^4]): 13</td>
<td>NR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Mean age</th>
<th>SES</th>
<th>Race</th>
<th>% Female</th>
<th>Median CPD</th>
<th>Nicotine dependence</th>
<th>Other smoking history</th>
<th>Readiness to quit</th>
<th>Quit history</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tseng, 2016[^5][^6]</td>
<td>28.9</td>
<td>Marital status: NR</td>
<td>African American: 29.2%</td>
<td>32.7</td>
<td>14.8</td>
<td>Smoking Dependence Mild: 16.3%</td>
<td>Time to first CPD &lt;=5 min after waking: 25.5% 6-30 min after waking: 42.6% 31-60 min after waking: 21.3% &gt;60 min after waking: 10.6%</td>
<td>Confidence in ability to sustain abstinence (1-10 scale), mean: 6.3</td>
<td>Past year quit attempt: 42.9%</td>
</tr>
</tbody>
</table>

[^1]: Score of 15 and above indicates high motivation to quit.
[^2]: Score of 8 or greater indicates high nicotine dependence.
[^3]: 1 to 5 point Likert scale where a score of 1 indicates very low motivation to quit and a score of 5 indicates very high motivation to quit.

**Abbreviations:** AUTOS = autonomy over smoking scale; CPD = cigarettes per day; e-cig = electronic cigarette; eCO = expired carbon monoxide; FTND = fagerstrom test of nicotine dependence; NR = not reported; PPM = parts per million; SES = socioeconomic status.
## Appendix F Table 2. Intervention and Control Characteristics From Trials of Electronic Cigarettes for Tobacco Cessation

<table>
<thead>
<tr>
<th>Author, Year</th>
<th># of trial arms</th>
<th>Primary e-cig component</th>
<th>Additional intervention components</th>
<th>Behavioral support component description</th>
<th>Number and length of visit(s)</th>
<th>Setting</th>
<th>Delivered intervention details</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bullen, 2013⁴³</td>
<td>3</td>
<td>ARM 1 Elusion e-cigs I with 16 mg/mL nicotine cartridges for 12 weeks</td>
<td>Participants received a free e-cig and sufficient nicotine cartridges to last for 4–5 weeks. Participants instructed to use the device exclusively for 12 weeks</td>
<td>All participants referred to the New Zealand smoking cessation support helpline for a standardized cessation behavioral support program delivered by trained advisors, with a minimum of one follow-up support telephone call over 8–12 weeks. If participants did not want to receive this support, they had access to other support services such as ‘Txt2Quit’ (a mobile phone-based support service), ‘QuitCoach’ (an internet-based support service), and the ‘Quitter’s community’ (an internet-based blogging forum)</td>
<td>Total #: 4 Baseline visit, and 3 follow-up visits at months 1, 3 and 6.</td>
<td>Academic Clinics Research investigator(s)</td>
<td>Participants using both nicotine and placebo e-cigs reported having used an average of 0·7 cartridges per day at 6 months Nicotine patches were used as instructed (an average of one 21mg patch per day) At 6 months, in both the nicotine e-cig and NRT groups, two participants had used bupropion and five had used varenicline in the past month; in the placebo e-cig group, three participants reported using varenicline.</td>
<td>At the 6-month follow-up, adherence to study treatments was significantly higher in the nicotine e-cig group as compared with the NRT group (p&lt;0·0001) and with the placebo e-cig group (p&lt;0·0001) 29% (71/241) of the nicotine e-cig group and 35% (20 of 57) of the placebo e-cig group persisted with e-cigarette use, with only 8% (17/215) of those in the NRT group still using patches.</td>
</tr>
</tbody>
</table>
### Appendix F Table 2. Intervention and Control Characteristics From Trials of Electronic Cigarettes for Tobacco Cessation

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Trial name</th>
<th># of trial arms</th>
<th>Primary e-cig component</th>
<th>Additional intervention components</th>
<th>Behavioral support component description</th>
<th>Number and length of visit(s)</th>
<th>Setting</th>
<th>Delivered intervention details</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caponnetto, 2013[^141]</td>
<td>ECLAT</td>
<td>3</td>
<td>ARM 1: Categoria e-cig (model 401) with 7.2 mg nicotine cartridges used at will for 12 weeks</td>
<td>ARM 3: Placebo with Categoria e-cig (model 401) e-cigs and 12 weeks supply of no-nicotine cartridges</td>
<td>NA</td>
<td>Total #: 9 baseline visit and eight follow up visits at weeks 2, 4, 6, 8, 10, 12, 24 and 52.</td>
<td>Academic Clinics Research investigator(s)</td>
<td>Median cartridge use at 6- and 12-month followup was 0 (IQR 0-2) for the whole cohort and did not differ between study arm</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td>ECLAT</td>
<td>3</td>
<td>ARM 2: Categoria e-cig (model 401) with two 6-week supplies of cartridges, one of the 7.2 mg nicotine cartridges and a further 6 weeks with supply of 5.4 mg nicotine cartridges; used at will for 12 weeks total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hajek, 2019[^145]</td>
<td>TEC</td>
<td>2</td>
<td>One Kit (Aspire) e-cigs with 18mg nicotine cartridges for 52 weeks</td>
<td>NRT with any type of product (patch, gum, lozenge, nasal spray, inhalator, mouth spray, mouth strip, and microtabs) for 52 weeks</td>
<td>All the participants received the same multisession behavioral support as per U.K. stop-smoking service practice. This support involved weekly one-on-one sessions with local clinicians, who</td>
<td>Total #: 4 Baseline visit, and 3 followup visits at weeks 4, 26, and 52.</td>
<td>National Health Service (NHS) stop-smoking clinics</td>
<td>Most participants in the e-cig group started to purchase their own e-liquids from the first week onwards, with only 7% requesting the second bottle. The mean nicotine content was 18mg/ml, 12mg/ml and 8mg/ml at 4, 26 and 52 weeks, respectively.</td>
<td>At 12 months follow-up, 5.7% of EC arm participants reported using non-allocated NRT for at least five consecutive days in the past six months and 22.2% of NRT arm participants reported using non-allocated EC</td>
</tr>
</tbody>
</table>
Appendix F Table 2. Intervention and Control Characteristics From Trials of Electronic Cigarettes for Tobacco Cessation

<table>
<thead>
<tr>
<th>Author, Year</th>
<th># of arms</th>
<th>Primary e-cig component</th>
<th>Additional intervention components</th>
<th>Behavioral support component description</th>
<th>Number and length of visit(s)</th>
<th>Setting</th>
<th>Delivered intervention details</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walker, 2019</td>
<td>3</td>
<td>ARM 1 eVOD e-cigarette (2nd gen) starter pack with a supply of 18mg/mL nicotine e-liquid cartridges used ad libitum for 14 weeks + NRT (as described in Arm 3)</td>
<td>different strengths and flavors</td>
<td>faster-acting oral product. Participants were also free to switch product at any time during the follow-up period.</td>
<td></td>
<td></td>
<td>88% of NRT arm participants used NRT combinations. This comprised mostly patch plus one of the oral products</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ARM 2 eVOD e-cigarette (2nd gen) starter pack with a supply of placebo (no nicotine) e-liquid cartridges used ad libitum for 14 weeks + NRT (as described in Arm 3)</td>
<td></td>
<td>also monitored expired carbon monoxide levels for at least 4 weeks after the quit date</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ARM 3</td>
<td>Participants randomized to e-cigs were allowed to choose between two preselected flavors of e-liquid in the starter packs, after which both e-cigarette groups were free to seek out new e-cigs and other e-liquids at will</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>in the patch-only group, 15% of the participants crossed over and used e-cigarettes and 11% in the placebo e-cig group reported using nicotine e-cigs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Participants only received a median of 3 of the 6 scheduled
### Appendix F Table 2. Intervention and Control Characteristics From Trials of Electronic Cigarettes for Tobacco Cessation

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Trial name Quality</th>
<th># of trial arms</th>
<th>Primary e-cig component</th>
<th>Additional intervention components</th>
<th>Behavioral support component description</th>
<th>Number and length of visit(s)</th>
<th>Setting</th>
<th>Delivered intervention details</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpenter, 2017</td>
<td>Fair 143</td>
<td>3</td>
<td>ARM 1 BluCig Starter Pack, with 16 mg/mL nicotine used at will (with minimal instruction) for 4 months. ARM 2 Midway through the study, the manufacturer of Blu altered the product and discontinued availability of the device, replaced with BluPlus+, with 24 mg/mL nicotine, again offered in both tobacco and menthol flavorings</td>
<td>ARM 3 Control group continued smoking with conventional cigarettes</td>
<td>NRT with a 21mg, 24-hour nicotine patch (Habitrol); one patch per day for 14 weeks</td>
<td>NA</td>
<td>Total #: 7 Baseline visit and 6 follow up visits at weeks 2, 3, 4, 8, 12, and 16. Visit length: NR</td>
<td>Academic Clinics Research investigator(s)</td>
<td>44/46 participants randomized to the e-cig group used the e-cig at least once. Most participants reported a high frequency of use during the sampling period (&gt;5 days per week), which decreased to about 3 days per week during follow-up. Over the 21-day sampling period, average duration of e-cig use was 15.4 days among 16 mg e-cig participants and 17.0 days among the 24 mg e-cig group. Just under half (48%) of 24 mg e-cig participants used product all 21 days of the sampling period, versus 30% of 16 mg e-cig participants.</td>
</tr>
</tbody>
</table>
## Appendix F Table 2. Intervention and Control Characteristics From Trials of Electronic Cigarettes for Tobacco Cessation

<table>
<thead>
<tr>
<th>Author, Year &amp; Quality</th>
<th># of trial arms</th>
<th>Primary e-cig component</th>
<th>Additional intervention components</th>
<th>Behavioral support component description</th>
<th>Number and length of visit(s)</th>
<th>Setting</th>
<th>Delivered intervention details</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cravo, 2016 Fair 144</td>
<td>2</td>
<td>Prototype e-cig, developed by Fontem Ventures, with 2.7 mg nicotine capsules (menthol or tobacco flavor) for 12 weeks</td>
<td>Control group continued smoking with their own usual conventional cigarette brand for 12 weeks</td>
<td>Control group used a mean of 3.29 to 4.15 capsules per day over the study weeks.</td>
<td>Total #: 8 Baseline visit and 7 followup visits at weeks 1, 2, 4, 6, 8, 10, and 12. Visit length: NR</td>
<td>Ambulatory care settings Research investigator(s)</td>
<td>Subjects in the e-cig arm used a mean ISO nicotine yield of 0.81 mg and mean ISO tar yield of 9.2 mg. The mean daily CC use in the CC group over the 12 study weeks ranged from 12.33 to 14.1 CPD. Subjects in the e-cig arm used a mean of 3.29 to 4.15 capsules per day over the study weeks. The proportion of EVP-compliant subjects was highest in the subgroup of subjects with lowest CPD consumption at baseline and decreased with increasing CPD at baseline. EVP-compliant subjects did not use more EVP capsules than less-compliant subjects.</td>
<td>A total of 123 subjects (40.2%) were classified as “EVP-compliant” and 183 (59.8%) were classified as “less-EVP-compliant”.</td>
</tr>
<tr>
<td>Masiero, 2017 Fair 147</td>
<td>3</td>
<td>ARM 1 VP5 e-cig with 8mg nicotine cartridges for 3 months. Each participant received an e-cig kit and 12 10-mL liquid cartridges (8 mg/mL nicotine)</td>
<td>Placebo e-cig with VP5 e-cig Each participant received an e-cig kit and 12 10-mL liquid that did not contain nicotine free of charge. Participants were asked</td>
<td>Participants in all arms also received a low-intensity telephone counseling. The counselor provided information, supported participants’</td>
<td>Total #: 4 Baseline visit, and 3 followup visits at months 1, 2, and 3. Visit length: NR</td>
<td>Oncology Clinics</td>
<td>Participants in Arm 3 reported smoking an average of 10.034 cigarettes/day, while participants in Arm 1 and Arm 2 showed a lower consumption (7.671 and 9.091, respectively). Usage of the e-cig was assessed via a monthly telephone interview. Participants in Arm 1 and Arm 2 had a similar compliance in the use of e-cigs. And there was no...</td>
<td>...</td>
</tr>
</tbody>
</table>
## Appendix F Table 2. Intervention and Control Characteristics From Trials of Electronic Cigarettes for Tobacco Cessation

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Trial name</th>
<th># of trial arms</th>
<th>Primary e-cig component</th>
<th>Additional intervention components</th>
<th>Behavioral support component description</th>
<th>Number and length of visit(s)</th>
<th>Setting</th>
<th>Delivered intervention details</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tseng, 2016</strong>&lt;sup&gt;149&lt;/sup&gt;</td>
<td>Fair</td>
<td>2</td>
<td>ARM 1 NJOY, King Bold disposable e-cigs with 4.5% nicotine (tobacco flavor only) for 3 weeks ARM 2 Placebo with no-nicotine NJOY, King Bold disposable e-cigarettes (tobacco flavor only) for 3 weeks</td>
<td>Minimum EC use instruction was provided</td>
<td>Prior to receiving the ECs, subjects were required to complete a counseling session with a trained tobacco cessation counselor to review current smoking patterns and offer behavioral change strategies. These included specific smoking reduction options and other strategies to manage urges</td>
<td>Total #: 3 Baseline visit, and 2 followup visits at weeks 1 and 3. Visit length: NR, but counseling visit was 20-30 min in length</td>
<td>Ambulatory care settings Research investigator(s)</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

**Abbreviations:** CC = conventional cigarettes; CPD = cigarettes per day; e-cigs = electronic cigarettes; NR = not reported.
Appendix G Figure 1. NRT Interventions for Smoking Cessation During Pregnancy, Preterm Birth at <37 Weeks
Appendix G Figure 2. NRT Interventions for Smoking Cessation During Pregnancy, Mean Birth Weight in Grams

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Comparator</th>
<th>Mean birthweight difference (95% CI)</th>
<th>N. mean Treatment (SD)</th>
<th>N. mean Control (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin, 2014</td>
<td>Placebo</td>
<td>50.00 (-71.96, 171.96)</td>
<td>192, 3065 (810)</td>
<td>192, 3015 (810)</td>
</tr>
<tr>
<td>Coleman, 2012</td>
<td>Placebo</td>
<td>-20.00 (-92.87, 52.87)</td>
<td>521, 3180 (610)</td>
<td>521, 3200 (590)</td>
</tr>
<tr>
<td>Oncken, 2008</td>
<td>Placebo</td>
<td>337.00 (159.71, 514.29)</td>
<td>93, 3287 (566)</td>
<td>90, 2950 (653)</td>
</tr>
<tr>
<td>Wisborg, 2000</td>
<td>Placebo</td>
<td>186.00 (38.00, 336.00)</td>
<td>124, 3457 (805)</td>
<td>128, 3271 (805)</td>
</tr>
<tr>
<td>El-Mohandes, 2013</td>
<td>No Placebo</td>
<td>206.00 (-92.04, 504.04)</td>
<td>25, 3203 (588)</td>
<td>25, 2997 (482)</td>
</tr>
<tr>
<td>Pollack, 2007</td>
<td>No Placebo</td>
<td>-95.00 (-306.29, 116.29)</td>
<td>109, 3053 (881)</td>
<td>57, 3148 (648)</td>
</tr>
</tbody>
</table>
Appendix G Figure 3. NRT Interventions for Smoking Cessation During Pregnancy, Low Birth Weight (<2500 g)*

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Comparator</th>
<th>OR (95% CI)</th>
<th>n(N (%), IG</th>
<th>n(N (%), CG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin, 2014</td>
<td>Placebo</td>
<td>0.79 (0.45, 1.39)</td>
<td>27/192 (14.1)</td>
<td>33/192 (17.2)</td>
</tr>
<tr>
<td>Cowman, 2012</td>
<td>Placebo</td>
<td>1.38 (0.90, 2.09)</td>
<td>56/507 (11.1)</td>
<td>43/517 (8.3)</td>
</tr>
<tr>
<td>Oncken, 2008</td>
<td>Placebo</td>
<td>0.09 (0.02, 0.43)</td>
<td>2/93 (2.2)</td>
<td>16/85 (18.8)</td>
</tr>
<tr>
<td>Wisborg, 2006</td>
<td>Placebo</td>
<td>0.35 (0.11, 1.13)</td>
<td>4/120 (3.3)</td>
<td>11/122 (9.0)</td>
</tr>
<tr>
<td>El-Mohandes, 2013</td>
<td>No Placebo</td>
<td>0.72 (0.14, 3.59)</td>
<td>3/25 (12.0)</td>
<td>4/25 (16.0)</td>
</tr>
<tr>
<td>Pollack, 2007</td>
<td>No Placebo</td>
<td>1.92 (0.67, 5.51)</td>
<td>17/109 (15.6)</td>
<td>5/57 (8.8)</td>
</tr>
</tbody>
</table>

* When adequate data were not available in trial publications, results that were obtained directly from study authors by Coleman and colleagues and cited in their recent Cochrane review were used.

NOTE: Study reported odds ratios were used when reported in original publication.
### Appendix G Figure 4. NRT Interventions for Smoking Cessation During Pregnancy, Stillbirth*

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Comparator</th>
<th>RR (95% CI)</th>
<th>NRT Events</th>
<th>No NRT Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin, 2014</td>
<td>Placebo</td>
<td>0.80 (0.22, 2.94)</td>
<td>4/203</td>
<td>5/203</td>
</tr>
<tr>
<td>Coleman, 2012</td>
<td>Placebo</td>
<td>2.53 (0.49, 13.00)</td>
<td>5/512</td>
<td>2/519</td>
</tr>
<tr>
<td>Oncken, 2008</td>
<td>Placebo</td>
<td>1.82 (0.17, 19.74)</td>
<td>2/100</td>
<td>1/91</td>
</tr>
<tr>
<td>Pollack, 2007</td>
<td>No Placebo</td>
<td>0.99 (0.09, 10.72)</td>
<td>2/119</td>
<td>1/59</td>
</tr>
</tbody>
</table>

* When adequate data were not available in trial publications, results that were obtained directly from study authors by Coleman and colleagues and cited in their recent Cochrane review were used.
### Appendix G Figure 5. NRT Interventions in Placebo-Controlled Trials for Smoking Cessation During Pregnancy, Smoking Cessation (KQ 2)

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Events, RR (95% CI)</th>
<th>Events, %</th>
<th>NRT</th>
<th>Placebo</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin, 2014</td>
<td>1.08 (0.47, 2.48)</td>
<td>11/203</td>
<td>10/199</td>
<td>8.94</td>
<td></td>
</tr>
<tr>
<td>Coleman, 2012</td>
<td>1.24 (0.83, 1.86)</td>
<td>49/521</td>
<td>40/529</td>
<td>38.91</td>
<td></td>
</tr>
<tr>
<td>Oncken, 2008</td>
<td>1.21 (0.64, 2.29)</td>
<td>18/100</td>
<td>14/94</td>
<td>15.22</td>
<td></td>
</tr>
<tr>
<td>Wisborg, 2000</td>
<td>1.11 (0.74, 1.68)</td>
<td>35/124</td>
<td>32/126</td>
<td>36.93</td>
<td></td>
</tr>
<tr>
<td>Overall (i-squared = 0.0%, p = 0.978)</td>
<td>1.17 (0.91, 1.51)</td>
<td>113/948</td>
<td>96/948</td>
<td>100.00</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: Weights are from random effects analysis

NOTE: Pooled estimate from REML with Knapp-Hartung modification: RR= 1.17 (95% CI 0.78 to 1.76).
### Appendix G Table 1. Population Details From NRT Trials for Smoking Cessation Among Pregnant Women

<table>
<thead>
<tr>
<th>Author, Year Trial name Quality</th>
<th>Mean age</th>
<th>Weeks’ gestation at BL, mean (range)</th>
<th>SES</th>
<th>Race</th>
<th>OB &amp; medical Hx</th>
<th>Median CPD and Nicotine dependence</th>
<th>Readiness to quit</th>
<th>Quit Hx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin, 2014&lt;sup&gt;151&lt;/sup&gt; SNIPP Good</td>
<td>29.3*</td>
<td>NR (9-12 week’s gestation)</td>
<td>% Married*: 85 Edu: NR Employment*: 57% employed; Housewife: 22%; Unemployed or Student: 21% Other SES*: Annual household income (Euro), % &lt;12,000: 32.6 12,000 – 30,000: 50.0 30,000 – 100,000: 16.7 &gt; 100,000: 0.7</td>
<td>95% European 3% African</td>
<td>% Nulliparous*: 27.9 % with hx of Premature birth(s)<em>: 9.5 % with hx of small gestational age</em>: 10.7 Other medical: Maternal Disorders before randomization*: 9.5%</td>
<td>10.5* Fagerstrom test (0 to 10), Median: 4.5 (IQR 3-6)</td>
<td>Participants were required to have scored at least a 5 on a motivational scale (range 0-10)</td>
<td>Previous quit attempts (≥ 1 week): 1 (IQR 0-2)</td>
</tr>
<tr>
<td>El-Mohandes, 2013&lt;sup&gt;157&lt;/sup&gt; Fair</td>
<td>27.5*</td>
<td>18.5 (&lt;30 weeks’ gestation)</td>
<td>% Married*: 12 Edu: % &lt;HS degree: 33 HS graduate*: 50 At least some college: 17% Employment: % Full time: 17 % part-time: 13 % Not employed: 69 Other SES: Medicaid: 45 (96%)</td>
<td>% African American: 100</td>
<td>% Nulliparous: NR Pregnancies (+current), mean: 5.6 Number of live births, mean: 2.4 Alcohol use during pregnancy: 16 (31%) Any depressive symptoms: 31 (60%) Marijuana during pregnancy: 12 (235)</td>
<td>Mean # CPD &lt;7days: 6.0 Nicotine dependence: NR</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>
## Appendix G Table 1. Population Details From NRT Trials for Smoking Cessation Among Pregnant Women

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<thead>
<tr>
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<th>Race</th>
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<th>Median CPD and Nicotine dependence</th>
<th>Readiness to quit</th>
<th>Quit Hx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coleman, 2012\textsuperscript{152} SNAP Good</td>
<td>26.3*</td>
<td>16.3 (12-24 weeks’ gestation)</td>
<td>% Married*: NR Edu*: NR Employment: NR Other SES: NR Mean age at leaving full-time education, yrs*: 16.3</td>
<td>% White British*: 97.0</td>
<td>% Nulliparous*: 0-1: 68.5</td>
<td>14 Nicotine dependence: NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Oncken, 2008\textsuperscript{159} Fair</td>
<td>25.1</td>
<td>17.1 (≤26 weeks’ gestation)</td>
<td>% Married†: 30 Edu: &lt;HS grad: 50 HS grad: 33.5 Employment: 33 Other SES: Public Insurance: 83% Private Insurance: 17%</td>
<td>% Non-Hispanic White: 35 % Non-Hispanic Black: 30 % Hispanic: 54 % other: 3%</td>
<td>% Nulliparous: 16.5</td>
<td>14 Mean # CPD, last 7 days: 9.45 Mean Fagerstrom scores: 3.55 (IQR 1.93)</td>
<td>NR</td>
<td>Number of previous quit attempts: 2.79</td>
</tr>
</tbody>
</table>
# Appendix G Table 1. Population Details From NRT Trials for Smoking Cessation Among Pregnant Women

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Mean age</th>
<th>Weeks’ gestation at BL, mean (range)</th>
<th>SES</th>
<th>Race</th>
<th>OB &amp; medical Hx</th>
<th>Median CPD and Nicotine dependence</th>
<th>Readiness to quit</th>
<th>Quit Hx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollak, 2007</td>
<td>27</td>
<td>18 (13-25 weeks’ gestation)</td>
<td>% Married†: 30</td>
<td>% White: 69</td>
<td>Substance abuse Tx Hx: 18.5%</td>
<td>Mean CPD: 11 (5)</td>
<td>&quot;Desire to quit&quot; Mean: 6 (1)</td>
<td>Quit at least 24 hours during this pregnancy: 28%</td>
</tr>
<tr>
<td>Baby Steps</td>
<td></td>
<td></td>
<td>Edu: &lt;HS grad: 28</td>
<td>% with hx of Premature birth(s)*: 15</td>
<td>Nicotine dependence mean (SD): 3 (1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td></td>
<td></td>
<td>HS grad†: 31</td>
<td>% with hx of small gestational age*: 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>College degree or higher: 5</td>
<td>Other medical:</td>
<td>Number of prior pregnancies median (median, IQR): 2 (1,4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Employment:</td>
<td>Premature rupture of membranes: 7%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>% Full-time: 67</td>
<td>% with hx of high blood pressure: 19%</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>% part-time: 17</td>
<td>Prior history of miscarriage, ectopic pregnancy, or stillbirth: 50%</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>% Unemployed: 67</td>
<td>Other medical:</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other SES: NR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wisborg, 2000</td>
<td>28.4</td>
<td>NR (&lt;22 weeks’ gestation)</td>
<td>% Married*†: 76.5</td>
<td>% Nulliparous: 42.8</td>
<td>Mean CPD: 13.8</td>
<td>Mean Fagerstrom score: Listed but no data provided</td>
<td>NR</td>
<td>Previous attempts to quit, %* 0-2: 68.8 3-15: 31.2</td>
</tr>
<tr>
<td>Fair</td>
<td></td>
<td></td>
<td>Edu: Years of schooling*: &lt;10: 18.4</td>
<td>% with hx of Premature birth(s): NR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≥ 10: 66.8</td>
<td>% with hx of small gestational age: NR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Missing: 14.8</td>
<td>Other medical:</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Employment:</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>% Employed*: 51</td>
<td>% Nulliparous:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other SES:</td>
<td>42.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Appendix G Table 1. Population Details From NRT Trials for Smoking Cessation Among Pregnant Women

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Mean age</th>
<th>Weeks' gestation at BL, mean (range)</th>
<th>SES</th>
<th>Race</th>
<th>OB &amp; medical Hx</th>
<th>Median CPD and Nicotine dependence</th>
<th>Readiness to quit</th>
<th>Quit Hx</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>NR</td>
<td></td>
<td>Alcohol intake (drinks/wk)*: 0–2: 87.5%; ≥3: 9%; Missing: 11%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Calculated
† Married includes married or cohabitating
‡ HS graduate or GED
§ Defined as any previous pregnancy which lasted from 24 to 37 weeks
ǁ The median number of days before recruitment that women last used NRT among the 47 women who reported current or past use was 31 days for the NRT group (IQR 15 to 38 days) and 30 for the placebo group (IQR 14 to 68 days).

**Abbreviations:** BL = baseline; CPD = cigarettes per day; HS = high school; hx = history; IQR = interquartile range; NR = not reported; SES = socioeconomic status; Tx = treatment; yrs = years
Appendix G Table 2. Intervention Characteristics From NRT Trials for Smoking Cessation Among Pregnant Women, by Study Design

<table>
<thead>
<tr>
<th>Author, Year Trial name</th>
<th>Quality</th>
<th>NRT component</th>
<th>Behavioral component description</th>
<th>Number and length of visit(s)</th>
<th>Setting Provider</th>
<th>Delivered intervention details</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin, 2014 SNIPP65</td>
<td>Good</td>
<td>NRT, patch 10 mg and 15 mg; 16 hour delivery nicotine patches</td>
<td>Behavioral support Participants received behavioral support at each visit. Although the personalized, individual behavioral interventions were not specifically standardized, and the participating maternity wards could use their discretion to apply their own standard methods, these interventions were based on the national consensus document. The study’s website along with flyers in waiting rooms provided information that participants would receive personalized (not within groups) interventions by healthcare professionals specialized in smoking cessation. The core feature of the behavioral interventions included motivational interviewing, arrangement for follow-ups, behavioral counselling, establishment of good doctor-patient and midwife-patient relationships, and a clear definition of treatment aims</td>
<td>Total #: 7 Initial visit 1hr, following visits at least 10min</td>
<td>Maternity ward Research investigator(s)</td>
<td>Daily dose ranged from 10-30 mg/day Mean daily prescription dose for entire tx period IG: 18mg (SD 6.8mg), CG: 19.2 (SD 6.9mg). Median length of prescription was: IG: 105 days (IQR 35-175), CG: 70 (IQR 35-175) In total, 21,722 nicotine patches and 19,702 placebo patches were issued to the participants</td>
<td>Compliance was recorded among 307 (76%) participants at 1016 visits, self-reported. Compliance assessed in 164/203 (81%) women in the nicotine patch group and 143/199 (72%) in the placebo patch group. The median self-reported compliance rate was 85% (interquartile range 56-99%) in the nicotine patch group and 83% (56-95%) in the placebo patch group. Completed all visits: IG: 96/203 (47.3%), CG: 76/199 (38.2%)</td>
</tr>
<tr>
<td>Coleman, 2012 SNAP65</td>
<td>Good</td>
<td>Active nicotine patches 15 mg per 16 hours (4wk supply, additional 4wk supply if needed)</td>
<td>Behavioral counseling (1 face-to-face and 3 telephone sessions) At enrollment, research midwives provided behavioral support lasting up to 1 hour. In addition to behavioral support at enrollment, research midwives provided three sessions of</td>
<td>Total #: 4 (1 initial + 3 phone); +1 additional face-to-face for women still smoking after 1mo.</td>
<td>OBGYN, clinical Research midwives</td>
<td>Gum usage ranged from about 90% usage at visit 1 to 30% usage at visit 5. Number of days of gum use [placebo:</td>
<td>At delivery, only 7.2% (35/485) of IG and 2.8% (14/496) CG reported using trial medications for over 1 month</td>
</tr>
</tbody>
</table>
### Appendix G Table 2. Intervention Characteristics From NRT Trials for Smoking Cessation Among Pregnant Women, by Study Design

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<thead>
<tr>
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<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oncken, 2008 Fair</td>
<td>Nicotine gum 2mg; 6 weeks of treatment with the gum followed by a 6-week taper period.</td>
<td>behavioral support by telephone to participants: one session on the quit date, one session 3 days afterward, and one at 4 weeks. The women who collected a second month’s supply of NRT or placebo also received face-to-face support from the research midwife at the time of collection. Women were offered additional support from local National Health Service smoking cessation services and were encouraged to ask for support from the research midwives or smoking cessation service staff; support was provided according to the manual.</td>
<td>Initial visit up to 1hr; phone visits NR</td>
<td>NR Study Nurse (dispensed medication); Smoking cessation therapist; Research assistants</td>
<td>Initial session: lasted an average 64.7 minutes (SD15.8); CBT-only, 61.7, (16.7); and CBT+NRT, 66.1, (15.7). Sessions two through six lasted an average 25.7 minutes (SD14.1); CBTonly, Mean 23.6min, (10.7); and CBT+NRT: M27.0 min, (13.9). CBT+NRT (n=122): 72 selected the patch, 32 selected the placebo</td>
<td>Rates of use of nonstudy nicotine-replacement therapy were very low. Most participants had no additional contact, either face to face or by text message, with smoking-cessation advisors. Median number of extra phone contacts: 2 in each group</td>
</tr>
</tbody>
</table>
### Appendix G Table 2. Intervention Characteristics From NRT Trials for Smoking Cessation Among Pregnant Women, by Study Design

<table>
<thead>
<tr>
<th>Author, Year</th>
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<th>Setting Provider</th>
<th>Delivered intervention details</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wisborg, 2000</td>
<td>NRT, patch (15 mg/ 16 hrs for 8)</td>
<td>Behavioral counseling (4 visits)</td>
<td>Total #: 4</td>
<td>NR</td>
<td>Gum, 12 selected the lozenge, and 6 opted to use no NRT. Mean of 40 patches dispatched, however, women reported using a mean of only 23.4 patches. Gum dispensed to last the women 18 days; they reported using gum for 8 days. Lozenges dispensed to last 19 days; the women reported using lozenges for a mean of 4 days. Overall, 76% of the women in the CBT+NRT arm reported using some form of NRT. Only four women in the CBT-only arm reported using NRT.</td>
<td>In the nicotine group 17% used all</td>
</tr>
</tbody>
</table>
### Appendix G Table 2. Intervention Characteristics From NRT Trials for Smoking Cessation Among Pregnant Women, by Study Design

<table>
<thead>
<tr>
<th>Author, Year</th>
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<th>NRT component</th>
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<th>Delivered intervention details</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair</td>
<td>Fair</td>
<td>weeks, 10 mg/16 hrs for 3 weeks) planned for 11 weeks.</td>
<td>Prenatal smoking cessation counseling with a midwife four times during pregnancy. Visits were independent of routine antenatal care visits. At first visits, which lasted 45–60 minutes, participants were interviewed about their smoking habits and previous attempts to stop smoking. Women were informed about pharmacologic and psychologic aspects of smoking and the consequences of smoking during pregnancy. Methods to stop smoking were carefully explained and the day of stopping was planned. A pamphlet on smoking and pregnancy also was distributed; pamphlets contained information about the harmful effects of smoking and gave brief advice on smoking cessation. Initial visit: 45-60 min; remaining 3 lasted 15-20 min</td>
<td>Study midwife</td>
<td>15-mg patches and 11% used all 10-mg patches. In the placebo group 8% and 7% used all patches.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>El-Mohandes, 2013</td>
<td>Fair</td>
<td>Trans-dermal NRT, 14-21mg for 10 wks depending on CPD</td>
<td>Behavioral counseling (5 face-to-face and 1 telephone session) Delivery of an evidenced-based intervention: the Smoking Cessation or Reduction in Pregnancy Treatment (SCRIPT) Program. In addition to counseling, women were given A Pregnant Woman’s Guide to Quit Smoking, a manual to assist patients with problem-solving and coping skills, written at a 6th grade reading level. Women who continued after visit 1 received reinforcement and behavioral methods at Visits 2–5. Total #: 6 (max) Varied: “Frequency of contact and total time with each patient was standardized”</td>
<td>Clinical, private room</td>
<td>Majority received between 31-60 min (82%), 15.7% received &lt;30 min, and 2.3% received over 60 min behavioral support</td>
<td>Sixty-five percent of patients completed the NRT protocol. CG patients were adherent to the scheduled counseling and assessment visits. Although adherence levels in the IG and CG were comparable for Visit 1 to 4, the NRT Implementation Index was much</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix G Table 2. Intervention Characteristics From NRT Trials for Smoking Cessation Among Pregnant Women, by Study Design

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<tr>
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<th>Delivered intervention details</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollak, 2007</td>
<td>Choice of NRT from patch (7-21 mg/16 hrs depending on cpd), gum (2 mg per each cpd), or lozenge (2 mg per each cpd). Each woman's NRT dose was based on current smoking level: Overall encouraged to use NRT for 6wks.</td>
<td>All women received six one-on-one counseling sessions (five face-to-face at prenatal visits and one via telephone) designed to enhance motivation and develop skills needed to quit smoking. “Quit kit” given: a smoking cessation booklet designed for pregnant smokers (Make Yours a Fresh Start Family), water bottle, straws, hard candy, an exercise band, and a stress management tape. Support specialists helped the women devise an action plan. After the first session, each woman was mailed a card containing details of her action plan. In all sessions, support specialists attempted to increase the women’s motivation, self-efficacy, and skills. In addition to the smoking-specific content, support specialists covered a relevant content area (stress, rewards, social support, and relapse prevention). The counseling protocol was based on motivational interviewing, the transtheoretical model of behavior change, and social cognitive theory.</td>
<td>Total #: NR</td>
<td>Clinical (prenatal visits), 1 phone Support specialist (Behav)</td>
<td>The median number of patches used was 14 (range 0–77) in the nicotine group and 7 (range 0–77) in the placebo group. Women who did not attend visits were given another appointment within the subsequent 2 weeks. If they did not attend again they were contacted by telephone. At second, third, and fourth visits, 76 (31%), 106 (44%), and 129 women (53%), respectively, were telephoned.</td>
<td>A greater proportion of the women in the CBT+NRT arm completed four or more sessions (four was median number of sessions) than did women in the CBT-only arm (70% vs 53%, p=0.02, RD=0.17, 95% CI 0.10–0.24).</td>
</tr>
</tbody>
</table>

### Abbreviations:
- BL = baseline; CBT = cognitive behavioral therapy; CG = control group; CI = confidence interval; CPD = cigarettes per day; IG = intervention group; mg = milligram; min = minute(s); NR = not reported; NRT = nicotine replacement therapy; OBGYN = obstetrics and gynecology; RCT = randomized controlled trial; RD = risk difference; SES = socioeconomic status; Tx = treatment; wks = weeks; yrs = years
Appendix H Table 1. Intervention Details of Behavioral Interventions Among Adults

<table>
<thead>
<tr>
<th>Intervention Type</th>
<th>Physician or nurse advice</th>
<th>Individual or group-based counseling</th>
<th>Telephone and mobile phone-based interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary population</td>
<td>Adult smokers who were typically motivated to quit, including generally healthy smokers as well as those with specific health needs such as those with smoking-related diseases and people with mental illness.</td>
<td>Smoking cessation at the longest followup (at 6 months or more) using the strictest definition of abstinence, preferring sustained over point prevalence abstinence and using biochemically validated rates where available.</td>
<td>Providing proactive telephone counselors after smokers have called a Quitline improves rates of smoking cessation (RR 1.38 [95% CI, 1.19 to 1.61]; k=14; n=32,484), and moderate quality evidence that proactive telephone counseling increases quit rates in smoking in other settings (RR 1.25 [95% CI, 1.15 to 1.35]; k=65; n=41,233). Mobile phone-based interventions were less commonly studied but showed a positive benefit on smoking cessation at 6 months’ followup compared with usual care or a minimal intervention (RR 1.54 [95% CI, 1.19 to 2.00]; k=13; n=14,133) and no intervention (RR 1.59 [95% CI, 1.09 to 2.33]; k=4; n=997).</td>
</tr>
<tr>
<td>Primary outcomes measured</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study findings</td>
<td>Physician and nurse advice can increase the rate of smoking cessation at 6 or more months followup (RR for physician advice 1.76 [95% CI, 1.58 to 1.96]; 26 trials; n=22,239 and for nurse advice 1.29 [95% CI, 1.21 to 1.38]; k=44; n=20,881).</td>
<td>Individual counseling from a smoking cessation specialist increases the rate of cessation among smokers at 6 or more months followup versus no advice, brief advice, or self-help materials (RR 1.48 [95% CI, 1.34 to 1.64]; k=33; n=13,762) and moderate quality evidence that compared with non-group self-help programs, group-based therapy interventions can increase quitting smoking (RR 1.88 [95% CI, 1.52 to 2.33]; k=13; n=4395).</td>
<td></td>
</tr>
<tr>
<td>Behavior change goals and techniques</td>
<td>Advice was defined as verbal instructions from the provider with a “stop smoking” message irrespective of whether information was provided about the harm effects of smoking; however, the included interventions were highly variable. In most cases, advice was given verbally and was supplemented with print materials, additional advice from additional healthcare staff, or referral to a cessation clinic.</td>
<td>Typically included: review of smoking history and motivation to quit, help in the identification of high-risk situations, and the generation for problem-solving strategies to deal with such situations as well as non-specific support and encouragement. Many group-based sessions included cognitive behavioral therapy. Additional components such as written materials, video or audiotapes were also sometimes provided.</td>
<td>Telephone counseling and mobile phone-based interventions were generally tailored according to participants’ smoking history, readiness to quit and focused on increasing motivation and strategies to increase likelihood of quitting.</td>
</tr>
<tr>
<td>Duration of interventions</td>
<td>Most interventions took place during 1 session with followup between 1 week and 3 months.</td>
<td>Most interventions took place during one face-to-face session with followup consultations over 1 week to 4 months followup.</td>
<td>Highly variable ranging from 2 weeks to 1 year with most taking place over 3 to 4 months.</td>
</tr>
<tr>
<td>Settings of studies</td>
<td>Most took place in primary care or hospital settings.</td>
<td>Most took place in hospital or smoking cessation clinic settings.</td>
<td>Most interventions were delivered entirely remotely via telephone or mobile phone, with few providing any face-to-face support.</td>
</tr>
<tr>
<td>To whom is intervention targeted?</td>
<td>Adult smokers motivated to quit.</td>
<td>Adult smokers, regardless of motivation to quit.</td>
<td>Generally adult smokers motivated to quit. Most mobile phone-based interventions targeted younger- (mean age 18-27 years) or middle-aged adults (up to mean age of 45 years).</td>
</tr>
<tr>
<td>Mode and intensity of delivery</td>
<td>Most advice was given during a single consultation lasting less than 20 minutes (with or without print materials) plus up to one followup visits; although several studies compared more</td>
<td>Most individual-based advice was given during one face-to-face session with multiple followup sessions in-person or via the telephone. Group-based sessions included smokers meeting for scheduled meetings delivered over 6 to 8</td>
<td>Telephone counseling was typically delivered in scheduled phone calls that began after smokers had proactively called a smoking Quitline. The number of calls ranged from a single call to 12 calls. The duration of the calls was typically 10 to</td>
</tr>
</tbody>
</table>
## Appendix H Table 1. Intervention Details of Behavioral Interventions Among Adults

<table>
<thead>
<tr>
<th>Intervention Type</th>
<th>Physician or nurse advice</th>
<th>Individual or group-based counseling</th>
<th>Telephone and mobile phone-based interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>sessions, with the first few sessions devoted to discussion of motivation for quitting, health benefits, and strategies for planning a quit attempt.</td>
<td>20 minutes, although the first calls were often longer. Almost all the included trials of mobile phone-based interventions used text messaging (SMS) as a central component of the intervention. The number of text messages varied considerably but often was 0 to 2 messages per day every day over the course of the intervention.</td>
</tr>
<tr>
<td>Example interventions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morgan 1996&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>Bock 2013&lt;sup&gt;8&lt;/sup&gt;</td>
</tr>
<tr>
<td>Canga 2000&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>Curry 1999&lt;sup&gt;9&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fiore 2004&lt;sup&gt;4&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>Ellerbeck 2009&lt;sup&gt;6&lt;/sup&gt;</td>
</tr>
<tr>
<td>Glasgow 2000&lt;sup&gt;4&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>McClure 2005&lt;sup&gt;7&lt;/sup&gt;</td>
</tr>
<tr>
<td>Weissfeld 1991&lt;sup&gt;15&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>Orleans 1991&lt;sup&gt;11&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bock 2013&lt;sup&gt;8&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>Rigotti 2006&lt;sup&gt;12&lt;/sup&gt;</td>
</tr>
<tr>
<td>Curry 1995&lt;sup&gt;9&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ellerbeck 2009&lt;sup&gt;6&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>McClure 2005&lt;sup&gt;7&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orleans 1991&lt;sup&gt;11&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigotti 2006&lt;sup&gt;12&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Materials provided for practice<sup>17</sup>  
Treatment guide: Orleans CT, Rimer BK, Fleisher L. Clear horizons: a quit smoking guide especially for those 50 and over. Philadelphia: FoxChase Cancer Center, 1989. (Morgan 1996<sup>1</sup>)  
Intervention based on protocols established in How to Help Your Patients Stop Smoking: A National Cancer Institute Manual for Physicians<sup>13</sup> and followed the orientation of the Mayo Nicotine Dependence Center<sup>14</sup> (Canga 2000<sup>2</sup>)  
American Lung Association guide (Bock 2013<sup>8</sup>)  

### Evidence of effect modification  
There was insufficient evidence to establish differences according to the intensity of the intervention. There was some evidence that physician advice interventions that provided further followup to a minimal intervention vs. those delivered in one single session were more effective, but this effect was not seen related to nurse advice. There was no evidence that the effects differed by patient group or setting.  
No evidence of effect modification based on whether pharmacotherapy was offered or on population (hospital inpatients or outpatients vs. not). Evidence was too limited to determine whether there was a dose-response effect according to number of contacts or type (face-to-face vs. remote) of followup consultations.  
Some evidence that participants who were selected based on their motivation to quit may be more likely to quit smoking versus those who were not selected on their motivation in response to proactive telephone counseling. There was not enough evidence to suggest that a higher number of calls would result in a larger effect. There were minimal differences in the effectiveness of mobile
### Appendix H Table 1. Intervention Details of Behavioral Interventions Among Adults

<table>
<thead>
<tr>
<th>Intervention Type</th>
<th>Physician or nurse advice</th>
<th>Individual or group-based counseling</th>
<th>Telephone and mobile phone-based interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comparison group</strong></td>
<td>No advice or usual care.</td>
<td>No advice, brief advice, self-help materials, or usual care; non-group-based interventions.</td>
<td>No intervention, self-help materials, or other nontailored and noninteractive remote support.</td>
</tr>
<tr>
<td><strong>Interventionist and training required</strong></td>
<td>Physicians (e.g., general practitioners, family practice) or nursing staff with or without smoking-related duties as part of their core clinical duties. Information about training provided to staff was not synthesized and was rarely reported. In those reporting, training ranged from “brief tutorial” to a 4-hour training.</td>
<td>Smoking cessation specialists often with backgrounds in social work, psychology, psychiatry, health education, and nursing. Training was otherwise not described.</td>
<td>Telephone counseling was most often provided by professional counselors or trained health care professionals. Many text message-based interventions were developed and administered through computer expert generated systems.</td>
</tr>
<tr>
<td><strong>Reported adherence to intervention</strong></td>
<td>Adherence to intervention not synthesized or abstracted by reviews.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Table 1. Intervention Details of Behavioral Interventions Among Adults

## Appendix H Table 2. Intervention Details of Behavioral Interventions Among Pregnant Women

<table>
<thead>
<tr>
<th>Intervention Type</th>
<th>Individual psychosocial interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary population</strong></td>
<td>Generally healthy pregnant adult women over 16 years of age, but including those with specific health needs. About half of the included trials explicitly recruited women categorized as having low socioeconomic status.</td>
</tr>
<tr>
<td><strong>Primary outcomes measured</strong></td>
<td>Smoking cessation in late pregnancy and continued abstinence post-partum. Using the strictest definition of abstinence, preferring sustained over point prevalence abstinence and using biochemically validated rates where available.</td>
</tr>
<tr>
<td><strong>Study findings</strong></td>
<td>Psychosocial interventions among pregnant women increased the rate of smoking cessation in late pregnancy compared with control (RR 1.35 [95% CI, 1.23 to 1.48]; 97 trials; n=26,637).</td>
</tr>
<tr>
<td><strong>Behavior change goals and techniques</strong></td>
<td>Psychosocial interventions were defined as non-pharmacological strategies that use cognitive behavioral, motivational and supportive therapies to help women to quit. This included counselling, health education, feedback, financial incentives, social support from peers and/or partners, and exercise, as well as dissemination trials.</td>
</tr>
<tr>
<td><strong>Duration of interventions</strong></td>
<td>Most interventions recruited women during their first antenatal visit or second trimester of pregnancy; the duration of the intervention typically took place from this time until late pregnancy.</td>
</tr>
<tr>
<td><strong>Settings of studies</strong></td>
<td>Most interventions took place in women’s clinics or tobacco cessation clinics.</td>
</tr>
<tr>
<td><strong>To whom is intervention targeting?</strong></td>
<td>Pregnant women who are currently smoking or have recently quit smoking.</td>
</tr>
<tr>
<td><strong>Mode and intensity of delivery</strong></td>
<td>Smoking cessation interventions implemented during pregnancy differed substantially in their intensity, their duration, and the people involved in their implementation.</td>
</tr>
</tbody>
</table>
| **Example interventions**<sup>†</sup> | Bullock 2009<sup>1</sup>  
Lee 2015<sup>2</sup>  
Pollack 2013<sup>3</sup>  
Stotts 2009<sup>4</sup>  
Windsor 2011<sup>5</sup> |
| **Materials provided for practice**<sup>††</sup> | All patients (both control and experimental groups) received (Ask-Advise-Assess-Arrange) SCRIPT Procedures 1, 2, 3, 9, and 10<sup>6</sup>  
7<sup>8</sup>  
9<sup>9</sup> and experimental group patients also received Assist SCRIPT Procedures 4 through 8, which included a video,<sup>10</sup> guide to quit smoking,<sup>11</sup> and a 10 minute or less counselling session<sup>12</sup> |
| **Evidence of effect modification** | Meta regression analyses found no differences in the effects of behavioral interventions according to the specific intervention strategies, comparator, intensity (categorized according to frequency of contact), intervention duration, the provision of self-help manuals, including telephone support, the SES of the sample, newly added studies, or study design (cluster versus individually randomized trials). |
| **Comparison group**              | Any control |
| **Interventionist and training required** | Varied |
| **Reported adherence to intervention** | Adherence to intervention not synthesized by review. |

<sup>†</sup> Example interventions are those that demonstrated a positive direction of effect on smoking cessation, took place in the United States in primary care or a primary care-applicable setting, and were published in the past 10 years.
## Appendix H Table 2. Intervention Details of Behavioral Interventions Among Pregnant Women

† Inclusion of studies and materials are for example purposes only and does not indicate endorsement by the USPSTF.

** Materials provided for practice include materials or protocols that were noted within the source study and that we were able to locate.


### Appendix I Table 1. Ongoing or Recently Completed Studies: Electronic Cigarettes

<table>
<thead>
<tr>
<th>Study reference/ trial identifier</th>
<th>Study name</th>
<th>Location</th>
<th>Estimated N</th>
<th>Intervention Description</th>
<th>Relevant Outcomes</th>
<th>2019 status (October 2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCT03453385 Matthew Carpenter</td>
<td>Clinical Outcomes of a Nationwide, Naturalistic E-Cig Trial (CONNECT)</td>
<td>USA</td>
<td>660</td>
<td>2-arm smoking cessation trial for 6 months comparing (1) e-cigarettes (2) continued smoking with conventional cigarettes</td>
<td>7-day PPA at 6 months</td>
<td>Recruiting: Est completion date July, 2022</td>
</tr>
<tr>
<td>NCT03511001 Kim Pulvers</td>
<td>Effects Among Smokers Who Use and Do Not Use E-Cigarettes</td>
<td>USA</td>
<td>187</td>
<td>2-arm smoking cessation trial comparing (1) 6 weeks of JUUL e-cigarettes vs. (2) 6 weeks of smoking as usual</td>
<td>Blood pressure outcomes and Respiratory symptoms</td>
<td>Active, but not recruiting: Est completion date December, 2019</td>
</tr>
<tr>
<td>NCT04084210 Megan Piper</td>
<td>Understanding the Real-World Impact of the Use of Three Alternate Nicotine-Delivery Products on Combustible Cigarette Use</td>
<td>USA</td>
<td>200</td>
<td>3-arm smoking cessation trial comparing: 1) Very low nicotine cigarettes (VLNCs); 2) Juul e-cigarettes; or 3) no alternative product. During two different weeks, participants will be asked to switch from their usual cigarettes and use only study products. They will also be asked to use either an active nicotine or placebo patch (the within-subjects factor), provided in double-blind fashion and counterbalanced order.</td>
<td>Number of conventional cigarettes smoked during each Switch Week and Number of VLNCs or JUUL pods used during each Switch Week</td>
<td>Not yet recruiting: Est. completion date March, 2022</td>
</tr>
<tr>
<td>NCT03743532 Darla Kendzor</td>
<td>Preliminary Evaluation of Alternative Approaches to Combustible Cigarette Cessation (Exchange Project Sub-Study)</td>
<td>USA</td>
<td>60</td>
<td>3-arm smoking cessation trial among low SES persons comparing 1) incentives for quitting smoking in addition to combination nicotine replacement therapy (patches + lozenges), 2) the provision of JUUL(device and pods) along with instructions to switch over from combustible cigarettes to e-cigarettes exclusively, or 3) the combination of JUUL and CO-verified 7-day PPA at 1 month</td>
<td>Not yet recruiting: Est. completion date May, 2020</td>
<td></td>
</tr>
</tbody>
</table>
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<th>Study reference/ trial identifier</th>
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<th>Location</th>
<th>Estimated N</th>
<th>Intervention Description</th>
<th>Relevant Outcomes</th>
<th>2019 status (October 2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTRN12612001210864</td>
<td>Can using nicotine as a long-term substitute enhance smoking cessation over using it only as a cessation aid?</td>
<td>Australia</td>
<td>1600</td>
<td>Combination of varying levels of self-help materials, NRT, advice, or e-cigarettes</td>
<td>Continuous abstinence at 6 months&lt;br&gt;7-day PPA at 6 months</td>
<td>Not yet Recruiting</td>
</tr>
<tr>
<td>Coral Gartner</td>
<td>Evaluating the Efficacy of E-Cigarette Use for Smoking Cessation (E3) Trial</td>
<td>Canada</td>
<td>486</td>
<td>3-arm smoking cessation trial with 12 weeks intervention and observation up to 12 months comparing (1) Nicotine e-cigarettes plus minimal behavioral counseling with (2) placebo e-cigarettes plus minimal behavioral counseling and (3) minimal behavioral counseling only</td>
<td>Continuous abstinence verified by exhaled-CO&lt;11ppm at 6 and 12 months&lt;br&gt;7-day PPA verified by exhaled-CO&lt;11ppm at 6 and 12 months&lt;br&gt;Incidence of adverse events/serious adverse events at 3 months</td>
<td>Recruiting: Est completion date December, 2020</td>
</tr>
<tr>
<td>NCT02417467</td>
<td>E-Cigarette Inner City RCT</td>
<td>Canada</td>
<td>200</td>
<td>2-arm smoking cessation trial for 12 months comparing (1) NRT plus behavioral counseling with (2) e-cigarettes plus behavioral counseling</td>
<td>7-day PPA (validated) at 6 and 12 months&lt;br&gt;Quality of life at 6 months</td>
<td>Not yet recruiting: Est completion date September, 2020</td>
</tr>
<tr>
<td>Smita Pakhal</td>
<td>Efficacy and Safety of E-cigarettes for Smoking Cessation in Middle-aged Heavy Smokers (EFFECT)</td>
<td>Finland</td>
<td>450</td>
<td>3-arm smoking cessation trial with 12 weeks intervention and observation up to 12 months comparing (1) Nicotine e-cigarettes + placebo-pills + Motivational</td>
<td>7-day point prevalence abstinence (PPA) verified by exhaled-CO&lt;11ppm at 6 and 12 months&lt;br&gt;Quality of life at 6 months&lt;br&gt;Incidence of adverse events/serious adverse events at 3 months</td>
<td>Recruiting: Est completion date December, 2020</td>
</tr>
</tbody>
</table>
### Appendix I Table 1. Ongoing or Recently Completed Studies: Electronic Cigarettes

<table>
<thead>
<tr>
<th>Study reference/ trial identifier</th>
<th>Primary Investigator</th>
<th>Study name</th>
<th>Location</th>
<th>Estimated N</th>
<th>Intervention Description</th>
<th>Relevant Outcomes</th>
<th>2019 status (October 2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCT03630614</td>
<td>Ivan Berlin</td>
<td>Randomized Trial of Electronic Cigarettes with or Without Nicotine in Smoking Cessation (ECSMOKE)</td>
<td>France</td>
<td>650</td>
<td>3-arm smoking cessation trial for 6 months comparing (1) use of nicotine e-cigarettes plus placebo varenicline tablets with (2) placebo e-cigarettes plus active varenicline and (3) placebo e-cigarettes plus placebo varenicline</td>
<td>7-day PPA at 6 months, Incidence of adverse events at 6 months</td>
<td>Recruiting: Est completion date March, 2022</td>
</tr>
<tr>
<td>NCT01979796</td>
<td>Pasquale Caponnetto</td>
<td>Antismoking Effects of Electronic Cigarettes in Subjects with Schizophrenia and Their Potential Influence on Cognitive Functioning (SCARIS)</td>
<td>Italy</td>
<td>153</td>
<td>3-arm smoking cessation trial among persons with schizophrenia for 3 months (1) nicotine e-cigarettes with (2) placebo e-cigarettes and (3) no-nicotine inhalers</td>
<td>Continuous abstinence verified by exhaled-CO≤7ppm at 12 months</td>
<td>Not yet recruiting: Est completion date December, 2021</td>
</tr>
<tr>
<td>NCT02124187</td>
<td>Eugenio Aguglia</td>
<td>Smoking Cessation and Reduction in Depression (SCARID)</td>
<td>Italy</td>
<td>129</td>
<td>3-arm smoking cessation trial among persons with depression for 3 months comparing (1) nicotine e-cigarettes with (2) placebo e-cigarettes and (3) no-nicotine inhalers</td>
<td>Continuous abstinence verified by exhaled-CO≤7ppm at 12 months</td>
<td>Not yet recruiting: Est completion date June, 2022</td>
</tr>
<tr>
<td>NCT03589989</td>
<td>Reto Auer and Anna Schöni</td>
<td>Electronic Nicotine Delivery Systems (ENDS/Vaporizer/E-cigarette) as an Aid for Smoking Cessation (ESTxENDS)</td>
<td>Switzerland</td>
<td>1,172</td>
<td>2-arm smoking cessation trial for 6 months comparing (1) e-cigarettes plus behavioral counseling with (2) behavioral counseling only</td>
<td>Continuous abstinence verified by urinalysis and exhaled-CO at 6 months, 7-day PPA at 6 months validated by urinalysis</td>
<td>Recruiting: Est completion date January, 2021</td>
</tr>
</tbody>
</table>
# Appendix I Table 1. Ongoing or Recently Completed Studies: Electronic Cigarettes

<table>
<thead>
<tr>
<th>Study reference/ trial identifier</th>
<th>Primary Investigator</th>
<th>Study name</th>
<th>Location</th>
<th>Estimated N</th>
<th>Intervention Description</th>
<th>Relevant Outcomes</th>
<th>2019 status (October 2019)</th>
</tr>
</thead>
</table>

- Incidence of adverse events and withdrawal symptoms at 6 months
- Chemical toxin levels at 6 months
- Change in depressive symptoms, metabolism, stress levels, respiratory symptoms, and sleep quality at 6 months
<table>
<thead>
<tr>
<th>Study reference/ trial identifier/ Primary investigator</th>
<th>Study name</th>
<th>Location</th>
<th>Estimated n</th>
<th>Description</th>
<th>2019 status (May 2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCT01656733/ Cheryl Oncken</td>
<td>Nicotine Replacement for Smoking Cessation During Pregnancy</td>
<td>US</td>
<td>154</td>
<td>Pregnant smokers who smoke at least 5 cigarettes/day will receive nurse-delivered behavioral counseling and be randomized to receive a 6-week course of treatment with either a nicotine inhaler or placebo, followed by a 6-week taper.</td>
<td>Completed: Results submitted to clinical trials but not publicly available. No publication available</td>
</tr>
<tr>
<td>NCT02188459/ Henry Kranzler</td>
<td>Placebo-controlled Trial of Bupropion for Smoking Cessation in Pregnant Women (BIBS)</td>
<td>US</td>
<td>360</td>
<td>A randomized, parallel-group, double-blinded, placebo-controlled, 10 week trial of Bupropion in 360 pregnant women who smoke daily and wish to quit smoking.</td>
<td>Recruiting: Est completion date Dec 2022</td>
</tr>
<tr>
<td>NCT03819231/ David Black</td>
<td>Mindfulness Training Plus Oxytocin (MOXY)</td>
<td>US</td>
<td>180</td>
<td>Clinical trial aimed to examine the effects of mindfulness training and a single 40 IU dose of Pitocin (oxytocin, USP; concentration = 10 IU/1 mL; PAR Pharmaceuticals, NY, USA) on smoking.</td>
<td>Recruiting: Est completion date Dec 2023</td>
</tr>
<tr>
<td>NCT03480373/ Cheryl Oncken</td>
<td>Electronic Cigarette Use During Pregnancy</td>
<td>US</td>
<td>375</td>
<td>Observational study aimed to compare overall toxicant exposure in pregnant women who use e-cigs with women who smoke conventional cigarettes. Will also compare toxicant exposure and birth outcomes among infants born to pregnant women who use e-cigs compared to women who smoke conventional cigarettes.</td>
<td>Recruiting: Estimated completion date: May 2023</td>
</tr>
<tr>
<td>NCT01290445/ Pfizer</td>
<td>Varenicline Pregnancy Cohort Study</td>
<td>Denmark, Sweden</td>
<td>Actual enrollment: 885,185</td>
<td>A prospective population-based cohort study to examine whether varenicline use during pregnancy is associated with an increased risk of major congenital malformations in infants above that associated with smoking during pregnancy.</td>
<td>Completed May 2016: Results available on clinicaltrials.gov; no publication available</td>
</tr>
<tr>
<td>ACTRN12618000576224/ Adrian Dunlop</td>
<td>Targeted antenatal smoking cessation intervention in high-risk substance dependent pregnancy: a feasibility study</td>
<td>Australia</td>
<td>NR</td>
<td>This study aims to assess the feasibility and acceptability of the addition of current evidence-based smoking cessation care to routine prenatal care of women attending a substance use in pregnancy clinic.</td>
<td>Not recruiting yet: Anticipated date of enrollment May 2018</td>
</tr>
<tr>
<td>Study reference/ trial identifier</td>
<td>Study name</td>
<td>Location</td>
<td>Estimated n</td>
<td>Description</td>
<td>2019 status (May 2019)</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------</td>
<td>-------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>ACTRN12615001278527</td>
<td>Assessment of the acceptability, feasibility and impact on smoking cessation, of an intensive smoking cessation intervention, including financial incentives, among pregnant Indigenous women reporting daily smoking and receiving maternity care through the Birthing in Our Community program.</td>
<td>Australia</td>
<td>NR</td>
<td>This study will assess how effective the program is, what women think about it, and how easy it is to provide “Stop Smoking in its Tracks”. The study will involve collecting information on the care provided, whether women quit smoking and what other factors might be influencing quit attempts and successful quitting.</td>
<td>Recruiting: Anticipated date of last data collection Jun 2019</td>
</tr>
</tbody>
</table>

**Abbreviations:** EST = estimated; mg = milligram(s); UK = United Kingdom; US = United States