Internet-based interventions for smoking cessation (Review)

Civljak M, Sheikh A, Stead LF, Car J

This is a reprint of a Cochrane review, prepared and maintained by The Cochrane Collaboration and published in *The Cochrane Library* 2010, Issue 11

http://www.thecochranelibrary.com

TABLE OF CONTENTS

[Intervention Review]

Internet-based interventions for smoking cessation

Marta Civljak[2], Aziz Sheikh[3], Lindsay F Stead[4], Josip Car[1]

[1]Department of Primary Care and Public Health, Faculty of Medicine, Imperial College London, London, UK. [2]Dept of Medical Sociology and Health Economics, Medical School University of Zagreb, Zagreb, Croatia. [3]Centre for Population Health Sciences, University of Edinburgh, Edinburgh, UK. [4]Department of Primary Health Care, University of Oxford, Oxford, UK

Contact address: Josip Car, Department of Primary Care and Public Health, Faculty of Medicine, Imperial College London, Reynolds Building, St Dunstans Road, London, W6 8RP, UK. josip.car@imperial.ac.uk.

Editorial group: Cochrane Tobacco Addiction Group.
Publication status and date: Edited (no change to conclusions), published in Issue 11, 2010.
Review content assessed as up-to-date: 13 July 2010.

Citation: Civljak M, Sheikh A, Stead LF, Car J. Internet-based interventions for smoking cessation. *Cochrane Database of Systematic Reviews* 2010, Issue 9. Art. No.: CD007078. DOI: 10.1002/14651858.CD007078.pub3.

ABSTRACT

Background

The Internet has become a regular part of daily life for the majority of people in many parts of the world. It now offers an additional means of effecting changes to behaviour such as smoking.

Objectives

To determine the effectiveness of Internet-based interventions for smoking cessation.

Search strategy

We searched the Cochrane Tobacco Addiction Group Specialized Register, with additional searches of MEDLINE, EMBASE, CINAHL, PsycINFO, and Google Scholar. There were no restrictions placed on language of publication or publication date. The most recent search was in June 2010.

Selection criteria

We included randomized and quasi-randomized trials. Participants were people who smoked, with no exclusions based on age, gender, ethnicity, language or health status. Any type of Internet-based intervention was eligible. The comparison condition could be a no-intervention control or a different Internet site or programme.

Data collection and analysis

Methodological and study quality details were extracted using a standardised form. We selected smoking cessation outcomes at short term (one to three months) and long term (6 months or more) follow up, and reported study effects as a risk ratio with 95% confidence intervals. Only limited meta-analysis was performed, as the heterogeneity of the data for populations, interventions and outcomes allowed for very little pooling.

Main results

Twenty trials met the inclusion criteria. There were more female than male participants. Some Internet programmes were intensive and included multiple outreach contacts with participants, whilst others relied on participants to initiate and maintain use.

Ten trials compared an Internet intervention to a non-Internet based smoking cessation intervention or to a no intervention control. Six of these recruited adults, one recruited young adult university students and three recruited adolescents. Two trials of the same intensive

automated intervention in populations of adult who smoked showed significantly increased cessation compared to printed self-help materials at 12 months. In one of these, all trial participants were provided with nicotine replacement therapy (NRT). Three other trials in adults did not detect significant long term effects. One of these provided access to a website as an adjunct to counselling and bupropion, one compared web-based counselling, proactive telephone-based counselling or a combination of the two as an adjunct to varenicline. The third only provided a list of Internet resources. One further short-term trial did show a significant increase in quit rates at 3 months. A trial in college students increased point prevalence abstinence after 30 weeks but had no effect on sustained abstinence. Two small trials in adolescents did not detect an effect on cessation compared to control, whilst a third small trial did detect a benefit of a web-based adjunct to a group programme amongst adolescents.

Ten trials, all in adult populations, compared different Internet sites or programmes. There was some evidence that sites that were tailored and interactive might be more effective than static sites, but this was not detected in all the trials that explored this factor. One large trial did not detect differences between different Internet sites. One trial of a tailored intervention as an adjunct to NRT use showed a significant benefit but only had a 3-month follow up. One trial detected evidence of a benefit from tailored email letter compared to a non-tailored one. Trials failed to detect a benefit of including a mood management component (three trials), or an asynchronous bulletin board. Higher abstinence rates were typically reported by participants who actively engaged with the programme (as reflected by the number of log-ins).

Authors' conclusions

Results suggest that some Internet-based interventions can assist smoking cessation, especially if the information is appropriately tailored to the users and frequent automated contacts with the users are ensured, however trials did not show consistent effects.

PLAIN LANGUAGE SUMMARY

Can Internet based interventions help people to stop smoking?

More evidence is needed to determine if programmes delivered over the Internet can help people to stop smoking. This review found few trials reporting success rates for stopping smoking after six months or more, and those trials provided only limited evidence of long-term benefits of the Internet or web-based smoking cessation programmes. Internet intervention programmes that provide individually tailored information and support may be more effective than a static website. The Internet may have an additional benefit when used alongside other interventions, such as nicotine replacement therapy (NRT) or other pharmacotherapy. Innovative smoking cessation intervention delivered via the Internet may be more attractive to young people and females who smoke, and less attractive to smokers reporting depression.

BACKGROUND

Tobacco smoking is a major preventable cause of death in both developed and developing countries. Every day over 13,000 people die from tobacco-related diseases (WHO 2004). If current trends continue, by 2025 tobacco will contribute to the death of 10 million people worldwide each year, with seven million of these deaths occurring in developing countries (Mackay 2006). People who smoke are more prone to developing various types of cancer, such as those of the oral cavity, larynx, bladder and particularly lung cancer. Tobacco smokers are also at substantially increased risk of developing heart disease, stroke, emphysema and other fatal diseases (WHO 2004). Smoking also imposes a huge economic burden on society - currently up to 15% of the total healthcare costs in developed countries (Parrot 2004). Additionally, passive smoking is associated with serious morbidity (SCTH 1998). To reduce the growing global burden of tobacco-related mortality and morbidity, and the impact of tobacco use on economic indicators, tobacco control has become a world-wide public health imperative (WHO 2004).

Prevention and cessation are the two principal strategies in the battle against tobacco smoking. Nicotine is highly addictive (Surgeon General 1988). There is evidence that although 70% of US smokers say they want to quit, only five per cent are able to sustain cessation for one year (Schroeder 2002). The balance between the individual's motivation to stop smoking and his or her dependence

on cigarettes influences smoking cessation success. Dependence in smokers and their motivation to stop smoking can be assessed by simple questions (West 2004). Maximizing the delivery of smoking cessation interventions can achieve more in terms of years of life saved and economic benefits than most medical interventions for smoking-related illnesses (Coleman 2004).

There is good evidence for the effectiveness of brief, therapist-delivered interventions, such as advice from a physician (Stead 2008b). There appears to be additional benefit from more intensive behavioural interventions, such as group therapy (Stead 2005), individual counselling (Lancaster 2005a) and telephone counselling (Stead 2006). However, these more intensive therapies are usually dependent on a trained professional delivering or facilitating the interventions. This is both expensive and time-consuming for the health providers, and often inconvenient to the patient, because of lengthy waiting times and the need to take time off work. Another major limitation of these more intensive types of interventions is that they reach only a small proportion of those who smoke.

It is estimated that in 2009, there were 1.73 billion Internet users worldwide (Pingdom 2010), and the number of Internet users is likely to increase rapidly over a relatively short timeframe (Modis 2005). The Internet has the potential to deliver behaviour change interventions (Japuntich 2006; Strecher 2006; Swartz 2006; Graham 2007). Internet-based material is an attractive intervention tool, because of relatively low costs per user, resulting in high cost-effectiveness (Swartz 2006). The Internet can be accessed in people's homes, in public libraries and through other public Internet access points, such as Internet cafes and information kiosks. The Internet is available 24 hours a day and 365 days a year, even in areas where there are not the resources for a smoking cessation clinic (such as some rural or deprived areas and low-income countries). Online treatment programmes are convenient from the users' perspective, because content can be accessed at any time, and they also offer a greater level of anonymity than in-person or phone-based counselling. They have the potential to reach audiences who might not otherwise seek support, because of limited health care provision or possible stigmatisation. Existing smoking cessation services such as advice from health professionals and NRT are under-utilized by young people (Rodgers 2005). Internet use by young people has grown exponentially and has a powerful role in influencing youth culture. It may therefore reach a target population of young people who smoke more effectively than the more traditional providers are able to do.

The Internet is a promising vehicle for delivering smoking cessation treatment either as a stand-alone programme or as an adjunct to pharmacotherapy (Swartz 2006; Graham 2007). According to the Pew Internet & American Life Project (Fox 2005), seven per cent of adult US Internet users, (approximately eight million people), reported having searched online for information on 'how to quit smoking'. In the USA, 18% of those with less than high school education searched the web for information on how to quit smoking, which represents a higher proportion than those with more education (Fox 2005).

Materials tailored for individual smokers are more effective than untailored ones, although the absolute size of the effect is still small (Lancaster 2005b). Internet programmes can be highly tailored to mimic the individualization of one-to-one counselling. A web-based programme that collects relevant information from users and tailors the intervention to their specific needs had significant advantages over a web-based, non-tailored cessation programme (Strecher 2005). A Dutch study explored existing self-help materials which are currently available in the Netherlands, and found them to be ineffective for smoking cessation. However, this study suggested that computer-tailored interventions could potentially be successfully designed, and may be a promising means of communicating information on smoking and cessation (Dijkstra 1999). Another study on the efficacy of web-based tailored behavioural smoking cessation materials for nicotine patch users showed that participants in the tailored programme reported significantly higher 12-week continuous abstinence rates (22.8%) than those in a non-tailored programme (18.1%) (Strecher 2005).

Using the Internet for smoking cessation programmes may also have limitations. There are a large number of smoking cessation web sites, but they do not all provide a direct intervention. Some studies of popular smoking cessation web sites and their quality (Bock 2004; Etter 2006) suggest that smokers seeking tobacco dependence treatment online may have difficulty discriminating between the numerous sites available (Etter 2006). In addition, web sites that provide direct treatment often do not fully implement treatment guidelines and do not take full advantage of the interactive and tailoring capabilities of the Internet (Bock 2004). Furthermore, a study on rates and determinants of repeat participation in a web-based health behaviour change programme suggested that such programmes may reach those who need them the least. For example, older individuals who had never smoked were more likely to participate repeatedly than those who currently smoke (Verheijden 2007). The Internet is also less likely to be used by people on lower income, who are more likely to smoke (Eysenbach 2007; Kontos 2007).

There have been two recent reviews of this area (Myung 2009, Shahab 2009). Myung 2009 evaluated both web-based and computer-based cessation programmes. The review included 22 trials in a single random effects meta-analysis that showed a significant effect on cessation; similar effects were also seen in a range of subgroups including one limited to nine trials that used a web based intervention. They concluded there was evidence to support the use of web and computer-based cessation programmes for adults who smoked, but not adolescent smokers. Shahab 2009 focused on interactive online interventions, and also sought to identify treatment effect moderators and mediators. The review included eleven randomized trials. The authors concluded that web based

tailored and interactive interventions increased abstinence compared to booklet or email control, based on three trials. Both reviews identified large amounts of heterogeneity in both study designs and effect sizes.

OBJECTIVES

To determine the effectiveness of Internet-based interventions for smoking cessation.

METHODS

Criteria for considering studies for this review

Types of studies

Randomized or quasi-randomized controlled trials. Examples of quasi-random methods of assignment include alternation, date of birth, and medical record number.

Types of participants

Smokers who participated in Internet interventions for smoking cessation, with no exclusions on the basis of age, gender, ethnicity, language spoken or health status. Studies on adolescents and young adults were analysed separately from the general population studies, as both subgroups are important subgroups with particular needs, which warrant separate investigation.

Types of interventions

We included Internet studies in all settings and from all types of provider. There was no exclusion with respect to intervention method or duration. We included trials where the Internet intervention was evaluated as an adjunct to a pharmacotherapy such as nicotine replacement therapy (NRT), bupropion or varenicline, but only where the Internet component was the intervention being tested. The trials compared different types and combinations of intervention. The trials compared Internet-based programmes with no treatment or with other forms of treatment, such as self-help booklets. We included trials of interactive, personalised and non-interactive interventions, which focused on standard approaches to information delivery. Interactive interventions were not necessarily personalised.

Personalised interventions can vary considerably, from minimal personalisation to those which have been developed based on theoretical models which are relevant to desired treatment outcomes, such as self-efficacy. The interventions used in each study were fully described, as the heterogeneity of the interventions (for example, in relation to varying content, intensity, number of sessions, duration of contact time).

We excluded trials which used the Internet solely for recruitment and not for delivery of smoking cessation treatment. We also excluded trials where Internet-based programmes were used to remind participants of appointments for treatment that is not conducted online, e.g. face-to-face counselling, or pharmacotherapy. Text messaging interventions were covered in a Cochrane review of mobile phone interventions (Whittaker 2009) and are not covered in this review.

Types of outcome measures

The primary outcome was smoking cessation at least six months after the start of the intervention, and longer wherever the data were available. In order to assess short-term cessation we included trials with shorter follow-up period, but the gold-standard was six months' cessation. We excluded trials with fewer than four weeks follow up. We preferred sustained or prolonged cessation over point prevalence abstinence, but did not exclude studies which only reported the latter. We included studies which relied on self-reported cessation, as well as those which required biochemical validation of abstinence.

Where reported, we extracted data on user satisfaction rates for the Internet intervention compared to no or alternative interventions.

Search methods for identification of studies

Electronic Searches

We searched the specialised register of the Cochrane Tobacco Addiction Group, using the following terms: ('Internet', 'web$', 'www$', 'online', 'net', 'web-based', 'interventions') in the title, abstract or as keywords. The most recent search of the register was June 2010.This register has been developed from electronic searching of MEDLINE, EMBASE, Science Citation Index and PsycINFO, together with hand searching of specialist journals, conference proceedings, dissertations and reference lists of previous trials and overviews. We also performed ad hoc searches of a number of electronic databases, including the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, EMBASE, PsycINFO and CINAHL, using the exploded MeSH terms which included: 'smoking cessation', 'tobacco cessation', 'Internet' , 'computer' and 'online'. We also searched Google Scholar, and checked the first 500 records retrieved.

We searched online trials registers, e.g. Controlled Clinical Trials (www.controlled-trials.com), the National Research Register (www.nrr.nhs.uk), US registries (clinicaltrials.gov), and WHO registries (www.who.int/trialsearch/) for ongoing and recently completed studies.

Other Sources

We searched through the reference lists of identified studies for other potentially relevant trials. We contacted authors and experts in this field for unpublished work.
There were no restrictions on language or date of publication.

Data collection and analysis

Selection of studies

Two authors independently assessed potentially relevant papers for inclusion. Disagreements were resolved through discussion between the two authors responsible for screening. This was done by each author writing their reasons for inclusion/exclusion until a consensus was reached. An arbiter was not used at this stage of initial screening selection. Reasons for exclusion were noted.

Data extraction and management

Two authors independently extracted data; the first author then checked data and compared the findings. This stage included an evaluation of study quality. An arbiter (JC) was used where there was disagreement amongst two selecting authors over the further exclusion of studies at this stage.
We extracted the following information from each trial:

- Country and setting
- Method of selection of participants
- Definition of smoker used
- Methods of randomization (sequence generation and allocation concealment), and blinding of trialists, participants and assessors
- Demographic characteristics of participants (e.g. average age, sex, average cigs/day)
- Proportion of site visitors who are actively trying to quit smoking vs information seeking
- Intervention and control description (provider, material delivered, control intervention if any, duration, level of interactivity etc)
- Outcomes including definition of abstinence used, and biochemical validation of cessation
- Proportion of participants with follow-up data
- Any harms or adverse effects
- Sources of funding

Assessment of risk of bias in included studies

Two independent authors assessed each study according to the presence and quality of the randomization process, whether or not trialists and assessors were 'blinded', whether the analysis was appropriate to the study design, and the description of withdrawals and drop-outs, whether the baseline measurements were comparable and outcome measures valid.

Measures of treatment effect

We calculated a risk ratio (RR) for the outcome for each trial, defined as (number who stopped smoking in the intervention group / total number randomized to the intervention group) / (number who stopped smoking in the control group / total number randomized to the control group). We aimed to conduct an intention-to-treat (ITT) analysis, i.e. including all those randomized to their original groups, whether or not they remained in the study. We treated drop-outs or those lost to follow up as continuing smoking. A risk ratio greater than one indicates that more people stopped smoking in the intervention group than the control group. We displayed risk ratios with 95% confidence intervals in forest plots.

Assessment of heterogeneity

We considered clinical, statistical and methodological heterogeneity. We assessed statistical heterogeneity using the I^2 statistic, which assesses the proportion of the variation between studies is due to heterogeneity rather than to chance (Higgins 2003). Values over 50% suggest substantial heterogeneity, but its significance also depends upon the magnitude and direction of the effect, and the strength of the evidence (as estimated by the confidence interval or p value).

Data synthesis

Due to heterogeneity of design and variable quality overall and within prespecified subgroups, only very limited meta-analysis of the studies available for inclusion at this time, was possible. We have presented the results in a narrative form, and displayed the cessation outcomes for each study graphically. We separated trials in adolescents from those in young adults and older adults. We would have also considered studies in pregnant women separately. We also distinguished between tailored and non-tailored interventions. In the absence of heterogeneity we would have estimated a pooled weighted average of RRs, using the Mantel-Haenszel fixed-effect method, with a 95% confidence interval. We would also have used funnel plots to help identify possible biases.

Sensitivity analysis

Had it been appropriate to use meta-analysis we planned to use sensitivity analyses to investigate the impact on the estimated treatment effect of excluding from the meta-analysis any trials of questionable design, methodology or outcome measures.

RESULTS

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies; Characteristics of ongoing studies.

We identified 71 potentially relevant records. One paper reported on four studies of an Internet-based intervention of which two were eligible RCTs (Munoz 2006 Study 3; Munoz 2006 Study 4). Twenty studies met the inclusion criteria.

Recruitment

Triallists were mostly based in the USA and recruited participants based there. One trial was conducted in Switzerland, one in Norway, one in the Netherlands, one in England and one in the Republic of Ireland. The studies by Munoz and colleagues recruited from multiple countries.

Recruitment was mainly web-based; participants found the sites through search engines and browsing. Several trials used press releases, billboards, television advertisements and flyers in addition to the web-based recruitment. Therefore, participants included in these trials were smokers motivated to quit smoking, who chose the Internet as a tool for smoking cessation support. Clark 2004 recruited people undergoing chest computerized tomography (CT) as a screening assessment for lung cancer at their first follow-up visits. Strecher 2008 recruited from members of two health management organizations (HMOs) participating in the National Cancer Institute's Cancer Research Network, Swan 2010 recruited participants from a large healthcare organization. Sixteen studies recruited a full adult age range. An 2008 recruited young adult college students and three studies recruited adolescents (Woodruff 2007; Mermelstein 2006; Patten 2006). Sample sizes ranged from less than 150 (Mermelstein 2006; Woodruff 2007) to nearly 12,000 (Etter 2005). In some studies, participants were offered financial compensation for completing assessment surveys and for biochemical analysis (An 2008, Munoz 2006 Study 3; Munoz 2006 Study 4; Mermelstein 2006; Te Poel 2009; Woodruff 2007).

Interventions

Descriptions of the main features of each study intervention are provided in the Characteristics of included studies table.

A range of types of Internet interventions was tested in the included studies, from a very low intensity intervention, providing a list of web sites for smoking cessation (Clark 2004), to highly intensive interventions consisting of Internet, email and mobile phone delivered components (Brendryen 2008a; Brendryen 2008b). Tailored Internet interventions differed by the amount of tailoring, from a bulletin board facility (Stoddard 2008), a multimedia component (McKay 2008), tailored and personalised access (Strecher 2005; Rabius 2008) to very high-depth tailored stories and a highly personalized message sources (Strecher 2008). More details are given under comparisons section below.

Outcomes

Sixteen studies assessed smoking status at least six months after the start of the intervention (Clark 2004; Japuntich 2006; Mermelstein 2006; Patten 2006; Munoz 2006 Study 3; Munoz 2006 Study 4; Woodruff 2007; An 2008; Brendryen 2008a; Brendryen 2008b; McKay 2008; Rabius 2008; Strecher 2008; Munoz 2009, Swan 2010;Te Poel 2009). All of these except Strecher 2008 and Te Poel 2009 also assessed smoking at one or more intermediate follow-up points. Four studies followed participants for less than six months (Etter 2005; Strecher 2005; Swartz 2006; Stoddard 2008). Studies reported a range of definitions of abstinence at the time of follow up. Where studies reported abstinence rates for more than one definition we displayed the effect using the most conservative outcome [with the exception of An 2008, see below]. For most studies, seven-day smoking abstinence was the main outcome measure (Clark 2004; Etter 2005; Japuntich 2006;McKay 2008; Munoz 2006 Study 3; Munoz 2006 Study 4; Munoz 2009; Stoddard 2008;Strecher 2008; Swartz 2006; Te Poel 2009). A few studies reported 30-day self-reported smoking abstinence (Mermelstein 2006; Patten 2006; Swan 2010). One study assessed six-month prolonged abstinence from smoking (An 2008); this study also reported seven-day and 30-day prevalence abstinence. We used 30-day rates as our primary outcome because the programme did not involve setting a quit date, and the prolonged abstinence was based on self report of time since last cigarette rather than repeated assessments of abstinence. Three of the four short term studies assessed self-reported point prevalence abstinence at three-month follow up only (Etter 2005; Swartz 2006; Stoddard 2008) whilst Strecher 2005 assessed 28-day continuous abstinence rates at six-week follow up, and 10-week continuous abstinence rates at 12-week follow up. In one study, seven-day smoking abstinence was a secondary outcome, while time spent on the website, utilization of pages, cessation aids used in the past and during the study period were the main outcome measures (Stoddard 2008).

Due to the limited face-to-face contact and due to data collection through Internet or telephone interview, biochemical validation to confirm self-reported smoking abstinence was conducted in only five trials (Clark 2004; Japuntich 2006; Mermelstein 2006; Patten 2006; An 2008). All these measured carbon monoxide (CO) in expired air.

Utilization of the Internet site or programme use was a secondary outcome measure in 10 studies (Clark 2004; Japuntich 2006; Mermelstein 2006; Swartz 2006; Brendryen 2008b; McKay 2008; Rabius 2008; Strecher 2008; Munoz 2009; Swan 2010). Satisfaction with treatment condition was assessed in five trials (Strecher 2005; Woodruff 2007; Stoddard 2008; Munoz 2009; Te Poel 2009). Use of NRT or other pharmacotherapies was a secondary outcome measure in five trials (Patten 2006; Brendryen 2008b; McKay 2008; Strecher 2008; Swan 2010). Two of the studies in adolescents assessed reductions in the number of cigarettes or in smoking frequency as secondary outcomes (Patten 2006;

Woodruff 2007). Munoz 2009 reported the impact of method of obtaining follow-up data on quit rates; comparing phone with online follow-up procedure.

Comparisons

We first grouped studies in subgroups according to whether (1) they compared an Internet intervention with no intervention or a non-Internet intervention, or (2) compared a more complex or tailored Internet intervention with a less complex one. At the suggestion of peer reviewers we added a third comparison that included studies in which the intervention offered access to an interactive website and the control could be either a static website, or a control without Internet access. In five trials, all participants were using, or were offered, pharmacotherapy (Strecher 2005; Japuntich 2006; Brendryen 2008b; Strecher 2008; Swan 2010) and the Internet component was thus being evaluated as an adjunct to pharmacotherapy. These were grouped in comparisons based on the nature of the Internet component and the control.

Internet intervention compared to no Internet intervention or no intervention at all

Ten trials compared an Internet intervention to a non-Internet based smoking cessation intervention or to a no intervention control (Clark 2004; Japuntich 2006; Mermelstein 2006; Patten 2006; Swartz 2006; Woodruff 2007; Brendryen 2008a; Brendryen 2008b; An 2008; Swan 2010). Six trials recruited adults, one targeted young adult university students (An 2008) and three were conducted among adolescents (Mermelstein 2006; Patten 2006; Woodruff 2007).

Of the six trials that targeted adults, two studies (Brendryen 2008a; Brendryen 2008b) evaluated 'Happy Endings', a 1-year programme delivered via the Internet and cell phone, consisting of more than 400 contacts by email, web pages, interactive voice response, and short message service (SMS) technology. Brendryen 2008a recruited people attempting to quit without NRT, whilst Brendryen 2008b offered a free supply of NRT to all participants. Follow up was after 12 months in both studies. Japuntich 2006 evaluated a web-based system incorporating information, support and problem-solving assistance; this was tested as an adjunct to bupropion and brief face-to-face counselling, with follow up after six months. Swartz 2006 recruited participants via worksites to test a video-based Internet site that presented strategies for smoking cessation and motivational materials tailored to the user's race/ethnicity, sex and age. This study only reported short follow up (i.e. at 90 days); after this time the control group had access to the programme. Clark 2004 tested a very low intensity intervention for smokers having CT lung screening; a handout with a list of 10 Internet sites related to stopping smoking with a brief description of each site compared to printed self-help materials. Follow up was at 12 months. Swan 2010 was a three arm trial comparing an established proactive telephone counselling intervention, an interactive web site based on the same programme, and a combination of phone and Internet components, all providing behavioural support in conjunction with varenicline use.

An 2008 recruited college students who reported smoking in the past 30 days; the sample smoked an average of four cigarettes per day. Intervention group participants received $10 a week to visit an online college magazine that provided personalized smoking cessation messages and peer email support. The control group received only a confirmation email containing links to online health and academic resources. Both groups were informed about a campus-wide Quit&Win contest sponsored by University Health Service. The three small studies in adolescents recruited populations of relatively light smokers. Mermelstein 2006 evaluated the effectiveness of enhancing the American Lung Association's Not on Tobacco programme (NOT) with a web-based adjunct (NOT Plus), which included access to a specially designed web-site for teenagers, along with proactive phone calls from the group facilitator to the participant. Twenty-nine high schools were randomly assigned to either the NOT programme alone or to the NOT Plus one. Self-reported smoking behaviour was assessed at the end of the 10-week programme and three months later. Patten 2006 compared a home-based, Internet-delivered treatment for adolescent smoking cessation with a clinic-based brief office intervention (BOI) consisting of four individual counselling sessions. Adolescents assigned to the Internet condition had access to the web-site for 24 weeks and abstinence was assessed at the end of this period. Woodruff 2007 evaluated an Internet-based, virtual reality world combined with motivational interviewing, conducted in real-time by a smoking cessation counsellor. There was a measurement-only control condition involving four online surveys. Smoking status was assessed at baseline, post-intervention and at three and twelve-month follow up.

Comparisons between different Internet interventions

Ten trials compared two or more different Internet interventions (Etter 2005; Strecher 2005; Munoz 2006 Study 3; Munoz 2006 Study 4; Munoz 2009; McKay 2008; Rabius 2008; Stoddard 2008; Strecher 2008; Te Poel 2009)

Three of these studies had only short follow up (Etter 2005; Strecher 2005; Stoddard 2008). In two studies all participants were using nicotine patch pharmacotherapy (Strecher 2005; Strecher 2008).

A series of three studies by Munoz and colleagues evaluated adjuncts to an online resource, the 'Guia', a National Cancer Institute evidence-based intervention first developed for Spanish speaking smokers. In separate English language (Munoz 2006 Study 3) and Spanish (Munoz 2006 Study 4) studies the control condition was the provision of access to the Guia and 'Individually Timed Educational Messages' (ITEMs). The intervention tested was the addition of an online mood management course consisting of eight

weekly lessons. Munoz 2009 also used the 'Guia' as the control condition, but in a four-arm design that evaluated the successive addition of ITEMs; the mood management condition used in the Munoz 2006 studies; and a 'virtual group' asynchronous bulletin board. The study recruited English and Spanish-speaking Internet users from 68 countries.

In two trials (Strecher 2005; Rabius 2008) the control condition provided access to a relatively static Internet site whilst one or more intervention conditions provided more tailored and personalised access. Rabius 2008 compared five tailored and interactive Internet services with the targeted, minimally interactive American Cancer Society site providing stage-based quitting advice and peer modelling. Follow-up surveys were conducted four and 13 months after randomization. Strecher 2005 assigned purchasers of a particular brand of nicotine patch to receive either web-based, tailored behavioural smoking cessation materials or web-based non-tailored materials. This study measured smoking behaviour at three-month follow up.

The remaining five studies were distinctive in their designs. Etter 2005 compared the efficacy of two versions of an Internet-based, computer tailored cessation programme; the control group received a shorter version modified for use by those smoking and buying NRT over the counter, although use of NRT was not a condition for enrolment. Follow up was at 2.5 months. Stoddard 2008 evaluated the impact of adding a bulletin board facility to the 'smokefree.gov' cessation site. This study measured smoking behaviour three months after enrolment. Strecher 2008 identified active psychosocial and communication components of a web-based smoking cessation intervention and examined the impact of increasing the tailoring depth on smoking cessation among nicotine patch users. Five components of the intervention were randomized using a fractional factorial design: high versus low depth tailored success story, outcome expectation versus efficacy expectation messages; high versus low personalized source; and multiple versus single exposure to the intervention component. Abstinence was assessed after six months. McKay 2008 compared the Quit Smoking Network (QSN), a web-based tailored cessation programme with a multimedia component, with Active Lives, a web-based programme providing tailored physical activity recommendations and goal setting in order to encourage smoking cessation. Abstinence was assessed after six months. Te Poel 2009 compared tailored to untailored cessation advice letters sent by email, after participants had completed on online survey. We included this study in the review because information was gathered via a website.

Risk of bias in included studies

Allocation

The majority of studies did not explicitly describe the way in which the randomization sequence was generated or concealed until patient enrolment. In eleven studies, computer randomization was used to assign participants to intervention or control condition (Etter 2005; Strecher 2005; Munoz 2006 Study 3; Munoz 2006 Study 4; Swartz 2006; Brendryen 2008a; Brendryen 2008b; Stoddard 2008; Munoz 2009; ;Te Poel 2009; Swan 2010). Although there was little information about allocation concealment, when investigators used computerized randomization and had minimal interaction with participants we judged there to have been a low risk for selection bias. Munoz 2006 Study 3, Munoz 2006 Study 4, and Munoz 2009, used the baseline questionnaire to automatically implement stratified randomization by gender and major depressive episode (MDE) status (no MDE history, past MDE, current MDE) to the two conditions.

In the two studies (Mermelstein 2006; Woodruff 2007) that randomized schools to conditions there was the potential for bias due to the way in which individual students were recruited once their school was randomized. In both there were differences in the baseline smoking behaviour of intervention and control participants. The two studies also needed to take account of the non-independence of outcomes for students clustered within schools. Mermelstein 2006 used hierarchical linear modelling to allow for clustering. Woodruff 2007 assessed baseline variable intraclass correlations and average cluster sizes. Intraclass correlations were generally small (0.1 or less) and the magnitude of the effect sizes was below two, so analyses were conducted at the individual level without a school-level cluster term.

Incomplete outcome data

All studies included in this review used ITT analysis, reporting analyses based on the total number randomized, with drop-outs and participants lost to follow up classified as smoking. Wherever possible, we have noted the number of participants that completed the study in the Characteristics of Included studies table. In one study (Clark 2004) there were no drop-outs at one-year follow up, as all study participants attended their annual review at that point. Five studies (Japuntich 2006; An 2008; Brendryen 2008a; Brendryen 2008b; Strecher 2008) ascertained smoking status for over 80% of participants at follow up. Five studies ascertained smoking status for 50-80% of participants at follow up (Strecher 2005; Mermelstein 2006; Patten 2006; Swartz 2006; Woodruff 2007; Swan 2010). Eight studies had over 50% loss to follow up (Etter 2005; McKay 2008;Munoz 2006 Study 3 ; Munoz 2006 Study 4, Munoz 2009, Rabius 2008, Stoddard 2008;Te Poel 2009). All studies reported similar proportions loss to follow up in each group except in one study where survey non-response was higher among intervention participants then among controls (Woodruff 2007). We tested the sensitivity of our results to the assumption that lost participants were still smoking, by excluding those not reached at follow up from the denominator in the analyses, and

report this below.

Effects of interventions

Internet intervention compared to no Internet interventions or no interventions at all

There were six trials in adult populations (Clark 2004; Japuntich 2006; Swartz 2006; Brendryen 2008a; Brendryen 2008b; Swan 2010). Both the Happy Endings trials detected a significant effect of the Internet intervention on sustained abstinence at 12 months whether it was compared to a self-help control (Brendryen 2008a, RR 2.94, 95% CI 1.49 to 5.81) or tested as an adjunct to NRT (Brendryen 2008b, RR 1.71, 95% CI 1.10 to 2.66). Whilst the relative benefit of the intervention was similar, prolonged abstinence at 12 months was higher, 13%, amongst control group participants in Brendryen 2008b, who were offered NRT, than amongst controls who were not given pharmacotherapy (seven per cent in Brendryen 2008a). The authors noted that the relative effects were smaller for the outcome of point prevalence abstinence at 12 months, rather than repeated abstinence, because abstinence increased over time in the control group in both trials. Japuntich 2006 did not detect a significant effect of the Internet component as an adjunct to counselling and bupropion (RR 1.27, 95% CI 0.70 to 2.31) whilst Swan 2010 did not detect an effect of an Internet component either compared to, or as an adjunct to, telephone counselling and varenicline (RR 0.94 95% CI 0.79 to 1.13, combining web only and web plus phone arms). All three conditions achieved similar quit rates, ranging from 27.4% to 30.6% for 30 day abstinence at six months. Clark 2004, which was only a minimal intervention, also did not detect an effect (RR 0.45, 95% CI 0.14 to1.40). Relative effects were similar in these trials at shorter follow-up points. One study with only short-term follow up (Swartz 2006) detected a significant effect of Internet intervention compared to no intervention at all (RR 2.46, 95% CI 1.16 to 5.21).

One study in a population of college students (An 2008) detected a significant effect on 30-day abstinence at 30-week follow up (RR 1.95, 95% CI 1.42 to 2.69) although rates of prolonged abstinence were only six per cent and did not differ between groups.

Patten 2006 compared a home-based Internet delivered intervention (SOS) to a brief office intervention (BOI) for adolescent smoking cessation, and did not detect a difference in abstinence. Rates at 24 and 36 weeks follow up were higher for BOI (RR 0.44, 95% CI 0.14 to 1.36 at 36 weeks). Mermelstein 2006 detected a significant effect of the web-based adjuncts to the group-based approaches for adolescent smoking cessation (crude RR 1.96, 95% CI 1.02 to 3.77; also reported as significant, ($p < .05$), using mixed model logistic regression to account for clustering within schools). Woodruff 2007 recruited eligible adolescents based on a report of smoking in the past month; at baseline some described themselves as 'former' smokers or had not smoked in the past week. Intervention participants had lower past week abstinence rates at baseline than controls (14% vs. 29%). At the post-assessment, they had significantly higher abstinence rates than controls (35% vs. 22%), but by the final 12-month follow up, the two groups had almost identical past-week abstinence rates (RR 0.93, 95% CI 0.60 to 1.44). The interaction term considering all four assessments was not significant. Intervention participants (68%, n = 52) completed a five item questionnaire assessing their satisfaction with the programme immediately after the post-test assessment; 89% of participants reported they would recommend the programme to another person who smoked.

Comparison of different Internet intervention

None of the three Munoz studies detected significant benefits of adding a mood management intervention, and pooling the comparable arms did not make a difference at 12 months (RR 0.90, 95% CI 0.70 to 1.15 ; I^2 = 51%; Analysis 2.1) or in the shorter term. In fact Munoz 2006 Study 3 found that the more complex intervention (GUIA + ITEMS + MM) yielded significantly lower quit rates at 12 months. All four arms of Munoz 2009 had similar long- and short-term quit rates, ranging from 19.1% to 22.7% at 12 months, with no evidence that the more tailored conditions had any incremental benefit over the static website control. Authors of this trial also assessed user satisfaction with the treatment condition, and reported that there were significant differences in satisfaction across conditions at all follow-up assessments, with groups 3 and 4 generally reporting greater satisfaction at each time point.

Strecher 2005 and Rabius 2008 also compared tailored to static sites but Strecher 2005 used pharmacotherapy and only reported short-term outcomes, and Rabius 2008 compared multiple sites. Rabius 2008 detected no significant differences between a static cessation site and any of the other Internet sites included in the evaluation. Approximately 10% of enrolled participants assigned to the static site reported abstinence after 13 months compared with 8% to 12% among those assigned to any of the five different interactive sites (RR 1.12, 95% CI 0.92 to 1.36 pooling any interactive website versus the control site). At baseline, 30% of participants reported an indicator of depression. Post-hoc analyses found that this subgroup had significantly lower 13-month quit rates than those who did not have signs of depression (8% vs. 12%, $P < .001$). Amongst the 70% of participants who did not report an indicator of depression at baseline, the more interactive, tailored sites, as a whole, were associated with higher quitting rates than the less interactive American Cancer Society site (13% vs. 10% $P = .04$). This exploratory analysis suggested that tailored, interactive web-sites might help smokers who do not report the indicator of depression at baseline to quit and maintain cessation. Strecher 2005 reported higher continuous abstinence rates in the tailored condition than the control, as an adjunct to NRT. At 12

weeks, continuous abstinence rates were 22.8% vs. 18.1% respectively (RR 1.26, 95% CI 1.10 to 1.44). Satisfaction with the programme was also significantly higher in the tailored than in the non-tailored program.

McKay 2008 detected no difference at three or six-month follow up between two cessation interventions, one with a focus on physical activity presenting very few strategies for quitting smoking.

Te Poel 2009 detected evidence of a benefit from a tailored email letter compared to a non tailored one, (RR 2.48, 95% CI 1.11 to 5.55). All participants in this study accessed a website once to complete a questionnaire about their smoking.

Stoddard 2008 compared the publicly available version of smokfree.gov, designated as usual care condition (UC), to an identical-looking website that included an asynchronous bulletin board (BB) and found that quit rates for participants in both conditions were similar after three months (RR 0.95, 95% CI 0.64 to 1.40). Satisfaction with the website was high and did not differ significantly between conditions (UC: 90.2%, BB: 84.9%, *P*= 0.08).

Strecher 2008 compared multiple conditions in a fractional factorial design so results are not displayed in the analyses. Participants could receive up to three high-depth components, addressing efficacy expectations, outcome expectations and success stories, as part of their tailored web based intervention. Tailoring depth was marginally related (p<0.08) to 6-month smoking cessation in ITT analyses and was significantly related to cessation using per-protocol analysis (excluding participants who used other cessation aids during the follow-up period). The adjusted 6-month cessation rates among participants receiving all the three high-depth tailored components was 27.7% in the ITT analysis. There was some evidence that high-depth tailored success stories had a particular influence on participants with lower levels of education although this interaction was not significant in the ITT analysis. Participants reported using an average of 5.1 weeks of their supply of nicotine patches, with 26.7% using the patch for the full 10 weeks.

Comparison of interactive Internet sites with static sites or non Internet controls

From the studies discussed above, eight studies with long term outcomes (Munoz 2006 Study 3; Munoz 2006 Study 4; An 2008; Brendryen 2008a; McKay 2008;Rabius 2008; Brendryen 2008b; Munoz 2009) and another three with only short-term data (Etter 2005; Strecher 2005; Swartz 2006) might be pooled to assess whether sites that give smokers content tailored to their needs and interests are more useful than a control. However we found that the level of statistical heterogeneity was too large for a pooled estimate to be valid (I^2 = 75% for long term outcomes, Analysis 3.1, I^2 = 76% for short term outcomes, Analysis 3.2).

DISCUSSION

The Internet, with all its richness of options and opportunities for communication and sharing information, has now become a regular part of daily life for the majority of people in many countries. Therefore it is appropriate to consider using it as a tool to increase choice and access to smoking cessation support. Online treatment is convenient in that it can be accessed anywhere, at any time; it also offers the option of anonymity. For healthcare providers it has the potential for being very cost-effective if provided as an automated service. Internet interventions for smoking cessation can be provided in conjunction with other cessation support such as individual or group counselling and NRT or other pharmacotherapy.

We identified 20 trials yielding data from nearly 40,000 participants. Despite this large volume of data, this remains a relatively new field of research, with all trials published since 2004. The studies included in this review assess ways to help people quit smoking using a variety of Internet cessation programmes. Trials varied in the interventions studied and in the duration of the interventions; they also varied in the timing of follow-up assessments and the way in which abstinence was defined.

There is only a small number of studies comparing the long-term effects of Internet to a no-Internet or no intervention control. The results of these studies have been mixed so there is as yet only limited evidence to support a long-term effect of programmes that use the Internet.

Two studies assessed whether an Internet intervention was more effective than a self-help booklet for smoking cessation (Brendryen 2008a; Brendryen 2008b). These have shown evidence of both short- and longer-term effect with up to one-year follow up, but the programme delivered to the treatment group was fully automated, relatively intensive and proactive, and was delivered via both the Internet and mobile phone. The three other studies reporting long-term results did not detect a benefit, but these were relatively less intensive programmes with fewer proactive elements to encourage programme use. One additional short-term study providing tailored online cessation videos did detect an increase in abstinence at three months (Swartz 2006).

When considering trials comparing different intensities of Internet support, there is some evidence of a short-term beneficial effect of individually tailored Internet programmes compared to static web-sites or non-tailored programmes. For example, Etter et al found that an original more tailored programme versus a modified and less tailored programme increased quit rates and helped maintain short-term abstinence (Etter 2005). Strecher et al found that continuous abstinence rates at six and 12 weeks were significantly higher in the tailored intervention than in the non-tailored intervention (Strecher 2005). In contrast, however, one study found there was no significant difference in abstinence rates between participants assigned to interactive sites and participants assigned to static sites, even though interactive sites led to higher utilization

of the websites (Rabius 2008). There are also reported benefits of interactive sites with regard to satisfaction of the users (Munoz 2009; Strecher 2005; Woodruff 2007). One form of tailoring is to encourage website use by sending tailored email messages. Three studies by Munoz and colleagues used these as a component of an Internet programme, but none of them evaluated the effect compared to a non-Internet control, and only Munoz 2009 used a static site as a control; this study failed to detect any additional benefit of this particular tailoring. All three studies evaluated the effect of adding a mood management component and none detected any evidence that this was helpful, and the trend in two studies was for a reduction in success. In a post hoc analysis we explored pooling studies that evaluated tailored, interactive Internet based interventions, whatever the nature of the control, but found there to be too much between study heterogeneity in effect sizes.

Pharmacotherapies such as NRT and bupropion can help people who make a quit attempt increase their chances of success (Hughes 2007; Stead 2008a). Face-to-face behavioural support has an independent benefit but many people are not willing to attend or cannot access group based programmes or multi-session counselling. Internet programmes can be used to deliver additional behavioural support to people using pharmacotherapy, but there is so far little evidence of an effect of Internet intervention in addition to pharmacotherapies. Both Japuntich 2006 and Swan 2010 failed to detect any benefit, although Strecher 2005 suggested a short term advantage of a tailored site over a static one. Strecher 2008 identified components of tailored sites that could assist cessation.

Studies conducted among adolescents and young adults vary not only in the Internet intervention used, but also in methodology and setting. All three trials in adolescents were relatively small. Two suggested that the Internet condition had less benefit than the comparison condition, while one reported a marginally significant benefit sustained after the end of the programme (Mermelstein 2006). In this study, participants in the web arm also had phone calls from a counsellor so the independent effect of the web component is uncertain. These studies show that Internet assistance is attractive and suggest that tailored web sites are more popular among young people (Mermelstein 2006; Woodruff 2007; An 2008).

To achieve success in smoking cessation programmes, interventions must be accessible, efficacious and cost-effective and transportable. Only two of the included studies in this review reported any information about cost-effectiveness of their intervention (Etter 2005, Rabius 2008). Etter et al estimated that the total cost of implementing the website, for a reach of 8000 participants in computer tailored programmes and for 600 000 visitors per year to the website, is comparable to the cost of running a small smoking cessation clinic which would treat about 50 smokers a month. Therefore, Internet services provide greater potential for cost-efficiency because they can provide assistance to many smokers at a very low cost. Internet interventions can also be delivered alongside other more traditional smoking cessation programmes, providing smokers who are motivated to quit smoking with different tools which increases their overall choice (Etter 2005). Rabius et al found Internet assistance for smoking cessation to be cost-effective, since four days of programming at a cost of less than US $2000 allowed approximately 5000 additional users for services from the five tailored interactive service providers, comparing with the much larger cost of serving 1000 new clients with telephone counselling (approximately US $100,000) (Rabius 2008).

Quality of the evidence and potential biases

The trials enrolling adults generally relied on self-reported data on smoking status. Biochemical validation of self-reported cessation was only attempted in two trials where participants had face-to-face contact during the follow-up visit (Clark 2004; Japuntich 2006). The Society for Research on Nicotine and Tobacco subcommittee on biochemical verification in clinical trials (SRNT 2002) considers that verification is not necessary when a trial includes a large population with limited face-to-face contact, and where the optimal data collection methods are through the mail, telephone, or Internet. There is a recommendation that biochemical verification be used in studies of smoking cessation in special populations, including adolescents (SRNT 2002). Only one of the four studies in adolescents and young people did not use biochemical verification of self-reported abstinence (Woodruff 2007). Four included studies followed participants for less than six months (Etter 2005; Strecher 2005; Swartz 2006; Stoddard 2008). It is hoped that reporting six-month outcomes will become routine (West 2005).

Conducting research via the Internet provides opportunities to generate very large sample sizes, but it is also methodologically challenging, because of threats to internal and external validity such as selection bias or differential drop-out (Feil 2003, Cobb 2005). Although there was limited detail about procedures for sequence generation and allocation concealment, we judged that the likelihood of selection bias was small in studies that recruited participants online. Rates of loss to follow up were varied and were high in some large online studies. In our primary analyses we followed the convention of assuming that all those lost to follow up continued to smoke. This can be argued to be a reasonable approach with a volunteer sample and low attrition but if attrition rates are high, or differential across conditions, the assumption may be wrong in some cases and introduce bias (Hall 2001). We undertook a sensitivity analysis ignoring losses to follow up by omitting them from the denominators, and did not find any important differences in relative effects. A range of alternative assumptions about those lost to follow up could be tested, but it is important to recognise that bias in the relative effect will only occur if there the proportion of quitters amongst those lost to follow up differs between intervention and control group.

Determining the contribution of a specific Web site presents a difficult challenge, since Internet users appear to access different sites when searching for information or support to a specific topic. For example, contamination in control groups may be difficult to prevent because of unrestricted access to the Internet, whilst on the other side we cannot be sure that the intervention group is using only the intended intervention (Eysenbach 2002, Feil 2003).

The two other recent reviews in this area drew somewhat less cautious conclusions about the strength of the evidence for the effectiveness of Internet interventions. One review (Myung 2009) pooled data from a number of studies of both web- and computer-based interventions, and concluded that there is now sufficient evidence to support the use of both categories of intervention for adult smokers. Their estimate for Internet interventions based on nine studies, using a random effects model, was RR 1.40, 95% CI 1.13 to 1.72. Shahab et al also suggest that interactive, web-based cessation can be effective in aiding cessation (Shahab 2009), based on 11 studies, all but one of which is included in our review (we were able to include longer term data for Pike 2007, as Rabius 2008). We excluded Prochaska 2008, because we were unable to confirm all data with the authors. Shahab 2009 pools the studies in a number of subgroups; the intervention (tailored/untailored); length of treatment; motivation to quit; and whether the intervention was fully automated or not. They estimated interactive web-based smoking cessation interventions to be effective compared to untailored booklet or e-mail interventions (random effects RR 1.8, 95% CI 1.4 to 2.3), but this was based on just three trials. they also estimated that tailored interventions increase six-month abstinence by 17%. They also suggest that only interventions aimed at smokers motivated to quit were effective (RR 1.3 95% CI 1.0 to 1.7). We consider that our more cautious conclusions are due to a conservative approach to subgroup analyses, and our preference not to pool, even with a random effects approach, when there is evidence of substantial heterogeneity.

Further studies of the long-term effects of Internet based cessation interventions are clearly needed, and there are several ongoing studies in this area (see Characteristics of ongoing studies). Future trials and reviews should include analyses of participants according to sociodemographic data, in order to be able to identify the types of smokers who seek Internet assistance in quitting smoking. Feil et al detected that a large proportion of women was recruited in their study (Feil 2003). According to our findings there is some evidence that females are more interested in smoking cessation programmes delivered via Internet; only three of the included trials reported that more males enrolled (Munoz 2006 Study 3; Munoz 2006 Study 4; Woodruff 2007), and three had equal number of male and female participants (Clark 2004; Patten 2006; Brendryen 2008b).

In the future there may be an interest from patients with depression seeking Internet assistance for quitting smoking. Although there is evidence that depression is an important factor in smoking cessation (Niaura 2002), and that depression inhibits quitting success by decreasing self-efficacy (Haukkala 2000), only a few studies evaluated the impact of Internet interventions among the subgroup of smokers reporting depression. Rabius et al found no overall difference in quit rate among smokers assigned to six experimental groups (five interactive and one static site), but they also found that those who reported an indicator of depression and were assigned to interactive site had lower cessation rates than those assigned to the static site, although this difference was not significant. The authors attribute these findings to the increased time investment required from participants of interactive sites (Rabius 2008).

AUTHORS' CONCLUSIONS

Implications for practice

There is a small number of studies which provide very limited evidence of long-term benefits for programmes delivered only by the Internet compared to no-Internet controls. There is some evidence that tailored Internet interventions are more effective than non-tailored interventions.

Implications for research

More rigorous studies comparing the long-term effects of Internet interventions with non-Internet interventions or no intervention at all are needed in order to determine the true long-term effectiveness of the Internet as a tool for smoking cessation. These should, where possible, assess outcomes using objective measures, and also assess cost-effectiveness considerations. It is important that future trials also seek to describe the likely mechanisms through which these interventions may (or may not) be exerting their effects - they should therefore also report data on patient satisfaction, changes in knowledge, motivation, dependency, quit attempts and safety considerations.

Researchers should aim to assess smoking status after six months as a minimum, so that the longer-term benefit of programmes can be determined and meta-analyses of outcomes across studies be facilitated.

ACKNOWLEDGEMENTS

We thank Elizabeth Koshy and Matko Marlaias for their assistance in developing the protocol and selecting included studies for this review. We would like to thank Drs Jean-Francois Etter and Jennifer McClure for reading and commenting on earlier drafts of this protocol. We are also extremely grateful to Dr Etter for sharing with us his bibliography of Internet intervention trials. We also thank Shirley Manknell for consumer input.

REFERENCES

References to studies included in this review

An 2008 *{published data only}*

An LC, Klatt C, Perry CL, Lein EB, Hennrikus DJ, Pallonen UE, et al.The RealU online cessation intervention for college smokers: a randomized controlled trial. *Preventive Medicine* 2008;**47**:194–9.

Brendryen 2008a *{published data only}*

Brendryen H, Drozd F, Kraft P. A digital smoking cessation program delivered through internet and cell phone without nicotine replacement (Happy Ending): Randomized controlled trial. *Journal of Medical Internet Research* 2008;**10(5)**:e51.

Brendryen 2008b *{published data only}*

Brendryen H, Kraft P. Happy Ending: a randomized controlled trial of a digital multi-media smoking cessation intervention. *Addiction* 2008;**103**:478–84.

Clark 2004 *{published data only}*

Clark MM, Cox LS, Jett JR, Patten CA, Schroeder DR, Nirelli LM, et al.Effectiveness of smoking cessation self-help materials in a lung cancer screening population. *Lung Cancer* 2004;**44**(1):13–21.

Etter 2005 *{published data only}*

Etter JF. Comparing the efficacy of two Internet-based, computer-tailored smoking cessation programs: a randomized trial. *Journal of Medical Internet Research* 2005;**7**(1):e2.

Japuntich 2006 *{published data only}*

Japuntich SJ, Zehner ME, Smith SS, Jorenby DE, Valdez JA, Fiore MC, et al.Smoking cessation via the internet: a randomized clinical trial of an internet intervention as adjuvant treatment in a smoking cessation intervention. *Nicotine & Tobacco Research* 2006;**8 Suppl 1**:S59–67.

McKay 2008 *{published data only}*

Danaher BG, Hart LG, McKay HG, Severson HH. Measuring participant rurality in Web-based interventions. *BMC Public Health* 2007;**7**.

Danaher BG, Lichtenstein E, McKay HG, Seeley JR. Use of non-assigned smoking cessation programs among participants of a Web-based randomized controlled trial. *Journal of Medical Internet Research* 2009;**11**(2):e26.

* McKay HG, Danaher BG, Seeley JR, Lichtenstein E, Gau JM. Comparing two web-based smoking cessation programs: randomized controlled trial. *Journal of Medical Internet Research* 2008;**10**(5):e40.

Mermelstein 2006 *{published data only}*

Mermelstein R, Turner L. Web-based support as an adjunct to group-based smoking cessation for adolescents. *Nicotine & Tobacco Research* 2006;**8 Suppl 1**:S69–76.

Munoz 2006 Study 3 *{published data only}*

Lenert L, Munoz RF, Stoddard J, Delucchi K, Bansod A, Skoczen S, et al.Design and pilot evaluation of an internet smoking cessation program. *Journal of the American Medical Informatics Association* 2003;**10**(1):16–20.

Munoz RF, Lenert LL, Delucchi K, Stoddard J, Perez JE, Penilla C, et al.Toward evidence-based Internet interventions: A Spanish/English Web site for international smoking cessation trials. *Nicotine & Tobacco Research* 2006;**8**:77–87.

Munoz 2006 Study 4 *{published data only}*

Munoz RF, Lenert LL, Delucchi K, Stoddard J, Perez JE, Penilla C, et al.Toward evidence-based Internet interventions: A Spanish/English Web site for international smoking cessation trials. *Nicotine & Tobacco Research* 2006;**8**(1):77–87.

Munoz 2009 *{published data only}*

Munoz RF, Barrera AZ, Delucchi K, Penilla C, Torres LD, Perez-Stable EJ. International Spanish/English Internet smoking cessation trial yields 20% abstinence rates at 1 year. *Nicotine & Tobacco Research* 2009;**11**:1025–34.

Patten 2006 *{published data only}*

* Patten CA, Croghan IT, Meis TM, Decker PA, Pingree S, Colligan RC, et al.Randomized clinical trial of an Internet-based versus brief office intervention for adolescent smoking cessation. *Patient Education and Counseling* 2006;**64**(1-3):249–58.

Patten CA, Rock E, Meis TM, Decker PA, Colligan RC, Pingree S, et al.Frequency and type of use of a home-based, Internet intervention for adolescent smoking cessation. *Journal of Adolescent Health* 2007;**41**:427–43.

Rabius 2008 *{published data only}*

Pike KJ, Rabius V, McAlister A, Geiger A. American Cancer Society's QuitLink: randomized trial of Internet assistance. *Nicotine & Tobacco Research* 2007;**9**:415–20.

Rabius V, Pike J, Geiger A, Hunter J, McAlister A. The American Cancer Society's Quitlink: A randomized clinical trial evaluating internet-based smoking cessation programs and medication use (RPOS 3-62). Society for Research on Nicotine and Tobacco 12th Annual Meeting February 15-18, Orlando, Florida. 2006.

Rabius V, Pike KJ, Wiatrek D, McAlister AL. Comparing internet assistance for smoking cessation: 13-month follow-up of a six-arm randomized controlled trial. *Journal of Medical Internet Research* 2008;**10**(5):e45.

* Rabius V, Pike KJ, Wiatrek D, McAlister AL. Comparing internet assistance for smoking cessation: 13-month follow-up of a six-arm randomized controlled trial. *Journal of Medical Internet Research* 2008;**10**(5):e45.

Stoddard 2008 *{published data only}*

Stoddard J, Delucchi K, Munoz R, Collins N, Stable EP, Augustson E, et al.Smoking cessation research via the internet: a feasibility study. *J Health Commun* 2005;**10**(1):27–41.

* Stoddard JL, Augustson EM, Moser RP. Effect of adding a virtual community (bulletin board) to smokefree.gov: randomized controlled trial. *Journal of Medical Internet Research* 2008;**10**(5): e53.

Strecher 2005 *{published data only}*

Strecher VJ, Shiffman S, West R. Moderators and mediators of a web-based computer-tailored smoking cessation program among nicotine patch users. *Nicotine & Tobacco Research* 2006;**8 Suppl 1**: S95–101.

* Strecher VJ, Shiffman S, West R. Randomized controlled trial of a web-based computer-tailored smoking cessation program as a supplement to nicotine patch therapy. *Addiction* 2005;**100**(5): 682–8.

Strecher 2008 *{published data only}*

McClure JB, Greene SM, Wiese C, Johnson KE, Alexander G, Strecher V. Interest in an online smoking cessation program and effective recruitment strategies: results from Project Quit. *Journal of Medical Internet Research* 2006;**8**(3):e14.

* Strecher VJ, McClure JB, Alexander GL, Chakraborty B, Nair VN, Konkel JM, et al.Web-based smoking-cessation programs: results of a randomized trial. *American Journal of Preventive Medicine* 2008;**34**:373–81.

Swan 2010 *{published data only}*

McClure JB, Jack L, Deprey M, Catz S, McAfee T, Zbikowski S, et al.Canary in a coal mine? Interest in bupropion SR use among smokers in the COMPASS trial. *Nicotine & Tobacco Research* 2008; **10**(12):1815–6.

McClure JB, Swan GE, Jack L, Catz SL, Zbikowski SM, McAfee TA, et al.Mood, side-effects and smoking outcomes among persons with and without probable lifetime depression taking varenicline. *Journal of General Internal Medicine* 2009;**24**(5):563–9.

Swan GE, McClure JB, Jack LM, Zbikowski SM, Javitz HS, Catz SL, et al.Behavioral counseling and varenicline treatment for smoking cessation. *American Journal of Preventive Medicine* 2010; **38**:482–90.

Swartz 2006 *{published data only}*

Swartz LHG, Noell JW, Schroeder SW, Ary DV. A randomised control study of a fully automated internet based smoking cessation programme. *Tobacco Control* 2006;**15**(1):7–12.

Te Poel 2009 *{published data only}*

Te Poel F, Bolman C, Reubsaet A, de Vries H. Efficacy of single computer-tailored e-mail for smoking cessation: results after 6 months. *Health Education Research* 2009;**24**(6):930–940.

Woodruff 2007 *{published data only}*

Woodruff SI, Conway TL, Edwards CC. Sociodemographic and smoking-related psychosocial predictors of smoking behavior change among high school smokers. *Addictive Behaviors* 2008;**33**: 354–8.

* Woodruff SI, Conway TL, Edwards CC, Elliott SP, Crittenden J. Evaluation of an Internet virtual world chat room for adolescent smoking cessation. *Addictive Behaviors* 2007;**32**:1769–86.

References to studies excluded from this review

Abroms 2008 *{published data only}*

Abroms LC, Gill J, Windsor R, Simons-Morton B. A process evaluation of e-mail counselling for smoking cessation in college students: Feasibility, acceptability and cost. *Journal of Smoking cessation* 2009;**4**:26–33.

Abroms LC, Windsor R, Simons-Morton B. Getting young adults to quit smoking: A formative evaluation of the X-Pack Program. *Nicotine & Tobacco Research* 2008;**10**:27–33.

An 2007 *{published data only}*

An LC, Hennrikus DJ, Perry CL, Lein EB, Klatt C, Farley DM, et al.Feasibility of Internet health screening to recruit college students to an online smoking cessation intervention. *Nicotine & Tobacco Research* 2007;**9 Suppl 1**:S11–8.

Applegate 2007 *{published data only}*

Applegate BW, Raymond C, Collado-Rodriguez A, Riley WT, Schneider NG. Improving adherence to nicotine gum by SMS text messaging: a pilot study (RPOS3-57). Society for Research on Nicotine and Tobacco 13th Annual Meeting February 21-24, Austin, Texas. 2007.

Buller 2008 *{published data only}*

* Buller DB, Borland R, Woodall WG, Hall JR, Hines JM, Burris-Woodall P, et al.Randomized trials on consider this, a tailored, internet-delivered smoking prevention program for adolescents. *Health Education & Behavior* 2008;**35**(2):260–81.

Buller DB, Young WF, Fisher KH, Maloy JA. The effect of endorsement by local opinion leaders and testimonials from teachers on the dissemination of a web-based smoking prevention program. *Health Education Research* 2007;**22**(5):609–18.

Chen 2006 *{published data only}*

Chen HH, Yeh ML. Developing and evaluating a smoking cessation program combined with an Internet-assisted instruction program for adolescents with smoking. *Patient Education & Counseling* 2006;**61**(3):411–8.

Chew 2005 *{published data only}*

Chew F, Palmer S. Establishing an Internet-based tobacco-control network for Czech health professionals. *Health Promotion Practice* 2005;**6**(1):109–16.

Cobb 2006 *{published data only}*

Cobb NK, Graham AL. Characterizing Internet searchers of smoking cessation information. *Journal of Medical Internet Research* 2006;**8**(3).

Cobb 2005 *{published data only}*

Cobb NK, Graham AL, Bock BC, Papandonatos G, Abrams DB. Initial evaluation of a real-world Internet smoking cessation system. *Nicotine & Tobacco Research* 2005;**7**(2):207–16.

Danaher 2006 *{published data only}*

Danaher BG, McKay HG, Seeley JR. The information architecture of behavior change websites. *Journal of Medical Internet Research* 2005;**7**(2):e12.

Etter 2006 *{published data only}*

Etter JF. Internet-based smoking cessation programs. *International Journal of Medical Informatics* 2006;**75**(1):110–6.

Etter 2009 *{published data only}*

Etter JF, Huguelet P, Perneger TV, Cornuz J. Nicotine gum treatment before smoking cessation: a randomized trial. *Archives of Internal Medicine* 2009;**169**(11):1028–34.

Etter 2009a *{published data only}*

Etter JF. Comparing computer-tailored, internet based smoking cessation counseling reports with generic, untailored reports: a randomized trial. *Journal of Health Communication* 2009;**14**: 646–57.

Feil 2003 *{published data only}*

Feil EG, Noell J, Lichtenstein E, Boles SM, McKay HG. Evaluation of an Internet-based smoking cessation program: Lessons learned from a pilot study. *Nicotine & Tobacco Research* 2003;**5**(2):189–94.

Gala 2008 *{published data only}*

Gala S, Dobbs S, Murray J, Pesek F, Kavanagh C, Ellison J, Walsh. M. Internet-based spit tobacco (ST) cessation study. Society for Research on Nicotine and Tobacco 11th Annual Meeting, 20-23 March 2005; Prague, Czech Republic. 2005.

* Gala S, Pesek F, Murray J, Kavanagh C, Graham S, Walsh M. Design and pilot evaluation of an Internet spit tobacco cessation

program. J.Dent.Hyg. 82 (1):11, 2008. *Journal of Dental Hygiene* 2008;**82**(1):11.

Griffiths 2006 *{published data only}*
Griffiths F, Lindenmeyer A, Powell J, Lowe P, Thorogood M. Why are health care interventions delivered over the Internet? A systematic review of the published literature. *Journal of Medical Internet Research* 2006;**8**(2).

Houston 2005 *{published data only}*
Houston T, Ford DE. Smoking cessation websites as an approach to increasing physician visits for smoking cessation. *Journal of General Internal Medicine* 2005;**20**(Suppl. 1):190.

Houston 2008a *{published data only}*
Houston TK, Richman JS, Ray MN, Allison JJ, Gilbert GH, Shewchuk RM, et al.Internet delivered support for tobacco control in dental practice: randomized controlled trial. *Journal of Medical Internet Research* 2008;**10**:e38.

Houston 2008b *{published data only}*
Houston TK, Ford DE. A tailored Internet-delivered intervention for smoking cessation designed to encourage social support and treatment seeking: usability testing and user tracing. *Informatics for Health & Social Care* 2008;**33**(1):5–19.

Koo 2003 *{published data only}*
Koo M, Skinner H. Improving Web searches: case study of quit-smoking Web sites for teenagers. *Journal of Medical Internet Research* 2003;**5**(4):e28.

Koo 2005 *{published data only}*
Koo M, Skinner H. Challenges of internet recruitment: a case study with disappointing results. *Journal of Medical Internet Research* 2005;**7**(1):e6.

Lenert 2004 *{published data only}*
Lenert L, Munoz RF, Perez JE, Bansod A. Automated e-mail messaging as a tool for improving quit rates in an internet smoking cessation intervention. *Journal of the American Medical Informatics Association* 2004;**4**:235–40.

Muramoto 2007 *{published data only}*
Muramoto M, Campbell J, Connolly T, Aickin M. Project Reach: training community-based "health influencers" to help tobacco users quit (POS2-122). Society for Research on Nicotine and Tobacco 13th Annual Meeting February 21-24, Austin, Texas. 2007.
Muramoto M, Connolly T, Matthews E, Yuan NP, Mack J. Development of a client-centered tobacco brief intervention training for health influencers. Society for Research on Nicotine and Tobacco 11th Annual Meeting, 20-23 March; Prague, Czech Republic. 2005.

Norman 2004 *{published data only}*
Norman C. CATCH-IT report: Evaluation of an internet-based smoking cessation program: Lessons learned from a pilot study. *Journal of Medical Internet Research* 2004;**6**(4):8–10.

Norman 2008 *{published data only}*
* Norman CD, Maley O, Li X, Skinner HA. Using the internet to assist smoking prevention and cessation in schools: A randomized, controlled trial. *Health Psychol* 2008;**27**:799–810.
Skinner H, Maley O, Norman C. Website intervention for youth smoking prevention: findings from school-based randomized controlled trial. Society for Research on Nicotine and tobacco 11th Annual Meeting, 20-23 March 2005; Prague, Czech Republic. 2005.

Ota 2005 *{published data only}*
Ota, A, Takahashi, Y. Factors associated with successful smoking cessation among participants in a smoking cessation program involving use of the internet, e-mails, and mailing-list. *Nippon Koshu Eisei Zasshi - Japanese Journal of Public Health* 2005;**52**(11): 999–1005.
Ota A, Takahashi Y. Factors associated with successful smoking cessation among participants in a smoking cessation program involving use of the internet, e-mails, and mailing-list. *Nippon Koshu Eisei Zasshi - Japanese Journal of Public Health* 2005;**52**(11): 999–1005.

Pederson 2005 *{published data only}*
Pederson, L.L, Blumenthal, D. Smoking cessation: what works in primary care settings. *Ethn.Dis* 2005;**15**(2 Suppl 2):S10–S13.
Pederson LL, Blumenthal D. Smoking cessation: what works in primary care settings. *Ethn Dis* 2005;**15**(2 Suppl 2):S10–3.

Pisinger 2010 *{published data only}*
Pisinger C, Jorgensen MM, Moller NE, Dossing M, Jorgensen T. A cluster randomized trial in general practice with referral to a group-based or an Internet-based smoking cessation programme. *Journal of Public Health* 2010;**32**:62–70.

Prochaska 2008 *{published data only (unpublished sought but not used)}*
Prochaska JO, Butterworth S, Redding CA, Burden V, Perrin N, Leo M, et al.Initial efficacy of MI, TTM tailoring and HRI's with multiple behaviors for employee health promotion. *Preventive Medicine* 2008;**46**:226–31.

Prokhorov 2008 *{published data only}*
Prokhorov AV, Yost T, Mullin-Jones M, de MC, Ford KH, Marani S, et al."Look At Your Health": Outcomes associated with a computer-assisted smoking cessation counseling intervention for community college students. *Addictive Behaviors* 2008;**33**(6): 757–71.
Prokhorov AV, Yost T, Mullin-Jones M, de MC, Ford KH, Marani S, et al."Look At Your Health": Outcomes associated with a computer-assisted smoking cessation counseling intervention for community college students. *Addict Behav* 2008;**33**:757–71.

Rowan 2007 *{published data only}*
Rowan PJ, Cofta-Woerpel L, Mazas CA, Cinciripini PM, Jones LA, Li Y, et al.Neighborhood social context independently predicts tobacco dependence among African American smokers (POS2-135). Society for Research on Nicotine and Tobacco 13th Annual Meeting February 21-24, Austin, Texas. 2007.

Selby 2004 *{published data only}*
Selby P, McIntosh S, Bock B, Graham A, McDonald S. Web-assisted tobacco interventions (WATI): potential, promotion and pitfalls (SYM6). Society for Research on Nicotine and Tobacco 10th Annual Meeting February 18-21, Phoenix, Arizona. 2004.

Severson 2008 *{published data only}*

Danaher BG, Smolkowski K, Seeley JR, Severson HH. Mediators of a successful web-based smokeless tobacco cessation program. *Addiction* 2008;**103**(10):1706–12.

Gordon JS, Akers L, Severson HH, Danaher BG, Boles SM. Successful participant recruitment strategies for an online smokeless tobacco cessation program. *Nicotine & Tobacco Research* 2006;**8 Suppl 1**:S35–41.

Gordon JS, Severson HH, Akers L, Boles SM. Chewfree.com: development, recruitment, and user engagement. Society for Research on Nicotine and Tobacco 11th Annual Meeting, 20-23 March 2005; Prague, Czech Republic. 2005.

Severson HH, Gordon J, Danaher BG, Boles SM, Akers L. Outcome of a web delivered cessation program for smokeless tobacco users (POS1-118). Society for Research on Nicotine and Tobacco 13th Annual Meeting February 21-24, Austin, Texas. 2007.

Severson HH, Gordon JS, Akers L, Boles SM. User characteristics for smokeless tobacco cessation on the internet. Society for Research on Nicotine and Tobacco 11th Annual Meeting, 20-23 March 2005; Prague, Czech Republic. 2005.

Severson HH, Gordon JS, Boles SM, Danaher BG, Akers L. Chewfree.com: Results of a web-delivered smokeless tobacco cessation program (POS1-71). Society for Research on Nicotine and Tobacco 12th Annual Meeting February 15-18, Orlando, Florida. 2006.

Severson HH, Gordon JS, Danaher BG, Akers L. ChewFree.com: evaluation of a Web-based cessation program for smokeless tobacco users. *Nicotine & Tobacco Research* 2008;**10**(2):381–91.

Shegog 2005 *{published data only}*

Shegog R, McAlister AL, Hu S, Ford KC, Meshack AF, Peters RJ. Use of interactive health communication to affect smoking intentions in middle school students: a pilot test of the "Headbutt" risk assessment program. *Am J Health Promot* 2005;**19**(5):334–8.

Stoddard 2005 *{published data only}*

Stoddard J, Delucchi K, Munoz R, Collins N, Stable EP Augustson E, Lenert L. Smoking cessation research via the internet: a feasibility study. *Journal of Health Communication* 2005;**10**(1):27–41.

Stoops 2009 *{published data only}*

Stoops WW, Dallery J, Fields NM, Nuzzo PA, Schoenberg NE, Martin CA, et al.An internet-based abstinence reinforcement smoking cessation intervention in rural smokers. *Drug & Alcohol Dependence* 2009;**105**:56–62.

Thieleke 2005 *{published data only}*

Thieleke J, McMahon J, Meyer G, Yun KA. An evaluation of the Freedom From Smoking Online cessation program among Wisconsin residents. *WMJ* 2005;**104**(4):41–4.

Walters 2006 *{published data only}*

Walters ST, Wright JA, Shegog R. A review of computer and Internet-based interventions for smoking behavior. *Addictive Behaviors* 2006;**31**(2):264–77.

Wetter 2006 *{published data only}*

Wetter D, Cinciripini PM. Palmtop computer-delivered treatments for smoking cessation (SYM4C). Society for Research on Nicotine and Tobacco 12th Annual Meeting February 15-18, Orlando, Florida. 2006.

Woolf 2006 *{published data only}*

Woolf SH, Krist AH, Johnson RE, Wilson DB, Rothemich SF, Norman GJ, et al.A practice-sponsored Web site to help patients pursue healthy behaviors: an ACORN study. *Annals of Family Medicine* 2006;**4**(2):148–52.

References to ongoing studies

Graham 2008 *{published data only}*

Graham AL, Bock BC, Cobb NK, Niaura R, Abrams DB. Characteristics of smokers reached and recruited to an internet smoking cessation trial: a case of denominators. *Nicotine & Tobacco Research* 2006;**8 Suppl 1**:S43–8.

Graham AL, Papandonatos GD. Reliability of internet- versus telephone-administered questionnaires in a diverse sample of smokers. *Journal of Medical Internet Research* 2008;**10**(1):e8.

Graham AL, Papandonatos GD, Bock BC, Cobb NK, Baskin-Sommers A, Niaura R, et al.Internet- vs. telephone-administered questionnaires in a randomized trial of smoking cessation. *Nicotine & Tobacco Research* 2006;**8 Suppl 1**:S49–57.

Humfleet HIV+ve Study *{published data only}*

Humfleet GL, Delucchi K, Kelley K, Hall SM, Dilley J, Harrison G. Characteristics of HIV-positive cigarette smokers: a sample of smokers facing multiple challenges. *AIDS Education & Prevention* 2009;**21**(3 Suppl):54–64.

Humfleet LGBT Study 1 *{published data only}*

Humfleet G, Hall S, Munoz R, Greenwood G. Reaching and treating LGBT smokers: does the internet work? (POS1-117). Society for Research on Nicotine and Tobacco 13th Annual Meeting February 21-24, Austin, Texas. 2007.

Humfleet GL, Greenwood G, Hall S, Munoz R, Taylor A. Characteristics of lesbian, gay, bisexual, and transgender (LGBT) smokers seeking internet-based treatment (POS1-53). Society for Research on Nicotine and Tobacco 12th Annual Meeting February 15-18, Orlando, Florida. 2006.

Humfleet GL, Greenwood G, Hall SM, Munoz R, Hunt C, Taylor A. Internet-based smoking treatment for lesbian, gay, bisexual and transgender (LGBT) cigarette smokers. Society for Research on Nicotine and Tobacco 11th Annual Meeting, 20-23 March 2005; Prague, Czech Republic. 2005.

Humfleet LGBT Study 2 *{published data only}*

Reaching and Treating Lesbian, Gay, Bisexual, and Transgender (LGBT) Cigarette Smokers. Ongoing study February 2008.

Kramer 2009 *{published data only}*

Kramer JJ, Willemsen MC, Conijn B, van Emst AJ, Brunsting S, Riper H. Effectiveness of a web-based self-help smoking cessation intervention: protocol of a randomised controlled trial. *BMC Public Health* 2009;**9**:32.

Additional references

Bock 2004

Bock B, Graham A, Sciamanna C, Krishanamoorthy J, Whiteley J, Carmona-Barros R, et al.Smoking cessation treatment on the internet: content, quality, and usability. *Nicotine & Tobacco Research* 2004;**6**(2):207–19.

Cochrane Handbook
Higgins JPT, Green S. Cochrane Handbook for Systematic Reviews of Interventions 4.2.6 [updated September 2006]. http://www.cochrane.org/resources/handbook/hbook.htm (accessed November 30 2007).

Coleman 2004
Coleman T. Cessation interventions in routine health care. *BMJ* 2004;**328**:631–3.

Dijkstra 1999
Dijkstra A, De Vries H, Roijackers J. Targeting smokers with low readiness to change with tailored and nontailored self-help materials. *Preventive Medicine* 1999;**28**(2):203–11.

Etter 2006
Etter JF. A list of the most popular cessation web sites and a comparison of their quality. *Nicotine & Tobacco Research* 2006;**8 Suppl 1**:S27–34.

Eysenbach 2002
Eysenbach G. Issues in evaluating health websites in an Internet-based controlled trial. *J Med Internet Res* 2002;**4**(3):e17.

Eysenbach 2007
Eysenbach G. Poverty, human development and the role of e Health. *Journal of Medical Internet Research* 2007;**9**(4):e34.

Fox 2005
Fox S. Health information online: eight in ten internet users have looked for health information online, with increased interest in diet, fitness, drugs, health insurance, experimental treatments, and particular doctors and hospitals.. http://www.pewinternet.org/pdfs/PIP_Healthtopics_May05.pdf (accessed April 2006) 2005.

Graham 2007
Graham AL, Cobb NK, Raymond L, Sill S, Young J. Effectiveness of an internet-based worksite smoking cessation intervention at 12 months. *Journal of Occupational and Environmental Medicine* 2007;**49**(8):821–8.

Hall 2001
Hall SM, Delucchi KL, Velicer WF, Kahler CW, Ranger-Moore J, Hedeker D, et al.Statistical analysis of randomized trials in tobacco treatment: longitudinal designs with dichotomous outcome. *Nicotine & Tobacco Research* 2001;**3**:193–201.

Haukkala 2000
Haukkala A, Uutela A, Vartiainen E, McCalister A, Knekt P. Depression and smoking cessation: the role, motivation and self-efficacy. *Addict Behav* 2000;**25**(2):494–509.

Higgins 2003
Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ* 2003;**7414**:557–60.

Hughes 2007
Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. *Cochrane Database of Systematic Reviews* 2007, Issue 1. [DOI: 10.1002/14651858.CD000031.pub3]

Japuntich 2006
Japuntich SJ, Zehner ME, Smith SS, Jorenbv DE, Valdez JA, Fiore MC, et al.Smoking cessation via the internet: a randomized clinical trial of an internet intervention as adjuvant treatment in a smoking cessation intervention. *Nicotine & Tobacco Research* 2006;**8 Suppl 1**:S59–67.

Kontos 2007
Kontos EZ, Bennett GG, Viswanath K. Barriers and facilitators to home computer and internet use among urban novice computer users of low socioeconomic position. *Journal of Medical Internet Research* 2007;**9**(4):e 31.

Lancaster 2005a
Lancaster T, Stead LF. Individual behavioural counselling for smoking cessation. *Cochrane Database of Systematic Reviews* 2005, Issue 2. [DOI: 10.1002/14651858.CD001292.pub2]

Lancaster 2005b
Lancaster T, Stead LF. Self-help interventions for smoking cessation. *Cochrane Database of Systematic Reviews* 2005, Issue 3. [DOI: 10.1002/14651858.CD001118.pub2]

Mackay 2006
Mackay J, Eriksen M, Shafey O. *The Tobacco Atlas*. 2nd Edition. American Cancer Society, 2006.

Modis 2005
Modis T. The end of the internet rush. *Technological Forecasting and Social Change* 2005;**72**:938–43.

Munoz 2006
Munoz RF, Lenert LL, Delucchi K, Stoddard J, Perez JE, Penilla C, et al.Toward evidence-based Internet interventions: A Spanish/English Web site for international smoking cessation trials. *Nicotine & Tobacco Research* 2006;**8**:77–87.

Myung 2009
Myung SK, McDonell DD, Kazinets G, Seo HG, Moskowitz JM. Effects of Web-and Computer-Based Smoking Cessation Programs. *Arch Intern Med.* 2009;**169**(10):929–937.

Niaura 2002
Niaura R, Abrams DB. Smoking cessation: progress, priorities, and prospectus. *J Consult Clin Psychol* 2002;**70**(3):494–509.

Parrot 2004
Parrot S, Godfrey C. Economics of smoking cessation. *BMJ* 2004;**328**:947–9.

Pike 2007
Pike KJ, Rabius V, McAlister A, Geiger A. American Cancer Society's QuitLink: randomized trial of Internet assistance. *Nicotine & Tobacco Research* 2007;**9**:415–20.

Pingdom 2010
Internet 2009 in numbers. http://royal.pingdom.com/2010/01/22/internet-2009-in-numbers/.

Rodgers 2005
Rodgers A, Corbett T, Bramley D, Riddell T, Wills M, Lin RB, et al.Do u smoke after txt? Results of a randomised trial of smoking cessation using mobile phone text messaging. *Tobacco Control* 2005;**14**(4):255–61.

Schroeder 2002
Schroeder SA. Conflicting dispatches from the tobacco wars. *New England Journal of Medicine* 2002;**347**:1106–9.

SCTH 1998
Scientific Committee on Tobacco and Health and HMSO. *Report of the Scientific Committee on Tobacco and Health*. London: Her Majesty's Stationery Office, 1998.

Shahab 2009
Shahab L, McEwen A. Online support for smoking cessation: a systematic review of the literature. *Addiction* 2009;**104**:1792–1804.

SRNT 2002
SRNT Subcommittee on Biochemical Verification. Outcome criteria in smoking cessation trials:proposal for a common standard [Biochemical verification of tobacco use and cessation]. *Nicotine& Tobacco Research* 2002;**4**:149–159.

Stead 2005
Stead LF, Lancaster T. Group behaviour therapy programmes for smoking cessation. *Cochrane Database of Systematic Reviews* 2005, Issue 2. [DOI: 10.1002/14651858.CD001007.pub2]

Stead 2006
Stead LF, Lancaster T, Perera R. Telephone counselling for smoking cessation. *Cochrane Database of Systematic Reviews* 2006, Issue 3. [DOI: 10.1002/14651858.CD002850.pub2]

Stead 2008a
Stead LF, Perera R, Bullen C, Mant D, Lancaster T. Nicotine replacement therapy for smoking cessation. *Cochrane Database of Systematic Reviews* 2008, Issue 1. [DOI: 10.1002/14651858.CD000146.pub3]

Stead 2008b
Stead LF, Bergson G, Lancaster T. Physician advice for smoking cessation. *Cochrane Database of Systematic Reviews* 2004, Issue 2. [DOI: 10.1002/14651858.CD000165.pub3]

Strecher 2005
Strecher VJ, Shiffman S, West R. Randomized controlled trial of a web-based computer-tailored smoking cessation program as a supplement to nicotine patch therapy. *Addiction* 2005;**100**(5): 682–8.

Strecher 2006
Strecher VJ, Shiffman S, West R. Moderators and mediators of a web-based computer-tailored smoking cessation program among nicotine patch users. *Nicotine & Tobacco Research* 2006;**8 Suppl 1**: S95–101.

Surgeon General 1988
United States Public Health Service. The health consequences of smoking nicotine addiction : a report of the Surgeon General. Office of the Surgeon General 1988.

Swartz 2006
Swartz LH, Noell JW, Schroeder SW, Ary DV. A randomised control study of a fully automated internet based smoking cessation programme. *Tobacco Control* 2006;**15**(1):7–12.

Verheijden 2007
Verheijden MW, Jans MP, Hildebrandt VH, Hopman-Rock M. Rates and determinants of repeated participation in a web-based behaviour change program for healthy body weight and healthy life style. *Journal of Medical Internet Research* 2007;**9**(1):e1.

West 2004
West R. Assesment of dependence and motivation to stop smoking. *BMJ* 2004;**328**:338–9.

West 2005
West R, Hajek P, Stead L, Stapleton J. Outcome criteria in smoking cessation trials: proposal for a common standard. *Addiction* 2005; **100**:299–303.

Whittaker 2009
Mobile phone-based interventions for smoking cessation. Whittaker R, Borland R, Bullen C, Lin RB, McRobbie H, Rodgers A. *Cochrane Database of Systematic Reviews* 2009, Issue 4. [DOI: 10.1002/14651858.CD006611.pub2]

WHO 2004
World Health Organization. *Building blocks for Tobacco Control - A Handbook*. Serial, 2004.

* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

An 2008

Methods	Location: University of Minnesota, Twin Cities, USA Funding: Grant from Clear Way Minnesota, and University of Minnesota Trans disciplinary Tobacco Research Centre Recruitment: via Internet health screening in October 2004
Participants	517 (257 intervention, 260 control), aged 18 -24 smoked cigarettes in the past 30 days, and indicated that they intended to be in school for the next two semesters; av. age 20 years; 75.4% Female control vs. 70.4% intervention; 9.2% Non-white control vs. 7.8% intervention, av. CPD 4.2 control vs. 3.8 intervention, past year quit attempts 52.9% control vs. 46.9% intervention
Interventions	Intervention: RealU intervention group were asked to make 20 weekly visits to the study website over a 30-week period. At the start of each week participant received an e-mail invitation to visit the study website to 1) report on health and lifestyle habits for the prior week (e.g. days smoking, drinking, stress etc), 2) take an interactive quiz with tailored feedback to learn about a smoking related or general interest topic, 3) view a student authored general interest online college life magazine. Smoking cessation content and messages were introduced gradually over the intervention period. Participants were invited to take week long "breaks" from smoking throughout the intervention period but were not asked to quit for a longer time until the final month of intervention. The intervention site actively promoted the campus wide Quit & Win contest and included links to the on-line sign-up for this contest. Participants also received weekly e-mails written by one of nine peer coaches and were encouraged to write back to peer coaches through the "Question of the Week" contests (topics that encouraged participants to think about reasons for quitting). Control: received a confirmation email containing links to online health and academic resources. Quit & Win contest was promoted using advertisements in the student newspaper, campus posters, direct mail and email to all university students.
Outcomes	Long term abstinence: self-reported 30-day at week 30 validated by CO <8 ppm. (Individuals who reported 30 day abstinence at the final evaluation were offered $50 to complete an in-person exit interview during which exhaled carbon monoxide was measured) Short term abstinence: 7-day PP at 8 weeks Other reported abstinence outcomes: 6-month prolonged at 30 weeks based on reported duration of abstinence, 7-day PP at 20 & 30 weeks Other reported outcomes: quit attempts.
Notes	High level of incentives used to encourage adherence. 30 day abstinence with validation used as primary outcome. Prolonged abstinence rates were much lower and not significantly different; 6% overall.

Risk of bias

Item	Authors' judgement	Description

An 2008 (*Continued*)

Adequate sequence generation?	Yes	All eligible individuals identified on the health screening were asked to complete online baseline survey prior to enrolment. Participants who completed the baseline survey and provided online consent were enrolled and randomized in real time following a blocked random number sequence generated by the study statistician.
Allocation concealment?	Yes	Centralised process
Incomplete outcome data addressed? All outcomes	Yes	No individual withdrew from the study. Follow-up survey response rates exceeded 90% and did not differ between the groups at any time point. All randomized participants included in ITT analysis

Brendryen 2008a

Methods	Location: Web Funding: Cooperation and co-funding among the University of Oslo, Happy Ending AS, and the Norwegian Research Council Recruitment: via Internet advertisements
Participants	290 (144 intervention, 146 control), at least 18 years old, currently smoking five cigarettes or more on daily basis, willing to quit without using NRT, having daily access to the Internet and email, owning mobile phone (a Norwegian-registered phone number and postal address); av. age 39.5 years; 50% female; 49% intervention vs. 52% control had a college degree.
Interventions	Intervention: Happy Ending (HE), intense 1-year smoking cessation programme delivered via the Internet and cell phone. Consists of more than 400 contacts by email, Web pages, interactive voice response, and short message service technology. Includes a craving helpline and a relapse prevention system, providing just-in-time therapy. All components fully automated. Control: 44-page self-help booklet issued by the Norwegian Directorate for Health and Social Affairs. Contains general cessation information, quit calendar, 10-day quit log, phone number of the national quitline, and links to relevant and open online tobacco cessation resources
Outcomes	Long term abstinence: Prolonged abstinence at 12 months (i.e. repeated point abstinence at 1, 3, 6 & 12 m assessments). No biochemical validation Short term abstinence: Prolonged abstinence at 3 months (i.e. repeated point abstinence at 1 & 3 m assessments) Other reported abstinence outcomes: PP at 1, 3, 6, 12 m Other reported outcomes: Participant exposure (frequency and duration of each participant's visits to the Web based program), pharmacotherapy use, programme usability.

Brendryen 2008a (*Continued*)

Notes	The relative effect is smaller and not significant for 12 m PP abstinence (47/144 vs 33/146, RR 1.44), attributable to an increase in later quitting in the control	
Risk of bias		
Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Yes	Computer-generated random digit. Stratified block randomization applied to ensure equal numbers of both males and females in each group.
Allocation concealment?	Yes	Centralised system.
Incomplete outcome data addressed? All outcomes	Yes	57 participants discontinued intervention at follow ups, none discontinued in control group. Cumulative drop out at 12 months 26 in intervention, 38 in control groups. All randomized participants were included in ITT analysis.

Brendryen 2008b

Methods	Location: Web study based in Norway Funding: University of Oslo, Happy Ending AS and the Norwegian Research Council. Pfizer Norway provided a free supply of NRT Recruitment: via Internet advertisements.
Participants	396 (197 intervention, 199 control) aged 18 years or older, currently smoking more then 10 CPD, access to the Internet, e-mail and cell phone on a daily basis, willing to quit smoking. Av. age 36 years; 50.8% female intervention vs. 49.8% control; 42.1% intervention group vs. 39.7% control with college degree; av. CPD 18
Interventions	All participants offered free NRT Intervention: Happy ending intervention (HE) - fully automated and digitally delivered smoking cessation intervention. The programme lasted 54 weeks and consisted of more then 400 contacts by e-mail, web-pages, interactive voice response and short message service (SMS) technology) Control: received a self-help booklet.
Outcomes	Long term abstinence: Prolonged abstinence at 12 months (i.e. repeated point abstinence at 1, 3, 6 & 12 m assessments). No biochemical validation. Short term abstinence: PP at 3 m Other reported abstinence outcomes: PP at 1, 6, 12 m Other reported outcomes: Programme use, NRT adherence

Brendryen 2008b (*Continued*)

Notes	The relative effect is smaller but still significant for 12 m point prevalence (74/197 vs 48/199, RR 1.56)	
Risk of bias		
Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Yes	Computer-generated random digit
Allocation concealment?	Yes	Centralised system
Incomplete outcome data addressed? All outcomes	Yes	4 post randomization exclusion due to erroneous allocation. Response rate generally high across experimental condition and time (95.9% intervention vs. 91.5% control at 12 months assessment). All randomized participants were included in ITT analysis.

Clark 2004

Methods	Location: USA Funding: Grant from the National Cancer Institute Recruitment: current smokers undergoing low-dose fast spiral chest CT (SCTS) for lung cancer. Participants were recruited at the first annual follow-up visit	
Participants	171 current cigarette smokers (85 intervention group, 86 control group), had access to a computer with Internet service. Av. age 57,4 years, 50% female, 60% of participants were smoking less than 20 CPD.	
Interventions	Intervention: Handout with a list of 10 Internet sites related to stopping smoking and a brief description of each site Control: received a copy of a publication of the National Cancer Institute	
Outcomes	Long term abstinence: 7-day PP at 12 m Short term abstinence: 7-day PP at 30 days Validation: CO measurement at 12 m follow up Other reported outcomes: readiness to quit if not stopped, other tobacco use, number of quit attempts in previous year, other smokers in household, utilization of intervention materials at 30-day follow up.	
Notes		
Risk of bias		
Item	**Authors' judgement**	**Description**

Clark 2004 (*Continued*)

Adequate sequence generation?	Unclear	Randomized, method not described
Allocation concealment?	Unclear	No details given in the paper
Incomplete outcome data addressed? All outcomes	Yes	No-drop outs, as all study participants attended their annual review which corresponded with the 1-year follow up assessment.

Etter 2005

Methods	Location: Switzerland Funding: Health Department of the Canton of Geneva, Swiss Cancer League, Swiss Federal Office of Public Health, Novartis. The Health on the Net (HON) Foundation, provided an informatics engineer who developed the software that produced the counselling letters and who managed the data collection and storage. Recruitment: visitors of Stop - tabac.ch, a French-language website. Enrolment of participants took place between April 2003 and July 2004
Participants	11969 visitors to the website (5966 intervention group, 6003 control group), including current and ex-smokers. Av. age 34 years; 61% female; 19.5 CPD
Interventions	Compares two Internet based interventions Intervention: The original online programme was a tailored, interactive smoking cessation program. It was based on psychological and addiction theory, and preliminary research conducted in the same population. The tailoring questionnaire assessed demographic characteristics, smoking status, stage of change, level of tobacco dependence, attitudes toward smoking, self-efficacy, use of self-change strategies and coping methods, and intention to use nicotine replacement therapy (NRT). After answering the 62-item questionnaire, participants received a personal counselling letter of 6-9 pages (3000-4000 words) illustrated with cartoons and graphs that were also tailored to each participant answers. The counselling letter consisted of about 20 paragraph of text, chosen by the computer in a library of 350 paragraphs according to pre-established decision rules. Control: modified tailored programme (shorter, simplified version designed for NRT users). The modified programme used a shorter questionnaire (38 questions) that included ad hoc questions instead of validated multi-item scales. The counselling letter was of similar length (3000-4000 words), but contained more information on NRT and nicotine dependence and less information on health risks and coping strategies
Outcomes	Short term abstinence: self-reported 7-day PP abstinence at 11 weeks post randomization
Notes	Short term outcomes only. Differential drop out did not lead to substantial difference in relative effects.

Risk of bias

Item	**Authors' judgement**	**Description**

Etter 2005 (*Continued*)

Adequate sequence generation?	Yes	Computer based randomization
Allocation concealment?	Yes	Alternate questionnaires used by each separate person signing up to the web-site
Incomplete outcome data addressed? All outcomes	Yes	Follow-up survey completed by 2341 (39.2%) of those on original programme vs 1896 (31.6%) of those on modified (p<.001). All randomized participants were included in ITT analysis.

Japuntich 2006

Methods	Location: 2 research centres in Wisconsin, USA Funding: National Cancer Institute Grant Recruitment: from October 2001 to July 2002 via billboards, bus interior posters, flyers, television advertisements, and press releases. Recruitment materials did not state that the study tested an experimental computer program. Interested individuals called a central telephone number.
Participants	284 (140 intervention, 144 control), ≥18 years old, smoking ≥ 10 CPD, with traditional telephone line, literate in English. Av. age 41 years; 54.9% female; 79.1% Caucasian; av. CPD 21.6. Exclusion criteria: current depression, current use of psychiatric medication, medical conditions contra-indicating bupropion SR use, current use of a smoking cessation product or treatment, being pregnant or likely to become pregnant during the treatment phase of the study.
Interventions	Intervention: 9 weeks of twice daily bupropion SR (150mg), 3 brief counselling sessions and 5 follow-up visits plus 12 weeks access to Comprehensive Health Enhancement Support System for Smoking Cessation and Relapse prevention (CHESS SCRP) Web site (plus study computer and dial-up connection) The CHESS SCRP is a guided universe of information, emotional support and problem-solving assistance in a password-protected environment on the World Wide Web. The CHESS SCRP Web site was organized into four sections. The first section provided information about quitting smoking. The second section was a support centre that provided a variety of chat programmes as well as a cognitive behavioural therapy intervention for negative emotions. The third section was an information repository that allowed participants to save CHESS SCRP documents in an easy to find folder (my folder). The final section allowed participants to search for information within CHESS SCRP, provided a list of recommended Web sites and offered tips on evaluating Web sites participants may have found on their own Control group: As intervention but no access to CHESS.
Outcomes	Long term abstinence: 7-day PP 6 m after quit date Short term abstinence: 7-day PP abstinence 3 m after quit date Validation: CO ≤ 10 ppm Other reported outcomes: Number of times participants used CHESS SCRP website

Japuntich 2006 (*Continued*)

Notes	1 year follow up results not reported in paper.	
Risk of bias		
Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Unclear	Randomized, method not described
Allocation concealment?	Unclear	No details given in the paper
Incomplete outcome data addressed? All outcomes	Yes	63 participants withdrew from the study between randomization and the 1-year follow up (31 from intervention, 32 from control); 57 were lost to follow up (27 from intervention group, 30 from control). Drop-outs were considered smokers and all randomized participants were included in ITT analysis.

McKay 2008

Methods	Location: Web Funding: The study was supported by grant from the National Cancer Institute. Recruitment: An Internet-based recruitment campaign was designed and executed. The campaign involved ad placement on Google and Yahoo search engines (keywords quit smoking and stop smoking) and links to their relevant affiliated sites. Clicking those ads enabled users to (1) visit recruitment site (study description, inclusion/exclusion criteria) , (2) submit answers to screening items, (3) provide their informed consent, and (4) complete the baseline assessment.
Participants	2318 current smokers (1159 intervention, 1159 control), $\geq$ 18 years, interested in quitting within next 30 days, willing to engage in moderate physical activity, had access to the Internet and gave written informed consent. 70.5% female; 30-50 year old; 86.6% White; 40.7% of participants had some college education; 27.5% had college degree; smoked 20-40 CPD.
Interventions	Intervention: QSN condition incorporated a hybrid information architecture in which first-time users were directed through a series of tailored Web pages (tunnel design) in order to introduce them to the key concepts and strategies of a behavioural programme for quitting smoking. Once they emerged from the tunnel, users were able to choose their own path to access a broad array (using a matrix design) of additional content on quitting and maintaining non smoking. Components of the smoking cessation intervention used in the study are based on Social Cognitive Theory as it has been applied to tobacco abstinence. These components are designed to help encourage tobacco abstinence via the use of strategies that address each participants behaviour, cognition, and environment. Control: Active Lives control condition accessed a Web-based programme designed to encourage them to engage in a personalized fitness programme that would help them

	quit smoking. The programme guided each participant through a multi-step plan that included a motivational component (exploration of the benefits of physical activity and a clarification of personal goals and barriers), a behavioural action plan with extensive tracking features (e.g., weekly activity schedules personalized to each participants schedule and types of activities), additional online resources (articles and tips sheets), and access to a Web forum for peer support.
Outcomes	Long term abstinence: self-reported 7-day PP abstinence at 3 and 6 m post-enrolment. In addition, repeated point prevalence non-smoking at both the 3- and 6-m assessments was examined Other reported outcomes: participants exposure (frequency and duration of each participants visits to the Web based program), physical activity, pharmacotherapy use, programme usability.
Notes	Study name: Smokers' Health Improvement Project (SHIP)

Risk of bias

Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Yes	Computer based randomization
Allocation concealment?	Yes	Not described in the paper, but recruitment automated so risk of bias likely to be low
Incomplete outcome data addressed? All outcomes	Yes	27% of participants provided both 3 & 6 m assessment data, no significant difference between groups. All randomized participants were included in ITT analysis.

Mermelstein 2006

Methods	Location: 52 High Schools from Illinois Funding: grant from American Lung Associations of Illinois Recruitment: 29 schools were selected from initial 52 high schools throughout Illinois that had expressed interest to American Lung Association (ALA) in hosting the NOT program. Students were recruited through a combination of flyers, school announcements assemblies, and/personal referrals from teachers or coaches. All students participated voluntarily.
Participants	351 students from regular public or private high schools (171 intervention group, 180 control group); av. age 16.4 years, 53.8% female, 74.4% White, almost all daily smokers, 7-11cpd. At baseline, the two conditions differed significantly by smoking rate, with participants in the NOT condition smoking more than those in the NOT Plus condition.
Interventions	Intervention: a NOT Plus condition, which included three adjuncts. The first adjunct involved proactive, facilitator-initiated telephone calls to the students, with one call during quit week (week 5), and up to four booster calls between the end-of-treatment

Mermelstein 2006 (*Continued*)

	and 3-month follow up. The second adjunct was access to the Not Hooked Web site, developed specifically for adolescents trying to stop smoking. The third adjunct was access to the American Lung Association quitline; however, utilization of the quitline was very low (only five students called Control: the standard NOT program, a 10-session group-based program
Outcomes	Long term abstinence: 30 day abstinence at 3 months follow-up (approximately 6 months after baseline) Short term abstinence: 7-day PP smoking abstinence at end-of-treatment Validation: Partial CO assessment at end of treatment, no validation at longer follow up Other reported outcomes: web usage, receipt of proactive calls, general access to the Internet
Notes	Participants were paid a cash incentives for completing surveys. Schools were paid $500 for their participation and assistance in scheduling the program.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	Schools were randomly assigned.The method is unclear from the paper.
Allocation concealment?	Unclear	The method is unclear from the paper
Incomplete outcome data addressed? All outcomes	Yes	Surveys were returned by 64.1% at end of programme and 66.1% at follow up, attrition did not differ by condition. All randomized participants were included in ITT analysis.

Munoz 2006 Study 3

Methods	Location: 74 countries Funding: grants from the Tobacco - Related Disease Research and by grant from the University of California Committee on Latino Research to the UCSF/SFGH Latino Mental Health Research Program Recruitment: via press releases and standard links from search engines and the study was conducted in English.
Participants	280 English speaking participants (139 intervention vs. 141 control) being 18 years of age, smoking five or more cigarettes daily, using E-mail at least once weekly, and planning to quit within the next month; av.age 38.4 years, 67.9% female, 76.3% White, 20.3 av.cpd. Education: high school or less: 35.4%, some college: 29.3%, college grad: 25.4%, graduate degree: 10.0%

Munoz 2006 Study 3 (*Continued*)

Interventions	Compares variants of an Internet based intervention Intervention: The smoking cessation intervention (Guia) was the Guia para dejear de fumar (brochure in Spanish, translated into English) and adapted as a Web-based brochure for this study. In addition to Guia, individually timed educational messages (ITEMs) were used. These were e-mails inviting participants back to the site at specific time. The messages included encouraging comments and links to relevant sections of the assigned intervention, such as planning for the quit date, the early quit period, how to stay quit, and relapses if any. The component tested in the trial was an 8-lesson social-learning-oriented mood management (MM) course designed to improve quit rates. The course included instructions on how to use the materials; self-monitoring screens to record cigarettes smoked mood and anxiety levels, pleasant activities, helpful and harmful thought, and contacts with helpful people; and relaxation instructions. Lessons were made available one per week to simulate how such lessons would be delivered in a traditional smoking cessation group. Control: Guia and ITEMs alone
Outcomes	Long term abstinence: self-reported 7-day PP at 12 months after entry. Short term abstinence: self-reported 7-day PP at 3 months. Abstinence also assessed at 1 & 6 m. Other reported outcomes: abstinence rates by history of major depression
Notes	High level of incentives were used to encourage adherence.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Yes	Computer randomization
Allocation concealment?	Yes	Results of the baseline questionnaires were used to automatically implement stratified randomization by gender and MDE status
Incomplete outcome data addressed? All outcomes	Yes	Follow-up data were provided by 35.4%, and 34.6% of those completing baseline questionnaires and randomized at the 3 and 12 month follow ups respectively. All randomized participants were included in ITT analysis.

Munoz 2006 Study 4

Methods	Location: 74 countries Funding: grants from the Tobacco - Related Disease Research and by grant from the University of California Committee on Latino Research to the UCSF/SFGH Latino Mental Health Research Program Recruitment: via press releases and standard links from search engines and the study was conducted in Spanish
Participants	288 Spanish speaking participants (142 intervention vs. 146 control), being 18 years of age, smoking five or more cigarettes daily, using E-mail at least once weekly, and planning to quit within the next month; av. age 35 years, 41.3% female, 62% White, 22.8 av. CPD. Education: high school or less:. 22.6%, some college: 24.0% college grade: 39.2% graduate degree: 14.2%.
Interventions	Compares variants of an Internet based intervention Intervention: Same as Munoz 2006 Study 3; Guia + ITEMs + MM Control: Guia + ITEMs
Outcomes	Long term abstinence: self-reported 7-day PP at 12 months after entry. Short term abstinence: self-reported 7-day PP at 3 months. Abstinence also assessed at 1 & 6 m. Other reported outcomes: abstinence rates by history of major depression
Notes	High level of incentives were used to encourage adherence.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Yes	Computer randomization
Allocation concealment?	Yes	Results of the baseline questionnaires were used to automatically implement stratified randomization by gender and MDE status
Incomplete outcome data addressed? All outcomes	Yes	Follow-up data were provided by 66.3 %, and 61.5% of those completing baseline questionnaires and randomized at the 3 and 12-month follow ups respectively. All randomized participants were included in ITT analysis.

Munoz 2009

Methods	Location: 68 countries Funding: grant from the Tobacco Related Disease Research Program, and by infrastructure grant from the University of California Committee on Latino Research. Grant from the Tobacco Research Network Program, National Cancer Institute, National Institute on Drug Abuse, National Institutes of Health. Recruitment: Participants were recruited using Google Ad Words campaigns targeted at users world-wide. Smokers came to the study site via search engines, links from other Websites, media stories, or word of mouth.
Participants	1000 participants older then 18 years, smoking at least 5 CPD, intending to quit in the next month and using E-mail at least once weekly. They were assigned to four conditions : 1 (247 participants); 2 (251); 3 (251); 4 (251); av. age 37.9 years, 45% female, 53% Hispanic/Latino, 19.8 av. CPD. Education: Some college 39.5%, college graduate 28.7%, graduate degree 14.7%
Interventions	Compares cumulative variants of an Internet based intervention Condition 1 (*Guía* alone): the online static "*Guía*" as used in Munoz 2006 studies, a cigarette counter, and an online journal to record experiences while quitting. The *Guía* covered reasons to quit, cessation strategies, relapse prevention and management, pharmacological aids, and how to help a smoker quit. Condition 2 (*Guía* + ITEMs): As 1. plus Individually Timed Educational Messages (ITEMs); automated emails with links to sections of the *Guía* keyed to quit date. Condition 3 (*Guía* + ITEMs + MM): As 2. plus eight-lesson cognitive-behavioural mood management course as used in Munoz 2006. Condition 4 (*Guía* + ITEMs + MM + VG): As 3. plus "virtual group" asynchronous bulletin board for mutual support and suggestions.
Outcomes	Long term abstinence: self-reported 7-day PP at 12 months after entry. Short term abstinence: self-reported 7-day PP at 3 months. Abstinence also assessed at 1 & 6 m. Secondary outcome: satisfaction with Web site Other reported outcomes:site utilization
Notes	There were no significant differences among the conditions. Quit rates at 12 m: Condition 1 (*Guía*) 19.8% (49/247): Condition 2 (+ ITEMs) 19.1% (48/251): Condition 3 (+ MM) 20.7% (52/251): Condition 4 (+ VG) 22.7% (57/251). Conditions 3 vs 2 used in forest plot to make same comparison as Munoz 2006.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Yes	Computer based
Allocation concealment?	Yes	Stratified randomization using an automated algorithm programmed into the Web site

Incomplete outcome data addressed? All outcomes	Yes	90% responded to at least one follow up, 14% to one, 18% to two, 20% to three and 38% to all four. No differences between number of assessments were found between language groups. No significant difference in number of completed assessments were found based on treatment condition, sex or MDE history. All randomized participants included in ITT analysis.

Patten 2006

Methods	Location: three geographically and ethnically diverse sites: Rochester, Minnesota; Madison, Wisconsin; Hartford, Connecticut Funding: this trial was supported grant from the National Cancer Institute Recruitment: television commercials, radio and newspaper announcements, and flyers displayed in the schools and clinics at each respective site
Participants	139 adolescents aged 11-18 years (69 intervention condition vs. 70 control), smoked a total of 10 or more cigarettes during the previous 30 days, willing and able to complete treatment and assessment visits, provided written informed consent; av. age 16 years, 50 % female, 90 % Caucasian, 10 CPD
Interventions	Intervention (in this review): Stomp Out Smokes (SOS) Internet-based intervention. SOS participants were provided access to SOS and the Internet for 24 weeks and except for the assessment visits, study staff did not have any personal contact with participants. General content of the SOS site was consistent with the clinical practice guidelines on effective tobacco use intervention but tailored to adolescents, and updated every 6 months as needed. Reading level for content was at the sixth grade. The web architecture and design of the SOS site was also consistent with the National Cancer Institute Web usability guidelines. Control (in this review): Brief office intervention (BOI). Adolescents receiving the BOI met with a research counsellor for four consecutive, weekly, individual sessions. Duration of session 1 was projected to be 30-40 min, while the remaining three sessions were about 10-20 min. Adolescents were given a specific homework exercise at the end of each session which focused on preparing to stop smoking or practicing at least one of the techniques discussed in the session.
Outcomes	Long term abstinence: 30-day PP at 9 m Short term abstinence: 30-day PP at 3 m Abstinence also assessed at 2 and 6 m Validation: CO≤8 ppm at each follow up Other reported outcomes: cigarettes smoked per day and days smoked at 6 m, treatment compliance, concomitant behavioral and pharmacological treatment.
Notes	

Risk of bias

Patten 2006 (*Continued*)

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	Randomization method described
Allocation concealment?	Unclear	No details were given
Incomplete outcome data addressed? All outcomes	Yes	The percentage attending assessment visit in the intervention and control conditions, respectively, was 42 and 53% at 9 m. All randomized participants included in ITT analysis.

Rabius 2008

Methods	Location: Web Funding: American Cancer Society Recruitment: Through Internet. The link placed on American Cancer Society (ACS) website led smokers to the QuitLink study website, where they could answer eligibility questions, provide informed consent, and complete the baseline survey**.**
Participants	6451 English-speaking daily smokers residing in the United States who provided informed consent and completed the baseline survey randomized to 6 sites: Control Site (n = 1047), Site 1 (n = 1052), Site 2 (n = 1103), Site 3 (n = 1042), Site 4 (n = 1101), Site 5 (n = 1106). Av. age 41 years, 70% female, 87% Caucasian intervention vs. 74% control, had some college education 75 % intervention vs. 59% control, av.cpd 21, 6.3 past quit attempts
Interventions	Comparison between different Internet sites Intervention: received emailed access to one of five tailored interactive sites provided by cooperating research partners (SmokeClinic, CAMH, V-CC, ORCAS, QuitNet, and ProChange) Control: received access to a targeted, minimally interactive ACS site with text, photographs, and graphics providing stage based quitting advice and peer modelling.
Outcomes	Long term abstinence: self reported 30-day PP, 13 m after randomization Short term abstinence (Pike 2007): self reported 7-day PP abstinence at 3 m Other assessed outcomes: Utilisation of the different interactive sites (reported in Pike 2007). Link between quitting success and number of visits to interactive sites. Effect modification by indicator of depression at baseline
Notes	

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Yes	Computer based randomization

Rabius 2008 (*Continued*)

Allocation concealment?	Yes	No details given in the paper, but recruitment automated so risk of bias likely to be low
Incomplete outcome data addressed? All outcomes	Yes	38% provided information on their smoking status 13 months after randomization. All randomized participants were included in ITT analysis

Stoddard 2008

Methods	Location: Web Funding: supported by the Tobacco Control Research Branch of the National Cancer Institute. The project has been funded in whole or in part with federal funds from the National Cancer Institute, National Institutes of Health Recruitment: federal employees and contractors were invited by emails. Emails contained information about a service for smokers interested in quitting, along with an embedded link redirecting interested participants to a site used to screen for eligibility
Participants	1375 participants over 18 years of age (691 intervention vs. 684 control) who were ready to quit in the next 30 days or who had begun an initiation attempt within 5 days before enrolment; av. age 43.6 years, 54% female, non-Hispanic White (69.1%), 16.9% non-Hispanic Black and 7.0% Hispanic, 49.2% had some college education, av. CPD 18.3
Interventions	Compares variants of an Internet based intervention Intervention: website that included asynchronous bulletin board (BB condition). Beside basic content which was the same for both conditions, BB condition offered a forum when participants could respond to some seeded categories posted on the board or start their own message Control: publicly available smokefree.gov, designated as usual care (UC condition). The basic content was: 1) online quit guide and 5 unique self-help materials targeted to specific populations; 2) links for reaching a counsellor for one on one help either by telephone or instant messaging; 3) an interactive list of clinical trials still recruiting smokers who wish to quit; 4) an interactive smokers risk tool showing changes in a risk of death due to smoking based on the smokers history and time of quitting; and 5) a series of empirically based statements about positive health changes that commonly follow cessation
Outcomes	Short term abstinence: self reported 7 day PP abstinence at 3 m after enrolling in the study Other reported outcomes: time spent on the website, utilization of pages, cessation aids used in the past and during the study period
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**

Stoddard 2008 (*Continued*)

Adequate sequence generation?	Yes	Computerised randomization that selected from ID numbers generated with returned baseline questionnaires
Allocation concealment?	Yes	Centralised system
Incomplete outcome data addressed? All outcomes	Yes	39.7% returned a follow-up questionnaire after 3 months. All randomized participants were included in ITT analysis

Strecher 2005

Methods	Location: World Wide Web in England and Republic of Ireland Funding: supported by Glaxo Smith Kline Recruitment: smokers in the United Kingdom and Republic of Ireland who purchased NiQuitin CQ 21 mg patch and connected to a website to enrol for free behavioural support materials.
Participants	3971 participants 18 years of age or older (1991 intervention vs. 1980 control), smoking more then 10 CPD, but had a target quit date that was within 7 days from the enrolment date and had purchased NiQuitin CQ21 mg; av. age 36.9 years, 56.5% females, av. CPD 23.5
Interventions	Compares variants of an Internet based intervention to support NRT assisted quit attempts Intervention: Web-based tailored behavioural smoking cessation materials (CQ PLAN) . Information collected in the enrolment questionnaire were used to tailor CQ PLAN materials. programme materials consisted of an initial web based cessation guide, 3 sequential tailored newsletters delivered via e-mail over a 10 week period. The content of the program was based on cognitive-behavioural methods of smoking cessation and relapse prevention. In addition, subjects were allowed to identify a supportive person that would receive an e-mail message with tailored advice for supporting the subject. Control: web-based non-tailored materials (control condition). Cognitive behavioural concepts and instruction on product were similar to those addressed in the CQ PLAN. The differences were that control group did not receive: tailored materials, the 3 follow-up newsletters and the opportunity to identify the supportive person
Outcomes	Primary outcome: Self-reported continuous abstinence for 28 days (6-week follow up) or 10 weeks (12-week follow up). Secondary outcomes: Participant satisfaction.
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**

Strecher 2005 (*Continued*)

Adequate sequence generation?	Unclear	Randomization method not described
Allocation concealment?	Unclear	Insufficient information to assess risk of bias
Incomplete outcome data addressed? All outcomes	Yes	53.3% responded to the 6-week and 43.2% responded at the 12-week follow up survey analysis. All randomized participants were included in ITT

Strecher 2008

Methods	Location: Two HMOs: Group Health in Washington State and Henry Ford Health System in Michigan Funding: National Cancer Institute grants. Nicotine replacement therapy was provided by GlaxoSmithKline Recruitment: participants were recruited from the memberships of two HMOs participating in the National Cancer Institute's Research Network: Group Health in Washington State and Henry Ford Health System in Michigan.
Participants	1866 participants aged 21-70, currently smoking at least 10 cigarettes per day, seriously considering quitting in the next 30 days were randomized to one of the 16 study arms. One of the inclusion criteria was that participants were not currently enrolled in another formal smoking cessation programme or were not currently using pharmacotherapy for smoking cessation and had no medical contraindications for NRT; av. age 46.3 years, 59.5% females, 78.9% White, >High School 63.8%, av. CPD 21.8
Interventions	Compares variants of an Internet based intervention to support NRT assisted quit attempts Intervention: A web-based smoking cessation programme plus nicotine patch. Five components of the intervention were randomized using a factorial design. Intervention group was assigned to high depth tailored success story, outcome expectation, and efficacy expectation messages; high personalized source; and multiple exposure to the intervention components. Control: Participants in this group were assigned to low depth tailored success story, outcome expectation, and efficacy expectation messages; low personalized source; and single exposure to the intervention components.
Outcomes	Primary outcome: self-reported 7 day PP abstinence at the 6 month post quit date follow up Secondary outcomes: programme and NRT utilization
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**

Strecher 2008 (*Continued*)

Adequate sequence generation?	Yes	Computer based randomization
Allocation concealment?	Yes	Centralised - Stratified random allocation within HMO site immediately after assessment
Incomplete outcome data addressed? All outcomes	Unclear	76% responded to the 6-month follow up. All randomized participants were included in ITT

Swan 2010

Methods	Location: Internet, GroupHealth (nonprofit healthcare organization serving Washington and Idaho) Funding: National Cancer Institute. Varenicline and nominal support for recruitment from Pfizer. Recruitment: Group Health members recruited through health plan magazine advertisements, employee mailings, physician referrals and Free&Clear Quit for life program
Participants	1202 health plan members aged ≥18 years (Web=401, PTC=402, PTC-Web=399); smoked ≥10 CPD over past year & ≥ 5 CPD within past week; dependable phone & Internet access, comfortable using Internet; eligible for smoking cessation services, medically appropriate for varenicline use; av. age 47.3 years, 66.9% females, 89.7% White, av. CPD 21.8, quit attempts past year 48.3%, longest previous quit > 6 months 36.7%
Interventions	Intervention 1: Up to 5 proactive telephone-based calls from a Free & Clear tobacco treatment counsellor (PTC) Intervention 2: Interactive online programme, tools modified from PTC, tailored to stage in quit process, including discussion forums (Web) Intervention 3: PTC-Web; combination of 1 & 2; counsellor had access to data entered online [Does not contribute to this review] All participants received a 12 week supply of varenicline, written information about medication use, 5-10 min orientation call, printed Quit Guides, access to toll free phone line for reactive support
Outcomes	Primary outcome: 30 day PP abstinence at 6 months Other reported outcomes: 7 day PP abstinence at 6 months, 7 & 30 day PP abstinence at 3 months, utilization by treatment group (number of contacts, contact duration in minutes), medication use (number of days varenicline taken, number of pills taken)
Notes	Trial is registered at Clinicaltrials.gov (NCT00301145)

Risk of bias

Item	**Authors' judgement**	**Description**

Swan 2010 (*Continued*)

Adequate sequence generation?	Yes	Computer randomization using an automated algorithm
Allocation concealment?	Yes	Allocation at end of intake survey, algorithm built into study database
Incomplete outcome data addressed? All outcomes	Yes	76.3% reached for 3-month interview, 74.2% reached for 6-month interview. No differences between the three treatment groups at either time point. All randomized participants were included in ITT.

Swartz 2006

Methods	Location: Internet Funding: National Cancer Institute Grant Recruitment: through large worksites. Promotional materials (for example, posters and brochures) with smoking cessation messages and the website address (www.Quitcigs.org) were displayed in the worksites. Some organisations also placed a link to the Quitcigs website on their intranet websites or sent broadcast emails or electronic newsletters to employees promoting the research study.
Participants	351 participants (171 intervention, 180 control),18 years or older, currently smoking cigarettes on a daily basis, considering quitting smoking in next 30 days, and being able to access the website; 51.9% female, 82.1% White, 68% smoke up to 20 CPD; majority aged 26-39 (38.2%) or 40-55 years (48.4%)
Interventions	Intervention: Consisted of a video based Internet site that presented current strategies for smoking cessation and motivational materials tailored to the users' race/ethnicity, sex and age. The programme contained approximately 20 hour of video material, although individual subjects saw only a fraction of that amount. The video segments presented three types of characters: a physician who presented a brief message on health importance of stopping smoking and information regarding pharmacological aids; an ex-smoker-guide matched to the user in sex and race/ethnicity; and numerous testimonials from ex-smokers. The entire intervention was provided by the website server programme. Control: received nothing for 90 days and were then allowed access to the programme
Outcomes	Short term abstinence: self-reported 7 day PP abstinence at 90 day assessment Other reported outcomes: programme use
Notes	

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Yes	Randomized using computer algorithm

Swartz 2006 (*Continued*)

Allocation concealment?	Unclear	No details given
Incomplete outcome data addressed? All outcomes	Yes	At 90 day follow up 197 subjects returned to complete the assessment, 87 (50.9%) of treatment subjects, 110 (61.1%) of control. All randomized participants were included in ITT analysis.

Te Poel 2009

Methods	Location: Netherlands Funding: The Netherlands Organization for Health Research and Development. The Netherlands foundation for a smoke free future Recruitment: advertisements in local newspapers, banners on websites, flyers and posters and via a random selection of smokers e-mail addresses purchased from a customer information management company
Participants	458 participants (224 intervention, 234 control), 18 years or older, smoker of cigarettes and/or loose-cut tobacco, intending to quit within 1 year; av. age 46.1 years, 56,1% were female, 15,7% had no or little vocational training, 48,7 had advanced vocational training, 31,7% had college/university training. Participants in the intervention group smoked on average significantly more tobacco products per day at baseline (Mean=22) compared with control (Mean=20)
Interventions	Intervention: 7-9 page computer-tailored e-mail letter generated from responses to an online questionnaire. Control: 7 page generic, non-tailored e-mail letter, after completing same questionnaire. Emails addressed motivational (attitudes, social influences, self-efficacy) and post-motivational (skills, action planning) determinants.
Outcomes	Primary outcome: 7 day PP abstinence at 6 months Other reported outcomes: 24 hour PP abstinence at 6 months, programme evaluation
Notes	Participants were offered 7.50 Euro to fill out all questionnaires.

Risk of bias

Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Yes	Computer generated random assignment
Allocation concealment?	Yes	Computerised, no risk of selection bias
Incomplete outcome data addressed? All outcomes	Unclear	58.5% lost to follow up from intervention group, 56.4% lost from control. All randomized participants included in ITT analyses

Woodruff 2007

Methods	Location: 14 high school sites in San Diego County Funding: grant from Californias Tobacco-related Disease Research Program Recruitment: classroom presentations, lunch-hour sign-up tables, flyers, posters, school newspaper ads and articles, school-wide announcements, and school liaison referrals. At the suggestion of school personnel, the recruitment approach and materials were different for intervention and control schools.
Participants	136 adolescent smokers (at least one cigarette smoked in last 30 days) from 14 high schools (77 intervention, 59 control, mean of 11 participants per intervention school, 8.4 per control school); av. age 16 years, 46% female, 51% Hispanic, 28% White non-Hispanic
Interventions	Intervention: Internet-based, virtual reality world combined with motivational interviewing conducted in real-time by a smoking cessation counsellor (Seven 45-minute virtual world sessions over a 7-week period, and complete the 4 online surveys) Control: measurement-only control condition (4 online surveys)
Outcomes	Long term abstinence: self-reported 7 day PP abstinence at 12 m Short term abstinence: self-reported 7 day PP abstinence at 3 m Secondary outcomes: satisfaction with the programme (5 item questionnaire; ease of use , liking the program, usefulness for "helping you quit" and for "helping other teen smokers quit") Other reported outcomes: programme use
Notes	Participants were offered $50 to complete 4 online surveys over a 15 m period

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	Cluster randomized by school method not described.
Allocation concealment?	No	Students recruited after schools randomized, with different recruitment methods. The two conditions did not differ significantly on demographic data, although a significantly greater proportion of intervention subjects were alternative/continuation high school students. The groups differed significantly on several baseline smoking variables
Incomplete outcome data addressed? All outcomes	Yes	Loss to follow up was 25% post-intervention, 21% for the 3-m follow up survey, and 27% at 12 m. Survey non-response was higher among intervention participants then among controls (33% vs. 15%) . All randomized participants included in

Woodruff 2007 (*Continued*)

		ITT analysis.

CPD: cigarettes per day
m: months
PP: point prevalence

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Abroms 2008	Intervention used email for delivering counselling, but no Internet component.
An 2007	The Internet was used to quickly identify and enroll large numbers of college smokers in an online smoking cessation intervention, not as an intervention. There was no comparison group.
Applegate 2007	This study presents data that examined the feasibility of implementing a web and SMS text messaging programme to dose quitters properly and remind them to take medication at regular intervals.
Buller 2008	In this study the Internet was used as a tool for prevention of smoking , not as an intervention for smoking cessation.
Chen 2006	This study does not have smoking cessation as an outcome.
Chew 2005	This article describes the background, implementation, and evaluation of an Internet-based health promotion network in the Czech Republic.
Cobb 2006	Not an RCT. The primary goal of this study was to characterize individuals who search for smoking cessation information on the Internet to determine appropriate triage and treatment strategies. The secondary goal was to estimate the incidence of searches for cessation information using a publicly available search engine data.
Cobb 2005	Not an RCT; uncontrolled evaluation of 'QuitNet' with a 25.6% response rate.
Danaher 2006	This paper describes information architecture designs when creating effective Web-based interventions.
Etter 2006	This is a literature review and an Internet survey in 1506 current and former evaluation smokers.
Etter 2009	Internet was not intervention, both groups had access to web site but intervention was NRT.
Etter 2009a	Very short follow up (48 hours after baseline).
Feil 2003	Subsample of 370 subjects followed for 3 months with no comparison group.
Gala 2008	Pilot study among college baseball players (smokeless tobacco users) with a small sample size and short follow up period (1 month).

(*Continued*)

Griffiths 2006	A qualitative systematic review of peer-reviewed evaluations of health interventions delivered to a known client/patient group using networked features of the Internet. Papers were reviewed for the reasons given for using the Internet, and these reasons were categorized.
Houston 2005	Randomized trial with 250 participants randomized to two different websites. Reported as an abstract, no further details available.
Houston 2008a	Internet intervention targeted dentist, not smokers. No smoking cessation outcomes.
Houston 2008b	Not an RCT. Pre-post study evaluating a change in website content to change user behaviour.
Koo 2003	The paper describes characteristics of web sites for smoking cessation.
Koo 2005	The study evaluates strategies of recruiting teenagers for the evaluation of a smoking-cessation website through the Internet.
Lenert 2004	Not an RCT. Compared variants of a cessation intervention with consecutive series of participants. See Munoz 2006 Study 3, Munoz 2006 Study 4 and Munoz 2009 for trials of same intervention.
Muramoto 2007	Trial compares the efficacy of in-person training vs. web-based training vs. a usual practice comparison group to teach non-medical "health influencers" tobacco cessation skills.
Norman 2004	Study evaluates a strategy for online study recruitment and retention, the influence of incentives on follow-up response, and the impact of the Quit Smoking Network site on smoking behaviour.
Norman 2008	Classroom based smoking cessation and prevention intervention for adolescents. Did not assess smoking cessation as an outcome, only lowered smoking status.
Ota 2005	Cross-sectional survey, no control group.
Pederson 2005	Describes strategies for assisting patients in quitting smoking.
Pisinger 2010	Very low usage of the programme.
Prochaska 2008	Unable to confirm denominators for reported cessation rates which exclude losses to follow up. Study includes 136 smokers assigned to 3 conditions. Compared online tailored support to motivational interviewing as an adjunct to a health risk assessment.
Prokhorov 2008	Evaluates a computer-assisted, counsellor-delivered smoking cessation program.
Rowan 2007	This study examined the relations between neighbourhood social context and smoking-related factors among African-Americans. A culturally-tailored cessation treatment was delivered by palmtop computer.
Selby 2004	Not an RCT.
Severson 2008	RCT of intervention for users of smokeless tobacco.

(*Continued*)

Shegog 2005	Pilot study evaluating the use of a Web-based tobacco prevention programme to change intentions of middle school children to smoke tobacco. Cross sectional survey with no control group.
Stoddard 2005	Feasibility study. No control group.
Stoops 2009	All participants used web based components in the same way. The study differentiated between the incentive schedule used.
Thieleke 2005	Small sample size, no control group.
Walters 2006	A review - it reviews studies of computer and Internet-based interventions for smoking behavior, published between 1995 and August 2004.
Wetter 2006	This paper describes three projects - computer delivered treatments for smoking cessation.
Woolf 2006	9-month pre-post comparison with non randomized control practices, 6 family practices (4 intervention, 2 control) . Authors tested whether patients are more likely to pursue healthy behaviours (e.g., physical activity, smoking cessation) if referred to a tailored Web site that provides valuable information for behavior change.

Characteristics of ongoing studies *[ordered by study ID]*

Graham 2008

Trial name or title	Internet and telephone counselling for smoking cessation
Methods	Three arm RCT
Participants	2205 smokers
Interventions	1) basic Internet program: Patients are directed to a website of existing QuitNet? smoking cessation materials. These materials are not tailored and have no interactive features. 2) premium Internet program: Patients receive free 6-month access to the QuitNet website including interactive and individualized intervention features. 3) premium Internet programme plus telephone counselling: Patients receive free access to the QuitNet website as in arm 2. Patients also receive up to 5 telephone counselling sessions, scheduled at their convenience.
Outcomes	Smoking status at 12 months following treatment.
Starting date	August 2004
Contact information	Amanda Graham, Lombardi Cancer Research Center
Notes	NCT002282009. NCI sponsored

Humfleet HIV+ve Study

Trial name or title	Smoking treatment in HIC Clinical Care Settings
Methods	Three arm RCT
Participants	280 HIV positive smokers
Interventions	1) Internet-based self-help including social support via message boards. 2) 6 individual counselling sessions over 12 weeks. 3) Self-help manual. All participants will have access to 10 weeks of NRT.
Outcomes	Smoking status at 3, 6, 9, 12 months following start of treatment
Starting date	January 2006
Contact information	Gary Humfleet, ghumfleet@lppi.ucsf.edu. University of California, San Francisco
Notes	NCT00297453, NIDA sponsored

Humfleet LGBT Study 1

Trial name or title	LGBT Internet Based Smoking Treatment - 1
Methods	Two arm RCT
Participants	600 lesbian, gay, bisexual and transgender (LGBT) smokers
Interventions	1) a self-help intervention tailored LGBT smokers plus social support plus email-based counselling, or 2) a standard self-help condition alone, similar to other general smoking cessation treatments
Outcomes	Smoking status will be determined at 1, 3, 6, and 12 months following the start of treatment
Starting date	September 2002
Contact information	Gary Humfleet, ghumfleet@lppi.ucsf.edu. University of California, San Francisco
Notes	NCT00111501, NIDA sponsored

Humfleet LGBT Study 2

Trial name or title	Reaching and Treating Lesbian, Gay, Bisexual, and Transgender (LGBT) Cigarette Smokers
Methods	Four arm RCT
Participants	lesbian, gay, bisexual and transgender (LGBT) smokers

Humfleet LGBT Study 2 (*Continued*)

Interventions	1) a Mail-based Self Help (MSH) treatment; 2) MSH plus an Internet-based Smoking Treatment (IST); MSH plus Telephone Counseling (TC) or 4) MSH plus IST plus TC.
Outcomes	Smoking status will be determined at 3, 6, and 12 months following the start of treatment
Starting date	February 2008
Contact information	Gary Humfleet, ghumfleet@lppi.ucsf.edu. University of California, San Francisco
Notes	NCT00634218

Kramer 2009

Trial name or title	Effectiveness of a web-based self-help smoking cessation intervention: protocol of a randomized controlled trial
Methods	Study design: randomized controlled trial Recruitment: Participants were recruited over a one-year period using advertisements in daily and weekly national or regional newspapers or on the Internet. Enrolment took place via a website.
Participants	Inclusion criteria: Adults aged18 and older who were currently smoking cigarettes ore rolling tobacco, were willing to quit smoking within 3 months and have Internet access Exclusion criteria: smokers who were already preparing to stop smoking with the support of a coach , a course or pharmacotherapy, or if they were already enrolled in another smoking cessation study.
Interventions	Intervention:web-based interactive self-help intervention (Stop SIte) Control: access to the Dutch online self-help guide developed by STIVORO
Outcomes	Primary outcome measure: prolonged abstinence in the past 3 months Secondary outcomes: point prevalence abstinence, number of cigarettes smoked, and incidence of quit attempts at follow up assessments Methods of assessing outcome: self reported smoking abstinence Methods of follow up for non-respondents: ITT analysis. Timing of outcome assessment: 3 and 12 months after 1 month grace period for starting the intervention after baseline.
Starting date	
Contact information	jkramer@trimbos.nl
Notes	

DATA AND ANALYSES

Comparison 1. Internet versus no Internet comparisons

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Smoking abstinence at longest follow-up	9		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.1 Trials in adults	5		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
1.2 Trials in young adults	1		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
1.3 Trials in adolescents	3		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
2 Smoking abstinence at short term follow-up	6		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Trials in adults	4		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
2.2 Trials in young adults	0		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
2.3 Trials in adolescents	2		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable

Comparison 2. Comparisons between different Internet interventions

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Smoking abstinence at longest follow-up	6		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.1 Munoz studies	3		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
1.2 Other studies	3		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
2 Smoking abstinence at short term follow-up	8		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Munoz studies	3		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
2.2 Other studies	5		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable

Comparison 3. Tailored interactive internet versus non tailored/non internet

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Smoking abstinence at longest follow-up	8	11042	Risk Ratio (M-H, Fixed, 95% CI)	1.22 [1.08, 1.38]
2 Smoking abstinence at short term follow-up	10	26816	Risk Ratio (M-H, Fixed, 95% CI)	1.25 [1.18, 1.34]

Comparison 4. Complete case sensitivity analysis- 1 Internet versus no Internet comparisons

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Smoking abstinence at longest follow-up	8		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.1 Trials in adults	4		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
1.2 Trials in young adults	1		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
1.3 Trials in adolescents	3		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable

Comparison 5. Complete case sensitivity analysis 2 Comparisons between different Internet interventions

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Smoking abstinence at longest follow-up	5		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
1.1 Munoz studies	3	717	Risk Ratio (M-H, Fixed, 95% CI)	0.82 [0.65, 1.04]
1.2 Other studies	2	4631	Risk Ratio (M-H, Fixed, 95% CI)	1.10 [0.93, 1.31]

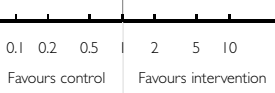
Analysis 1.1. Comparison 1 Internet versus no Internet comparisons, Outcome 1 Smoking abstinence at longest follow-up.

Review: Internet-based interventions for smoking cessation

Comparison: 1 Internet versus no Internet comparisons

Outcome: 1 Smoking abstinence at longest follow-up

Study or subgroup	Internet n/N	No Internet n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Trials in adults				
Brendryen 2008a	29/144	10/146		2.94 [1.49, 5.81]
Brendryen 2008b	44/197	26/199		1.71 [1.10, 2.66]
Clark 2004	4/85	9/86		0.45 [0.14, 1.40]
Japuntich 2006	21/140	17/144		1.27 [0.70, 2.31]
Swan 2010	231/800	123/402		0.94 [0.79, 1.13]
2 Trials in young adults				
An 2008	85/257	44/260		1.95 [1.42, 2.69]
3 Trials in adolescents				
Mermelstein 2006	25/181	12/170		1.96 [1.02, 3.77]
Patten 2006	4/70	9/69		0.44 [0.14, 1.36]
Woodruff 2007	28/77	23/59		0.93 [0.60, 1.44]



Analysis 1.2. Comparison 1 Internet versus no Internet comparisons, Outcome 2 Smoking abstinence at short term follow-up.

Review: Internet-based interventions for smoking cessation

Comparison: 1 Internet versus no Internet comparisons

Outcome: 2 Smoking abstinence at short term follow-up

Study or subgroup	Internet n/N	No Internet n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Trials in adults				
Brendryen 2008a	43/144	17/146		2.56 [1.54, 4.28]
Brendryen 2008b	88/170	57/199		1.81 [1.39, 2.35]
Japuntich 2006	32/140	30/144		1.10 [0.71, 1.70]
Swartz 2006	21/171	9/180		2.46 [1.16, 5.21]
2 Trials in young adults				
3 Trials in adolescents				
Patten 2006	4/70	9/69		0.44 [0.14, 1.36]
Woodruff 2007	39/77	47/59		0.64 [0.49, 0.82]

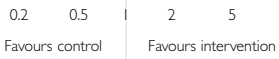
Analysis 2.1. Comparison 2 Comparisons between different Internet interventions, Outcome 1 Smoking abstinence at longest follow-up.

Review: Internet-based interventions for smoking cessation

Comparison: 2 Comparisons between different Internet interventions

Outcome: 1 Smoking abstinence at longest follow-up

Study or subgroup	Experimental n/N	Control n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Munoz studies				
Munoz 2006 Study 3	12/139	24/141		0.51 [0.26, 0.97]
Munoz 2006 Study 4	29/142	33/146		0.90 [0.58, 1.41]
Munoz 2009	52/251	48/251		1.08 [0.76, 1.54]
2 Other studies				
McKay 2008	45/1159	44/1159		1.02 [0.68, 1.54]
Rabius 2008	612/5404	106/1047		1.12 [0.92, 1.36]
Te Poel 2009	19/224	8/234		2.48 [1.11, 5.55]



Analysis 2.2. Comparison 2 Comparisons between different Internet interventions, Outcome 2 Smoking abstinence at short term follow-up.

Review: Internet-based interventions for smoking cessation

Comparison: 2 Comparisons between different Internet interventions

Outcome: 2 Smoking abstinence at short term follow-up

Study or subgroup	Favours experimental n/N	Control n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Munoz studies				
Munoz 2006 Study 3	17/139	17/141		1.01 [0.54, 1.90]
Munoz 2006 Study 4	28/142	41/146		0.70 [0.46, 1.07]
Munoz 2009	35/251	45/251		0.78 [0.52, 1.17]
2 Other studies				
Etter 2005	876/6003	638/5966		1.36 [1.24, 1.50]
McKay 2008	99/1159	103/1159		0.96 [0.74, 1.25]
Rabius 2008	594/5404	114/1047		1.01 [0.84, 1.22]
Stoddard 2008	45/684	48/691		0.95 [0.64, 1.40]
Strecher 2005	400/1991	315/1980		1.26 [1.10, 1.44]

Analysis 3.1. Comparison 3 Tailored interactive internet versus non tailored/non internet, Outcome 1 Smoking abstinence at longest follow-up.

Review: Internet-based interventions for smoking cessation

Comparison: 3 Tailored interactive internet versus non tailored/non internet

Outcome: 1 Smoking abstinence at longest follow-up

Study or subgroup	Tailored internet n/N	Static internet/ control n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
An 2008	85/257	44/260		10.8 %	1.95 [1.42, 2.69]
Brendryen 2008a	29/144	10/146		2.4 %	2.94 [1.49, 5.81]
Brendryen 2008b	44/197	26/199		6.4 %	1.71 [1.10, 2.66]
McKay 2008	45/1159	44/1159		10.9 %	1.02 [0.68, 1.54]
Munoz 2006 Study 3	12/139	24/141		5.9 %	0.51 [0.26, 0.97]
Munoz 2006 Study 4	29/142	33/146		8.0 %	0.90 [0.58, 1.41]
Munoz 2009	52/251	48/251		11.8 %	1.08 [0.76, 1.54]
Rabius 2008	612/5404	106/1047		43.8 %	1.12 [0.92, 1.36]
Total (95% CI)	**7693**	**3349**		**100.0 %**	**1.22 [1.08, 1.38]**
Total events: 908 (Tailored internet), 335 (Static internet/ control)					
Heterogeneity: Chi^2 = 27.58, df = 7 (P = 0.00026); I^2 =75%					
Test for overall effect: Z = 3.22 (P = 0.0013)					

Analysis 3.2. Comparison 3 Tailored interactive internet versus non tailored/non internet, Outcome 2 Smoking abstinence at short term follow-up.

Review: Internet-based interventions for smoking cessation

Comparison: 3 Tailored interactive internet versus non tailored/non internet

Outcome: 2 Smoking abstinence at short term follow-up

Study or subgroup	Tailored internet n/N	Static internet/ control n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Brendryen 2008a	43/144	17/146		1.2 %	2.56 [1.54, 4.28]
Brendryen 2008b	88/197	57/199		4.0 %	1.56 [1.19, 2.04]
Etter 2005	876/6003	638/5966		44.6 %	1.36 [1.24, 1.50]
McKay 2008	99/1159	103/1159		7.2 %	0.96 [0.74, 1.25]
Munoz 2006 Study 3	17/139	17/141		1.2 %	1.01 [0.54, 1.90]
Munoz 2006 Study 4	28/142	41/146		2.8 %	0.70 [0.46, 1.07]
Munoz 2009	35/251	45/251		3.1 %	0.78 [0.52, 1.17]
Rabius 2008	594/5404	114/1047		13.3 %	1.01 [0.84, 1.22]
Strecher 2005	400/1991	315/1980		22.0 %	1.26 [1.10, 1.44]
Swartz 2006	21/171	9/180		0.6 %	2.46 [1.16, 5.21]
Total (95% CI)	**15601**	**11215**		**100.0 %**	**1.25 [1.18, 1.34]**

Total events: 2201 (Tailored internet), 1356 (Static internet/ control)

Heterogeneity: Chi^2 = 38.11, df = 9 (P = 0.00002); I^2 =76%

Test for overall effect: Z = 6.89 (P < 0.00001)

Analysis 4.1. Comparison 4 Complete case sensitivity analysis- 1 Internet versus no Internet comparisons, Outcome 1 Smoking abstinence at longest follow-up.

Review: Internet-based interventions for smoking cessation

Comparison: 4 Complete case sensitivity analysis- 1 Internet versus no Internet comparisons

Outcome: 1 Smoking abstinence at longest follow-up

Study or subgroup	Internet n/N	No Internet n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Trials in adults				
Brendryen 2008a	29/118	10/108		2.65 [1.36, 5.19]
Brendryen 2008b	44/187	26/183		1.66 [1.07, 2.57]
Clark 2004	4/85	9/86		0.45 [0.14, 1.40]
Japuntich 2006	21/113	17/114		1.25 [0.69, 2.24]
2 Trials in young adults				
An 2008	85/231	44/234		1.96 [1.43, 2.68]
3 Trials in adolescents				
Mermelstein 2006	25/120	12/112		1.94 [1.03, 3.68]
Patten 2006	4/37	9/37		0.44 [0.15, 1.32]
Woodruff 2007	28/52	23/50		1.17 [0.79, 1.73]

Analysis 5.1. Comparison 5 Complete case sensitivity analysis 2 Comparisons between different Internet interventions, Outcome 1 Smoking abstinence at longest follow-up.

Review: Internet-based interventions for smoking cessation

Comparison: 5 Complete case sensitivity analysis 2 Comparisons between different Internet interventions

Outcome: 1 Smoking abstinence at longest follow-up

Study or subgroup	Experimental n/N	Control n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
1 Munoz studies					
Munoz 2006 Study 3	12/107	24/66		26.9 %	0.31 [0.17, 0.57]
Munoz 2006 Study 4	29/95	33/93		30.3 %	0.86 [0.57, 1.29]
Munoz 2009	52/175	48/181		42.8 %	1.12 [0.80, 1.56]
Subtotal (95% CI)	**377**	**340**		**100.0 %**	**0.82 [0.65, 1.04]**
Total events: 93 (Experimental), 105 (Control)					
Heterogeneity: Chi^2 = 12.93, df = 2 (P = 0.002); I^2 =85%					
Test for overall effect: Z = 1.64 (P = 0.10)					
2 Other studies					
McKay 2008	45/314	44/317		19.8 %	1.03 [0.70, 1.52]
Rabius 2008	612/3350	106/650		80.2 %	1.12 [0.93, 1.35]
Subtotal (95% CI)	**3664**	**967**		**100.0 %**	**1.10 [0.93, 1.31]**
Total events: 657 (Experimental), 150 (Control)					
Heterogeneity: Chi^2 = 0.14, df = 1 (P = 0.71); I^2 =0.0%					
Test for overall effect: Z = 1.13 (P = 0.26)					

WHAT'S NEW

Last assessed as up-to-date: 13 July 2010.

Date	Event	Description
21 September 2010	Amended	Correction to axis labels in comparison 3

HISTORY

Protocol first published: Issue 2, 2008

Review first published: Issue 9, 2010

Date	Event	Description
27 November 2008	New citation required and minor changes	Error in author order corrected
21 September 2008	Amended	Converted to new review format.

CONTRIBUTIONS OF AUTHORS

Josip Car conceived the idea for this review and managed the review as contact author; he acts as guarantor for this paper. All authors contributed to the design. Marta Civljak lead the writing of the review. Lindsay Stead assisted with methodological support, data extraction and revising the draft review. Josip Car arbitrated the selection of studies and supervised the overall writing. Aziz Sheikh contributed to interpretation of the review findings and editing the text.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- Department of Primary Care and Social Medicine, Imperial College London, UK.
- Ministry of Science, Education and Sport, Croatia.

External sources

- NHS Connecting for Health Evaluation Programme (NHS CFHEP 001), UK.

INDEX TERMS

Medical Subject Headings (MeSH)

*Internet; Adolescent; Randomized Controlled Trials as Topic; Smoking Cessation [*methods]; Therapy, Computer-Assisted [*methods]; Treatment Outcome

MeSH check words

Adult; Female; Humans; Male