

## Brief interventions to prevent sexually transmitted infections suitable for in-service use: a systematic review

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## Accepted Manuscript

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Running head: Brief interventions to prevent sexually transmitted infections

**Brief Interventions to Prevent Sexually Transmitted Infections suitable for In-Service use: A Systematic Review**

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## Abstract

Background: Sexually transmitted infections (STIs) are more common in young people and men who have sex with men (MSM) and effective in-service interventions are needed.

Methods: A systematic review of randomized control trials (RCTs) of waiting-room-delivered, self-delivered and brief healthcare-provider-delivered interventions designed to reduce STIs, increase use of home-based STI testing, or reduce STI-risk behavior was conducted. Six databases were searched between January 2000 to October 2014.

Results: 17,916 articles were screened. 23 RCTs of interventions for young people met our inclusion criteria. Significant STI reductions were found in four RCTs of interventions using brief one-to-one counselling (2 RCTs), video (1 RCT) and a STI home-testing kit (1 RCT). Increase in STI test uptake was found in five studies using video (1 RCT), one-to-one counselling (1 RCT), home test kit (2 RCTs) and a web-based intervention (1 RCT). Reduction in STI-risk behavior was found in seven RCTs of interventions using digital online (web-based) and offline (computer software) (3 RCTs), printed materials (1 RCT) and video (3 RCTs). Ten RCTs of interventions for MSM met our inclusion criteria. Three tested for STI reductions but none found significant differences between intervention and control groups. Increased STI test uptake was found in two studies using brief one-to-one counselling (1 RCT) and an online web-based intervention (1 RCT). Reduction in STI-risk behavior was found in six studies using digital online (web-based) interventions (4 RCTs) and brief one-to-one counselling (2 RCTs).

Conclusion: A small number of interventions which could be used, or adapted for use, in sexual health clinics were found to be effective in reducing STIs among young people and in promoting self-reported STI-risk behavior change in MSM.

## Introduction

Reducing sexually transmitted infections (STIs) is a public health priority, worldwide. The World Health Organization report that 498 million people aged 15 to 49 are infected each year with chlamydia, gonorrhoea, syphilis, or trichomonas (1). Men who have sex with Men (MSM) and young people account for the majority of new STI diagnosis (2, 3). For example, in England, in 2014, there were approximately 440,000 STI diagnoses and, despite operation of a national chlamydia screening program and expansion of open access sexual health services across the UK, STIs have risen year on year (Public Health England (PHE) (4). A lack of information, motivation, confidence and skills in relation to precautions such as consistent condom use or sexual negotiation may contribute to infection rates (2). Population-tailored interventions targeting these potential determinants could reduce infection rates (6, 7).

Sexual health services in contact with those at risk of STIs offer a practical site for risk-reduction interventions and evidence suggests that the effectiveness of such services can be enhanced by integration of preventive behavioral interventions for clinic attendees. Interventions ranging in intensity from 30 minutes or less (low intensity) to 3 hours of contact time (high intensity) have been found to be effective in preventing STIs (3).

### *Review Objective and Research Question*

We conducted a systematic review to identify practical, effective interventions for young people and MSM for use in health service settings. The search focused on interventions that could be implemented, or adapted for use, in sexual health clinics. Consequently, we included interventions involving no more than three hours of contact time that aimed to reduce STI rates and/or increase STI test uptake and/or change STI-risk behavior patterns and had been evaluated using a randomized controlled trial (RCT). We noted the mode of delivery used and the change techniques incorporated in each intervention (9, 10).

This systematic review aimed to summarize evidence of clinical effectiveness of low-intensity interventions that could be implemented, or adapted for use, in sexual health clinics. Interventions meeting specified inclusion criteria, evaluated among young people (14-25 years old) or MSM using RCTs were included. The research question addressed was:

Are waiting-room-delivered, self-delivered and brief healthcare-provider-delivered interventions (1) suitable for use in sexual health clinics and (2) effective in reducing the incidence of STIs, increasing STI-test uptake or reducing STI-risk behavior patterns in young people and MSM.

### **Methods.**

The review was undertaken following the principles published by the UK National Health Service Centre for Reviews and Dissemination and a protocol published (PROSPERO registration number: CRD42014014375) (11) Supplementary document A).

#### *Literature Search*

We searched for papers published in the English language between January 2000 and October 2014. The search strategy (Figure 1) was agreed by the research team and independently checked by an information specialist. The following databases were searched: MEDLINE (OVID); PsycINFO (OVID); EMBASE (OVID); CINAHL (EBSCO); CENTRAL; DARE (via Cochrane); HTA (via Cochrane). We searched for grey literature by website searching and talking to experts. For included papers, backward citation chasing was undertaken, that is, we accessed potentially relevant empirical reports and reviews, assessed their relevance, and reviewed the references in the studies found. This led to ten additional inclusions (see Figure 2).

We considered RCTs of individual participants and cluster randomized trials. Relevant studies were identified in two stages using pre-defined eligibility criteria which were chosen on the basis of consultations with clinic-based practitioners across a range of UK clinics. Titles and abstracts were examined independently by two researchers and screened for duplicates and inclusion. Full texts were retained and papers then examined independently by two reviewers to ascertain eligibility for inclusion. At both stages, disagreements were resolved by discussion and a third reviewer was involved to discuss borderline decisions. Gwet's AC1 statistic was calculated to assess reliability of inclusion decisions (4).

#### *Inclusion and exclusion criteria*

We searched for interventions designed to reduce sexual health risks that could be implemented in sexual health clinics for young people (14-25yrs inclusive) and MSM. Our inclusion criteria were selected to ensure feasibility and sustainability within clinic settings following consultations with clinical staff. For lower risk attendees, a one-session face-to-

face intervention to prevent further risk behavior was thought to be feasible. For repeat attendees, multiple meetings could be considered, especially if there was good evidence of effectiveness. Discussions suggested that very short meetings could fail to establish the trust necessary for such interventions and that one-hour-plus meetings would be difficult to sustain amidst other demands. Consequently, interventions were categorized as “brief” if they involved one 30-minute session or less contact time and as “intensive” if they involved two to six sessions of up to 30 minutes each. We excluded face-to-face interventions requiring greater staff contact time. To ensure high-quality evidence of effectiveness we only included interventions evaluated using included RCTs.

A range of delivery formats were considered including waiting room tasks, self-delivered interventions and healthcare provider-delivered interventions. The comparator(s) included usual care and alternative interventions. No restrictions were placed on intervention setting. Interventions included online materials presented on social networking sites as well as interventions delivered in primary care, in emergency care settings, in community treatment settings e.g. sexual health clinics and in educational settings (including schools and colleges). We focused on interventions used in high-income countries with similar healthcare systems including North America, Europe and Australia. Unpublished literature was identified by contacting authors of relevant meeting abstracts or conference proceedings, and included if sufficient data and methodological details were provided.

The following were excluded: studies with follow-up of less than 60 days, uncontrolled studies; animal model studies; narrative reviews, editorials, opinions; non-English language papers and reports.

The methodological quality of each study was assessed using the Cochrane ‘risk of bias’ tool (5). The tool includes six key criteria against which potential risk of bias is judged: adequacy of allocation sequence generation; adequacy of allocation concealment; blinding of participants, personnel or outcome assessors; completeness of outcome data; selectivity of outcome reporting, and other biases. Quality was assessed by one reviewer, with judgements checked by a second, and discrepancies discussed and resolved.

### *Outcomes*

Data were extracted on any of the following outcomes: sexual health (e.g. STI incidence); home-based testing (for HIV or STI); sexual behavior patterns (e.g. condom use or number of sexual partners); appointment booking and screening / clinic visits for STI check-ups. All

were considered important because changes in testing may prompt risk-reduction behavior change which in turn may reduce STI incidence. Psychological changes (such as attitude change) were not considered to be outcomes. Data on the study design, the setting, the population, the intervention, the outcomes and results were collected using a standardized, piloted data extraction form. Data were extracted by one reviewer and 50% checked for accuracy by a second reviewer.

#### *Data analysis and synthesis*

Findings of each RCT were tabulated along with an assessment of the quality of the evidence, providing a narrative synthesis. Summary tables describing both intervention delivery (delivery format and intervention components) and study outcomes were created. Characteristics of interventions (e.g., degree of tailoring, and number of sessions) and participant population (e.g., sex, sexual orientation and co-existing conditions) were also recorded (See tables included as Supplementary documents B and C).

Intervention content was categorized into ten categories based on Albarracin et al. (2005) (6). The ten intervention component categories were: information provision (Info), normative arguments (NormA), attitudinal arguments (AttA), threat-inducing arguments (ThreatA), behavioural skills arguments (SkillA), condom use skills training (CondomTrain), interpersonal skills training (PersonTrain), self-management skills training (SelfManTrain), condom provision (Condom) and HIV/STI testing and counselling (STI-test). Definitions of these 10 categories are provided in Supplementary Document D. Presence or absence of each component was independently coded for each intervention description by one reviewer and 50% were independently coded by a second reviewer. Gwet's AC1 statistic was calculated to assess inter-rater reliability.

## **Results**

The search strategy yielded 27,482 hits. After de-duplication, 17,916 references were identified for screening. Titles and abstracts of all 17,916 references were screened for inclusion by two independent reviewers with near perfect agreement (99.2% agreement; AC1= 0.99). As a result 84 full text articles, including 10 from references identified in review articles, were screened for eligibility (Figure 2). This process identified 33 RCTs; 23



trials conducted with young people (6-29) and 10 with MSM (20, 30-38). Inter-rater reliability for inclusion was good (81 percent agreement; AC1= 0.63).

Study characteristics are summarized in Tables 1 and 2 for young people and MSM, respectively. Interventions were very heterogeneous but shared some components. The majority of trials sought to minimize higher-risk sexual behaviors (for example, unprotected sexual intercourse or multiple partners) and maximize protective behaviors (for example, condom use). Many interventions provided general information about STIs and STI transmission and commonly included risk assessment, hands-on skills training in condom use, problem solving, decision making, goal setting, and communication surrounding condom use and safe sex. The depth with which topics were covered varied. For example, some interventions included additional components, such as HIV/STI testing. Many interventions were culturally tailored to a target group, based on, for example, age, gender, sexual orientation and ethnicity. A summary of intervention features found in young people and MSM are detailed in Table 1.

The majority of interventions for young people were trialed in the United States, with three studies conducted in the UK (7, 9, 38). Most trials were limited to sexually active young women or young people in general; only one trial focused exclusively on sexually active young men (28). The majority (15 of 23, 65%) were delivered in primary or secondary health care and sexual health clinics. Interventions for young people included one to four sessions and employed a variety of delivery formats including video; one-to-one counselling; STI home test kit; web-based digital interventions, including use of email and social media; computer-based digital interventions; text messaging digital interventions and printed materials. Most interventions were low intensity, involving brief individual meetings with a counsellor or primary care provider, or were limited to print, web-based, computer-based, or video-based materials but some were of moderate intensity and included up to 2 hours of one-to-one contact.

Nine of the 23 RCTs that recruited young people reported at least one STI outcome and 16 reported at least one behavioral outcome. Nine of 10 RCTs that recruited MSM reported at least one behavioral outcome. Behavioral outcomes were most commonly condom use or frequency of condom-less sex (see Tables 1 and 2).

The 23 trials with young people were generally of fair to good quality. Two trials (11, 24) were judged to be at risk of selection bias due to poor randomization procedures. Two trials

(11, 29) reported inadequate allocation concealment procedures, two trials had a high risk of reporting bias (16, 24) and two trials were judged to be at high risk of attrition bias due to incomplete outcome data (22, 24) (see Supplementary document E).

All 10 of the interventions for MSM were trialed in the United States and five were delivered online.

Interventions for MSM included one to two sessions and employed either web-based digital interventions, or one-to-one counselling. Most interventions were low intensity, either involving brief individual meetings with a counsellor or primary care provider plus a STI test, or were limited to web-based materials with online sessions lasting up to 2 hours.

The 10 trials with MSM were generally of fair to good quality. One trial was judged to be at risk of selection bias due to poor randomization procedures (37), and one trial (30) was judged to be at high risk of both attrition bias (due to incomplete outcome data) and detection bias (due to poor blinding of outcome assessment) (see Supplementary document F).

### *Effectiveness of Interventions*

Table 3 maps the delivery format of effective and ineffective interventions for both young people and MSM onto the outcomes considered here.

The content of interventions was categorized using ten pre-defined components (Albarracín et al., 2005) namely, information provision, normative arguments, attitudinal arguments, threat-inducing arguments, behavioral skills arguments, condom use skills training, interpersonal skills training, self-management skills training, condom provision and HIV/STI testing and counselling. The presence (or absence of these 10 components) was identified in each intervention description and good inter-rater reliability recorded (91 percent agreement; AC1=0.86). Table 3 shows the content components of effective and ineffective interventions. While numbers are too small to perform meta-analyses these mappings of delivery format and content components (Table 3) provides a rough guide to what works, identifying best-bet interventions.

Table 3 shows that across 15 interventions for young people and eight for MSM all 10 of the content components were identified. In effective interventions for young people six components were consistently identified, namely, provision of information, provision of

attitudinal, normative and behavior skills arguments, interpersonal training and STI-testing. In effective interventions for MSM, 4 components were consistently identified, namely provision of information, provision of normative and behavior skills arguments, and STI-testing.

Comparing effective and ineffective intervention we observed that only two ineffective interventions included any of the 10 coded components. Both of these ineffective studies evaluated digital interventions targeting young women; one was a 1 hour multi-media DVD on STIs (21) while the other involved a sequence of personalized risk reduction text messages received once a week for 3 months (27). Both digital interventions included provision of information. In the multi-media DVD intervention (21); the information included examples of where to obtain condoms on campus and prevalence rates among young adults (i.e for pregnancy, STI, or HIV), while video clips were used to highlight common myths associated with condom use as stated by student actors, identified as false by the intervention narrators, and substituted with correct information. In the text message intervention (27), participants received a series of weekly text messages that incorporated an information component in the messages relaying effective health information about STDs specific to young adult women. Both interventions were found to be ineffective for reducing risky sexual behavior.

In contrast, three digital interventions for young people were found to be effective for reducing risky sexual behavior. One (10) was a social media (Facebook) intervention designed for young people; another (24) was a computer software program (2 x 1 hr sessions) based on a successful group-level intervention for young African American females (14-18 yrs) “Sisters Informing, Healing, Living, and Empowering” (SiHLE); while another (25) was a tailored online intervention for young people consisting of a virtual STI public clinic and virtual “consultant”, with content individually tailored according to the participants responses. All three interventions were effective in reducing risky sexual behavior in the short to medium term (up to 3 months) and all included normative arguments and behavioral skills training. In the Facebook social media intervention (10), normative arguments and behavioral skills training components took the form of content including “expectations for a healthy relationship” and “skills building for condom negotiation and condom use”; in the computer software program (24) behavioral skills training took the form of video demonstrations of how to use both a male and a female condom as well as clips showing young African American women negotiating safer sex and giving their advice in response to

two scenarios about condom use, alcohol, and relationships. Normative arguments included videos of young African American women discussing role models and personal values as well as stating how they lower their HIV/STI risk. In the third tailored online intervention (25), content included assessment of both condom use and STI-testing confidence followed by tailored positive reinforcing feedback and/or supporting information and suggestions/tips.

These findings indicate that provision of normative and behavior skills arguments in digital interventions may be more effective than the provision of information to change risky sexual behaviour in young people, and we suggest that this observation may provide some guidance to developers of digital interventions on content more likely to reduce risky sexual behavior in young people. We also note that when comparing intervention delivery formats across young people studies, both digital (10, 24, 25) and video (23, 26, 29) interventions that were effective for reducing risky sexual behavior in young people consistently included behavior skills arguments, indicating that this component may be especially important for inclusion when developing interventions targeting young people.

Albarracín et al. (2005) provide a comprehensive meta-analysis of how these 10 content components relate to effectiveness of condom-use-promoting interventions across target groups (6)

### Interventions for young people

#### *Reduced STI rates*

Table 3 shows that two of seven interventions (8, 17) employing one-to-one counselling for young people reduced STIs. Content components found in the two effective one-to-one counselling interventions for young people (8, 17) included HIV/STI testing. One of five trials of video interventions aimed at young people reduced STIs and employed information provision, attitudinal arguments, behavioral skills training and interpersonal skills training. One of three trials of home-test kits reduced STIs in young people (22).

Two of seven interventions (16, 20) employing one-to-one counselling for young people were ineffective for the main outcomes of interest assessed including reducing STI events. These

ineffective counselling interventions did not have any intervention components in common. (Table 3))

#### *Increased STI test uptake*

One of six interventions using a digital format for young people increased STI test uptake (19). This online web-based social media intervention included provision of information about testing. One of seven interventions employing one-to-one counselling in young people increased STI test uptake (14). The intervention included an oral swab test for both HIV infection and hepatitis B and C in young people attending a community drug service.

One of five video interventions increased STI test uptake among young people (15). This video was designed to replace one-to-one counselling before an HIV test. Two of three interventions that included home test kits increased STI test uptake by young people (13, 28). Both included information provision and instructions on using the test kit.

One of seven interventions (16) employing one-to-one counselling and one in five interventions (9) employing video for young people were found to be ineffective for the main outcomes of interest assessed including increasing STI-testing.

#### *Reduced self-reported STI-risk behaviors*

The majority of interventions targeting behavior change employed either offline computer software or online web-based (digital) interventions or one-to-one counselling. Digital (offline and online) interventions reduced STI-risk behaviors in three of six interventions for young people (10, 24, 25). None of the seven one-to-one counselling interventions reduced STI-risk behavior among young people. All three digital interventions found to reduce sexual risk behavior in young people employed normative arguments and behavioral skills training.

Three of five video-based interventions (23, 26, 29) and one of two interventions using printed materials (12) reduced STI-risk behavior among young people. All three videos found to reduce sexual risk behavior employed behavioral skills training and interpersonal skills training, with other content components (attitudinal arguments, information and threat-inducing arguments) found in only two of the effective video interventions.

Two of six interventions (21, 27) employing digital interventions (one for offline computer software and one for text messaging) for young people were found to be ineffective for the outcomes of interest assessed including STI-risk behavior. Two of seven one-to-one counselling interventions ((16, 20)) were found to be ineffective for the main outcomes of

interest assessed including STI-risk behavior. These ineffective counselling interventions did not have any intervention components in common.

### Interventions for MSM

#### *Reduced STI rates*

No trials for MSM reported significant reductions in STIs. Only one of the six online web-based interventions tested for STIs (37), and was found to be ineffective. Two of four one-to-one counselling interventions tested for STIs ((20, 34)) and were found to be ineffective.

#### *Increased STI test uptake*

One of six online web-based interventions for MSM was found to be effective. The effective intervention used social media and included an option to request a home test kit (38). One of four one-to-one counselling interventions for MSM (30) increased STI test uptake and included an oral swab test for HIV. However, no trials of stand-alone home tests for MSM were identified.

#### *Reduced self-reported STI-risk behaviors*

Four of six online web-based interventions for MSM (31, 35-37) reduced STI-risk behaviors. Two of four interventions using one-to-one counselling reduced STI-risk behavior among MSM by increasing condom use and reducing number of sexual partners (20, 32). All four digital interventions found to reduce sexual risk behavior employed normative arguments and behavioral skills training, while two (31, 35) additionally employed both information and self-management skills training.

One of four interventions (34) employing one-to-one counselling and one in six interventions employing digital interventions for MSM were found to be ineffective for the main outcomes of interest assessed including reducing STI-risk behavior.

No RCTs evaluating interventions using video-based or printed materials for MSM were found in this review.

## **Discussion**

This review has identified a small number of effective interventions (16 for young people and eight for MSM) suitable for in-service delivery in sexual health clinics that reduced STIs among young people, increased STI testing and reduced STI-risk behaviors among young

people and MSM. Of the studies that measured STI rates (three out of ten for MSM and nine out of 23 for young people), no intervention reduced STI incidence among MSM and four reduced STI incidence among young people. Effective interventions included one-to-one counselling, video presentations, digital offline computer software and online web-based interventions including use of social media. Notably, the inclusion of STI self-sampling increased STI testing in both groups. Interventions were trialed in the US, Europe and Australia and are likely to be most effective in clinics operating in middle and high income, post-industrialized economies where they have the potential to enhance the STI-preventive services.

Assessment of STI reduction was generally based on laboratory tests for bacterial infections, predominantly gonorrhea and chlamydia. Four interventions involving young people were found to be effective at reducing STIs; two included one-to-one counselling with a STI-test, one used a standalone offline video and one used a home test. These provide promising examples of interventions that could be integrated into clinic services for young people. No trials of interventions for MSM reported significant reductions in STIs; three studies found no improvement while seven MSM studies did not test for STIs. This presents a challenge for intervention designers. Can delivery methods and content found to be effective for young people be adapted to provide new effective interventions for MSM?

Five interventions for young people were found to be effective in increasing STI test uptake; one evaluated an online web-based intervention that provided information in the form of individualized advice in personalized emails (19), one employed one-to-one counselling (14), one used video (15) and two included home-based STI test kits (13, 28). One of these studies was of notably high quality with no risk of bias and both provided information, including information about testing (13). Two interventions for MSM were found to be effective in increasing STI testing; one used an online web-based intervention (through which a home-test kit could be requested (38)) while the other employed one-to-one counselling and a swab test for HIV (30). Provision of home-based testing kits was effective in increasing STI testing uptake among young people. Thus wider use of home test kits may enhance service delivery. However, no trials of direct provision of such kits were found for MSM, highlighting a gap in intervention provision.

Seven trials involving young people identified interventions that reduced STI-risk behavior; three were offline computer software or online web-based interventions (10, 24, 25) that

employed information, normative arguments and behavioral skills arguments, although it is notable that one of these studies (24) had four reported sources of bias and two potential sources of bias ; three used video presentations (23, 26, 29) employing behavioral skills training and interpersonal skills training, and one intervention used printed materials and condom provision, employing information and condom use skills training (12).

Six of nine trials of interventions for MSM were found to reduce STI-risk behavior; four evaluated digital online web-based interventions (31, 35-37) and employed normative arguments and behavioral skills training components, with one study being of high quality with no risk of bias (35); two evaluated one-to-one counselling interventions (20, 32) that also employed HIV/STI testing, and were of high quality, with one study (20) having no risk of bias. While one-to-one counselling was effective in reducing STI-risk behavior among MSM, no trials of one-to-one counselling interventions were effective among young people. No trials for offline videos or printed materials specifically targeting risky behavior in MSM populations were identified. This may indicate a lack of rigorous evaluations of such interventions with MSM.

#### *Limitations and Strengths of this Review*

A key strength of this review is that it began with a broad search for randomized controlled trials of practical behavioral interventions that would be suitable for implementation in sexual health clinics. A further strength of the review is that it was conducted by a research team using the latest evidence and to a pre-specified protocol (Supplementary document A and PROSPERO CRD42014014375).

Many of the studies reporting effective interventions identified in this review use fairly large and representative samples, so reducing uncertainty about the effect size in individual trials.

The searches were limited to English language due to resource limitations, which may have led us to exclude important studies. We did not consider uncontrolled studies to assure high quality with minimum risk of bias. We acknowledge that effectiveness is determined, in part, by variations in usual care control conditions and that such variations are rarely described across trials (39). While RCTs provide robust evidence of clinical effectiveness, we note that observational studies may provide useful additional data on implementation and mechanism of action.



This review was limited to middle to high-income countries with relatively well-resourced sexual health services. The review is limited to young people and MSM populations, with many of the effective interventions identified in the review specifically tailored to the age, gender, sexual orientation and race/ethnicity of participants. For example, six of 23 trials involving young people and all of those involving MSM were conducted in the USA. Consequently, it is unclear how generalizable these interventions are to other populations in other cultural contexts.

Adaptation and piloting of interventions would be required before the interventions described in this review are implemented elsewhere. We have also identified gaps in the trial evidence suggesting a need for further studies. Overall the number of good quality trials is relatively small.

We have mapped delivery mode and intervention content in effective interventions to exemplify what type of interventions have been found to be effective. The small number of trials available prohibited quantification of associations between delivery modes and content and effect sizes. Moreover, delivery mode and content interact to determine effectiveness and we were unable to disentangle these independent and synergistic effects.

#### *Implications for Research and Practice*

These limitations, notwithstanding, our findings have important implications for future research and practice. For young people, video-based interventions were effective for improving all three outcomes of interest (STI rates, STI-testing and self-reported sexual risk behavior patterns) so this may be an important delivery mode for brief intervention design in sexual health clinics. Yet this mode of delivery was not used in interventions for MSM. One trial identified in our searches, which did not meet our inclusion criteria, tested a brief video-based intervention in STI clinic waiting rooms (40) and found a significant reduction in incidence of STIs in general populations attending STI clinics, with a secondary sub group analysis performed for MSM. Future intervention design could test the utility of clinic-based video interventions for MSM.

For young people, two of seven studies involving one-to-one counselling (involving 2 x 20 min sessions) (19, 25) and all three studies involving home STI test kits (17, 32, 35) were found to be effective for reducing STI rates and increasing STI testing. while one of two studies involving offline computer software (28), two of three online web-based

interventions (21, 29) and one of two interventions involving printed materials (12) were found to be effective for reducing self-reported sexual risk behavior patterns in young people. Hence a range of delivery modes and content could be combined when developing new STI-reduction interventions for young people. Based on the evidence presented here from higher quality studies, it seems likely that clinic-based interventions for young people capable of reducing STIs should consider inclusion of one-to-one counselling (e.g., 2 x 20 mins sessions) plus a HIV/STI test to reduce incidence of HIV and other STIs including herpes simplex in young people. In addition, home-testing kits and standalone interactive videos in the clinic setting (see e.g., [www.WhatCouldYouDo.org](http://www.WhatCouldYouDo.org)) may be effective for young people. Our review did not identify particular intervention types likely to be effective in reducing STIs among MSM. While introducing these intervention components would have resource and staff cost implications they could be implemented and sustained in many clinic environments and, if effective, could be cost saving. In clinics with limited resources, such interventions may only be feasible for high-risk or frequent-return groups.

Our findings may also offer guidance for intervention developers of digital interventions aiming to reduce risky sexual behavior in young people as provision of normative and behavior skills arguments in digital intervention content may be more effective than the provision of information for reducing risky sexual behavior. We also note that when comparing intervention delivery formats across young people studies, both digital (10, 24, 25) and video (23, 26, 29) interventions that were effective for reducing risky sexual behavior in young people consistently included behavior skills arguments, indicating that this component may be especially important for inclusion when developing both digital and video interventions targeting young people. Our findings may also offer guidance for developers of digital interventions aiming to reduce risky sexual behavior in MSM. Similar to findings for young people, provision of normative and behavior skills arguments in digital intervention content may be effective for reducing risky sexual behavior in MSM.

#### *Further research*

Further work is needed to better understand the specific psychological processes or regulatory mechanisms that may account for differences in intervention effectiveness (6, 41) as well as the impact of contextual factors (e.g. substance and/or alcohol use). Economic evaluation of such interventions is essential to inform commissioning and implementation planning.

### *Conclusion*

This review has identified a small number of interventions that may be suitable for in-service delivery within sexual health clinics in middle and high income countries that were effective in reducing STI rates among young people, increasing STI-testing uptake and reducing sexual behavior risks among young people and MSM. These effective interventions used a variety of delivery formats (one-to-one counselling, provision of STI home-test kits and videos) and specific persuasion and behavioral change techniques (including information provision, normative arguments, behavioral skills arguments, and STI-testing). The effective interventions, their delivery formats and content components provide useful illustrations of how in-service sexual health intervention could be introduced to enhance usual care in sexual health services.

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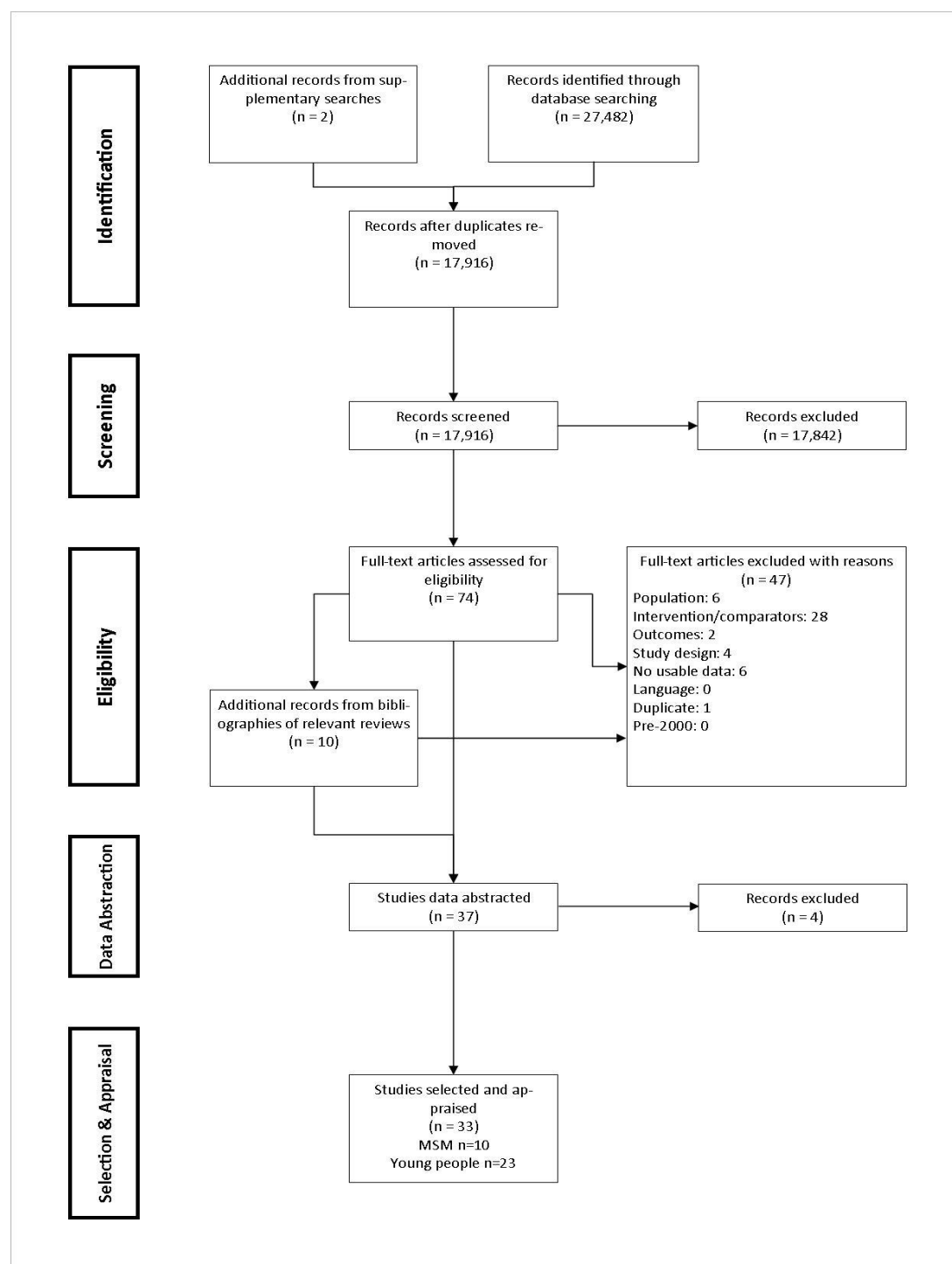
ACCEPTED MANUSCRIPT

Figure 1 : Medline search strategy

1. exp Health Promotion/
2. exp Health Education/
3. exp Sex Education/
4. exp Preventive Health Services/
5. exp Preventive Medicine/
6. exp Primary Prevention/
7. Public Health/
8. exp Social Medicine/
9. exp Behavior Therapy/
10. exp Health Behavior/
11. exp Sexual Behavior/
12. exp risk reduction behavior/ or exp risk-taking/ or exp condoms/
13. exp unsafe sex/
14. exp safe sex/
15. exp sexual abstinence/
16. exp Sex Education/ or exp sexology/
17. ((prevent\$ or reduc\$ or educat\$ or promot\$ or increas\$ or decreas\$ or facilitat\$ or barrier\$ or encourag\$) adj2 (sex\$ or HIV or STI or STIs or STD\$)).ab,ti.
18. attitude to health/ or health knowledge, attitudes, practice/
19. or/1-18
20. exp Sexually Transmitted Diseases/
21. exp chancroid/ or exp chlamydia infections/ or exp lymphogranuloma venereum/ or exp gonorrhoea/ or exp granuloma inguinale/ or exp syphilis/
22. exp HIV infections/
23. HIV\*.ti,ab.
24. acquired immuno deficiency syndrome/
25. exp Acquired Immunodeficiency Syndrome/
26. Herpes Genitalis/
27. Condylomata Acuminata/
28. (HPV or human papilloma\$).ab,ti.
29. ((genital or venereal) adj2 wart\$).ab,ti.

30. (STI or STIs or STD or STDs).ab,ti.
31. (Sexual\$ transmit\$ adj3 (infect\$ or disease\$)).ab,ti.
32. or/20-31
33. exp Adolescent/
34. (young\$ adj2 (men or man or woman or women or female\$ or male\$ or people or person)).ab,ti.
35. (teenage\$ or adolescen\$ or youth or youths).ab,ti.
36. exp men/
37. ((gay adj2 man) or men).ti,ab.
38. (men\$ adj6 men).ab,ti.
39. or/33-38
40. 19 and 32 and 39
41. randomized controlled trial.pt.
42. controlled clinical trial.pt.
43. random\$.ti,ab.
44. control\$.ab,ti.
45. (effectiveness or trial).ti.
46. placebo.ab,ti.
47. one to one intervention\$.ti,ab.
48. intervention\$.tw.
49. ((control\$ or experimental or compar\$) adj2 (Group\$ or trial\$ or study or studies or evaluat\$ or condition)).ti,ab.
50. or/41-49
51. 40 and 50
52. limit 51 to (english language and yr="2000-Current")

Figure 2: PRISMA flowchart of included studie



**Excluded Articles:** Full text articles excluded due to: Population (42-47); Intervention / comparators (48-75); Outcomes (76, 77); Study design (78-81); No usable data (82-87); Duplicate (19)

**Table 1: Summary of MSM and Young People Interventions**

Population	Young People	MSM
No. of sessions	1-4	1-2
Delivery formats	Video; printed materials; home STI test kit; one-to-one counselling (with/without STI-test); web-based digital interventions; computer-based digital interventions (e.g. DVDs); text messaging digital interventions	Web-based digital interventions; one-to-one counselling (with STI test)
Intensity	4 mins – 120 mins	14 mins -120 mins

Table 2: Summary Table for Young People Studies

Study	Study Summary	Study population	Mode of delivery			Outcomes measured			Validity	Intervention strategy components
				STI Events	STI Test Uptake	Unprotected (condom less) Intercourse and Condom Use	Other Sexual Behavior	Other results		
<b>DIGITAL DELIVERY FORMAT</b>										
Kang (2012)	<p><b>Setting:</b> online (Australia)</p> <p><b>Intervention:</b> internet (website and personalized emails)</p> <p><b>Follow-up:</b> 6 mnths</p> <p><b>Conclusions:</b> effective for increasing STI test uptake in longer term (6</p>	Young people aged 16-25 yrs	Variable	N/A	benefit of treatment (1)	no difference between groups	N/A	No difference between groups	Performance bias; unclear if there is risk of detection bias	Info

	mnths)									
Bull (2012)	<p><b>Setting:</b> online (USA)</p> <p><b>Intervention:</b> internet (Facebook page)</p> <p><b>Follow-up:</b> 2,6 mnths</p> <p><b>Conclusions:</b> effective for increasing condom use in short term (2 mnths) but not long term</p>	Young people aged 16-25 yrs	N/A	N/A	N/A	mixed results (2)	no difference between groups	No difference between groups (3)	Performance bias	NormA, Info, SkillA
Klein (2011)	<p><b>Setting:</b> USA</p> <p><b>Intervention:</b> computer-based software</p> <p><b>Follow-up:</b> 3 mnths</p> <p><b>Conclusions:</b> effective for increasing condom use in medium term (3 mnths)</p>	Young women aged 14- 18 yrs	2 x 1 hr computer-delivered session	N/A	N/A	benefit of treatment	no difference between groups	benefit of treatment	Selection bias (random sequence generation); Performance bias; Attrition bias; Reporting bias; Unclear if there is either risk of selection bias (allocation concealment) or detection	NormA, Info, SkillA, CondomTrain, PersonTrain

									bias	
Mevissen (2011)	<b>Setting:</b> online (Netherlands)  <b>Intervention:</b> internet  <b>Follow-up:</b> 3 mnths  <b>Conclusions:</b> tailored online session effective for reducing rates of unprotected sex in medium term (3 mnths)	Young people 18-25 yrs	One session of a tailored computer-delivered session	N/A	no difference between groups	benefit of treatment	N/A	benefit of treatment	Performance bias; Unclear if there is risk of either detection bias or other bias	NormA, AttA, Info, SkillA, ThreatA
			One session of a non-tailored computer-delivered session	N/A	no difference between groups	no difference between groups	N/A	no difference between groups		
Norton (2012)	<b>Setting:</b> USA  <b>Intervention:</b> DVD containing video, music, text and pictures  <b>Follow-up:</b> 1, 2 mnths  <b>Conclusions:</b> no significant differences between intervention(s)	Young people (mostly white, female undergraduate students > 18yrs)	1 x 60 min DVD-delivered intervention on HIV	N/A	N/A	no difference between groups	no difference between groups	N/A	Unclear if there is risk of either selection bias (allocation concealment) or detection bias	NormA, Info, SkillA
			1 x 60 min DVD-delivered intervention on STIs	N/A	N/A	no difference between groups (4)	no difference between groups (4)	N/A		NormA, Info, SkillA
			1 x 60 min DVD-delivered intervention on unplanned	N/A	N/A	no difference between groups (4)	no difference between groups (4)	N/A		NormA, Info, SkillA



	and control		pregnancy							
Suffoletto (2013)	<p><b>Setting:</b> emergency department (USA)</p> <p><b>Intervention:</b> text messages (SMS)</p> <p><b>Follow-up:</b> 3 mnths</p> <p><b>Conclusions:</b> no significant differences between intervention and control</p>		Sequence of personalized risk reduction text messages received once a week for 3 months	NR	NR	no difference between groups (5)	no difference between groups	no difference between groups	Unclear if there is risk of either selection bias (allocation concealment) or detection bias	AttA, Info, ThreatA, SelfManTrain
<b>ONE-TO-ONE COUNSELLING</b>										
Bolu (2004)	<p><b>Setting:</b> public STD clinics (USA)</p> <p><b>Intervention:</b> brief counselling + STI test</p> <p><b>Follow-up:</b> N/A</p> <p><b>Conclusions:</b> effective for</p>	Young people (< 20 yrs ; 20 - 25 yrs)	2 x 20 min sessions; second session conducted after HIV results were provided	consistent benefit of treatment (for <20yrs and 20-25 yrs)	N/A	N/A	N/A	N/A	Performance bias	STI

	reducing STIs									
Gottlieb (2004)	<p><b>Setting:</b> 5 STD clinics (USA)</p> <p><b>Intervention:</b> brief counselling</p> <p><b>Follow-up:</b> 3,6,9,12 mnths</p> <p><b>Conclusions:</b> effective for reducing STIs in longer term (6 – 12 months)</p>	Young people (14-40+; mean age 24 yrs)	2 x 20 min session of brief general risk reduction counseling	consistent benefit of treatment (6)	N/A	NR	NR	N/A	Performance bias	STI
Apoola (2011)	<p><b>Setting:</b> Community (The Young Person's Community Substance Misuse Service ) (UK)</p> <p><b>Intervention:</b> rapid HIV test (mouth swab)</p> <p><b>Follow-up:</b> N/A</p> <p><b>Conclusions:</b> effective for increasing STI</p>	Young people (< 20 yrs)	1 session	N/A	consistent benefit of treatment (7)	N/A	N/A	N/A	Performance bias; unclear if there is risk of either selection bias (random sequence generation and allocation concealment) or detection bias	STI

	testing									
Chacko (2010)	<p><b>Setting:</b> Urban reproductive health clinic (USA)</p> <p><b>Intervention:</b> MBI + booster session</p> <p><b>Follow-up:</b> not significantly effective compared to control</p> <p>:</p>	Young women 16 - 22.5 yrs	3 sessions of MBI (2 x 30 – 50 min sessions plus booster session (15 mins))	no difference between groups	no difference between groups	N/A	no difference between groups	N/A	Performance bias; reporting bias	NormA, AttA
Grimley (2005)	<p><b>Setting:</b> Hospital-based adolescent clinic (USA)</p> <p><b>Intervention:</b> brief counselling</p> <p><b>Follow-up:</b> 6,12 months</p> <p><b>Conclusions:</b> not significantly effective compared to control for any review outcome</p>	Young women (14-23)	3 x 15 min sessions	N/A	N/A	N/A	N/A	consistent benefit of treatment (8)	Performance bias; Unclear if there is risk of either selection bias (allocation concealment) or detection bias	NormA, AttA, Info, SkillA, SelfManTrain

	of interest (7)									
Metsch (2013)	<p><b>Setting:</b> 9 STD clinics (USA)</p> <p><b>Intervention:</b> counselling + test</p> <p><b>Follow-up:</b> 6 mnths</p> <p><b>Conclusions:</b> not significantly effective compared to control</p>	Young people (< 25yrs)	1 individual patient-centered counselling session plus rapid HIV test	no difference between groups	NR	NR	NR	NR	No risk of bias	STI, Condom
Proude (2004)	<p><b>Setting:</b> Family practice (Australia)</p> <p><b>Intervention:</b></p> <p><b>Follow-up:</b> 3 mnths</p> <p><b>Conclusions:</b> not significantly effective compared to control</p>	Young people (18 – 25 yrs)	Brief advice about safe sex plus complimentary resources	NR	NR	no difference between groups (9)	No difference between groups (9)	N/A	Performance bias; Selection bias (random sequence generation and allocation concealment); Unclear if there is risk of detection bias	Info, SkillA, Condom
<b>VIDEO</b>										

Downs (2004)	<p><b>Setting:</b> 4 urban health care sites (USA)</p> <p><b>Intervention:</b> video</p> <p><b>Follow-up:</b> 1,3,6 mnths</p> <p><b>Conclusions:</b> significant reduction in STIs compared to control in longer term (6 months)</p>	Young women 14-18 yrs	4 sessions ( 1st session 30 mins; subsequent sessions at least 15 mins)	consistent benefit of treatment	N/A	no difference between groups (10)	mixed results (11)		Unclear if there is risk of detection bias	AttA, Info, SkillA, PersonTrain, NormA
Calderon (2011)	<p><b>Setting:</b> Urban Medical Centre Emergency Department (USA)</p> <p><b>Intervention:</b> video-based HIV counselling + test</p> <p><b>Follow-up:</b> N/A</p> <p><b>Conclusions:</b> significant increase in STI</p>	Young people 15 - 21 yrs	1 session (4 mins)	N/A	consistent benefit of treatment (12)	N/A	N/A		Performance bias	STI

	testing									
Shrier (2001)	<p><b>Setting:</b> Urban children's hospital adolescent clinic and inpatient service (USA)</p> <p><b>Intervention:</b></p> <p><b>Follow-up:</b> 1,3,6, 12</p> <p><b>Conclusions:</b> significantly fewer participants had sex with a non-main partner in the longer term (6 months)</p>	Young women (< 24 yrs)	<p>4 sessions; each consisting of</p> <p>Video (7 mins) and one-to-one counselling (approx. 30 mins)</p>	no difference between groups	N/A	no difference between groups	consistent benefit of treatment	N/A	Performance bias; Selection bias (allocation concealment); Unclear if there is risk of either attrition bias or other bias	NormA, AttA, Info, SkillA, ThreatA, CondomTrain, PersonTrain, SelfManTrain, STI
Roye (2007)	<p><b>Setting:</b> Health clinics – Planned Parenthood sites (USA)</p> <p><b>Intervention:</b> video ; brief counselling; video + brief counselling</p>	Black and Latina teenage women (15-21 yrs)	video	NR	NR	no difference between groups	NR	NR	Performance bias; Unclear if there is risk of either selection bias (in either random sequence generation or allocation concealment) or risk of	SkillA, ThreatA
			brief one-to-one counselling	NR	NR	no difference between groups	NR	NR		PersonTrain
			video plus brief one-to-one counselling	no difference between	no difference between	no difference between groups	mixed results (13)	no difference between		SkillA, ThreatA, PersonTrain

	<p><b>Follow-up:</b> 3, 12 mnths</p> <p><b>Conclusions:</b> no significant difference between intervention and control in medium term (3 mnths)</p>			groups	groups			groups	detection bias	
Booth (2014)	<p><b>Setting:</b> School settings (sixth form college and a vocational college) (UK)</p> <p><b>Intervention:</b> Short video; posters</p> <p><b>Follow-up:</b> N/A</p> <p><b>Conclusions:</b> no significant difference between intervention and control</p>	Young people (16 - 24 yrs)	1 session (15 mins): video (approx. 1 min) followed by talks using posters, followed by repeat showing of video	N/A	no difference between groups (14)	N/A	N/A	N/A	Performance bias; Unclear if there is risk of detection bias	NormA, AttA, Info, CondomTrain
<b>PRINTED MATERIALS</b>										
Scholes	<b>Setting:</b>	Young women	Self-help magazine	N/A	N/A	consistent benefit of	N/A	N/A	Performance bias; Unclear	Condom, Info,

(2003)	<p>Two managed care settings: a mixed model health care system and a network of affiliated practices, clinics and hospitals (USA)</p> <p><b>Intervention:</b></p> <p><b>Follow-up:</b> 3.6 mnths</p> <p><b>Conclusions:</b> significantly more likely to use condoms during the prior 3 months with any partner and with a primary partner in the longer term (6 months)</p>	(18 - 24 yrs)	<p>booklet + condoms followed by</p> <p>a tailored booster feedback newsletter + condom</p>			treatment			if there is risk of reporting bias	CondomTrain
Crawford (2014)	<p><b>Setting:</b> Three public STD clinics (UK)</p> <p><b>Intervention:</b> Leaflet plus one-</p>	Young people 19 - 25 yrs	1 session (up to 30 mins)	NR	N/A	no difference between groups	NR	no difference between groups	Performance bias	Info



	<p>to-one (f-t-f or telephone)</p> <p><b>Follow-up:</b> 6 mnths</p> <p><b>Conclusions:</b> no significant difference between intervention and control</p>									
<b>HOME TEST KIT</b>										
Cook (2007)	<p><b>Setting:</b> Community-based medical clinics and high prevalence neighborhoods (USA)</p> <p><b>Intervention:</b> home testing kit</p> <p><b>Follow-up:</b> 12,24 mnths</p> <p><b>Conclusions:</b> effective for increasing STI testing in long</p>	Young women (15 – 24 yrs)	3 sessions (a home testing kit received at 6, 12 and 18 months)	no difference between groups	consistent benefit of treatment	no difference between groups	N/A	N/A	No risk of bias	Info

	term									
Ostergaard (2000)	<p><b>Setting:</b> 17 high schools (Denmark)</p> <p><b>Intervention:</b> Chlamydia home test kit</p> <p><b>Follow-up:</b> 12 mnths</p> <p><b>Conclusions:</b> effective for reducing STIs in long term (12 mnths)</p>	Young women 15	N/A	consistent benefit of treatment	NR	N/A	N/A	N/A	Performance bias; Attrition bias	Info, STI (16)
Scholes (2007)	<p><b>Setting:</b> Group Health Cooperative</p>	Young men (21-25 yrs)	Home testing kit ( letter +test request card)	NA	consistent benefit of treatment	NR	NR	NR	Unclear if there is risk of either	Info, STI

(USA)	<b>Intervention:</b> home testing kit		Home testing kit (letter +mail-back sampling kit)	NA	(17)	consistent benefit of treatment (17)	NR	NR	NR	selection bias (concealment allocation) or detection bias	
											Info, STI
	<b>Follow-up:</b> 4 mnths										
	<b>Conclusions:</b> effective for increasing STI testing in medium term (4 mnths)										

**Abbreviations:** **1** Participants were engaged appropriately by personalized e-mails : advice depended on the questions asked by the participants **2** There was a difference between intervention and control groups at 2 months for condom use, but that groups did not differ at 6 months follow up; proportion of protected acts remained stable from baseline to 2 months in the intervention group and decreased by the 6-month follow-up **3** There was no difference in participants being drunk or high during sex **4** No significant differences were observed between intervention conditions (collapsed together) and control. Participants exposed to the pregnancy or STI interventions reported greater condom use and less risky sexual behavior than those exposed to the HIV intervention **5** In the intervention group, there was an increase in the proportion with condom use with last vaginal sex from 20% (95% CI 4%-48%) to 53% (95% CI 27% - 79%) and an increase in always condom use over the past 28 days from 0% (95% CI 0%-22%) to 33% (95% CI 12%-62%). These changes were not statistically different from control participants **6** A decrease in incidence rates of herpes simplex virus type 2, chlamydia and gonorrhea was observed with brief counselling intervention compared to control. By controlling for baseline characteristics, the HRs for incidence of HSV-2 infection by arm did not substantially change **7** Increased no of participants attending for STI screening at the STI clinic for all three STIs (HIV, Hep B and Hep C) **8** Intervention resulted in reduced self-reported douching at both 6 and 12 month **9** There was an equivalent self-reported use of questions by the intervention and control groups to assess partners risk, and an equivalent proportion self-reporting that they used condoms on the first occasion of sex with this new partner **10** There was no significant difference in how often participants reported using condoms from baseline to 3 month visit, nor from 3- to 6- month visits; although the trend is toward more condom use among those who watched the video failures; in the period between 3 and 6 month visits, those in the video condition reported fewer condom failures compared to control **11** Intervention participants were significantly more likely to be abstinent from baseline to 3 months, a pattern which diminished over time between 3- and 6-month visits and to experience significantly fewer condom failures in the following 3 months compared to controls **12** Willingness to be HIV tested was greater in the intervention group **13** At 3 months, women who received only the video intervention or only the counselling intervention did not differ significantly on this outcome from control group. However, those who received both video and counselling were significantly different from control for this outcome at 3 months, but not at 12 months **14** Chlamydial, gonococcal or trichomonal infection **15** Both young men and women were tested, but only women were followed up **16** Intervention was a home test kit plus information but no counselling **17** Both interventions (test request card and mailed sample kit) resulted in significantly higher chlamydia testing compared to control usual care, with direct

mailing of the sampling kit yielding significantly higher testing rates than a test-request approach

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Table 3: Summary Table for MSM studies

Studies	Study Summary	Study population	Mode of delivery	Outcomes measured					Validity	Intervention strategies employed
				STI Events	STI Test Uptake	Unprotected (condom less) Intercourse and Condom Use	Other Sexual Behavior	Other results		
<b>DIGITAL DELIVERY FORMAT</b>										
Carpenter (2010)	<p><b>Setting:</b> online (USA)</p> <p><b>Intervention:</b> Internet (web-based)</p> <p><b>Follow-up:</b> 3 mnths</p> <p><b>Conclusions:</b> effective for reducing unprotected anal intercourse and oral intercourse with risky</p>	Younger MSM 18-30 yrs	1 online session (to be completed within 1 week). Tutorials (taking approx. 1.5 – 2 hrs)	NR	NR	consistent benefit of treatment (1)	NR	NR	Performance bias	AttA, Info, SkillA, SelfManTrain, NormA

	partners in medium term (3 mnths) (1)									
Hirshfield (2012)	<b>Setting:</b> online (USA) <b>Intervention:</b> Two digital prevention interventions (video intervention and an HIV prevention webpage) <b>Follow-up:</b> 2 mnths <b>Conclusions:</b> no significant difference between intervention and control were seen at the group level	MSM 18-81 yrs	HIV prevention videos (both dramatic (9 mins) and documentary (5 mins) ;	NR	no difference between groups	no difference between groups (2)	NR	consistent benefit of treatment (ref)	Performance bias; Unclear if there is risk of detection bias	SkillA, SelfManTrain
			HIV prevention webpage	NR	no difference between groups	no difference between groups (2)	NR	no difference between groups		
Milam (2014)	<b>Setting:</b> 3 university clinical sites (USA)	HIV-infected MSM ( □ 18 yrs)	Monthly brief internet-based intervention	no difference between groups	NR	consistent benefit of treatment (3)	NR	consistent benefit of treatment (3)	Performance bias; Selection bias (random sequence generation);	NormA, SkillA

	<p><b>Intervention:</b> internet</p> <p><b>Follow-up:</b> Monthly (1 -12 months)</p> <p><b>Conclusions:</b> greater relative decline in unprotected sex (anal/vaginal) compared to control in the medium to longer term (4, 7, 11 mnths) for participants with good adherence</p>								Unclear if there is risk of reporting bias	
Mustanski (2013)	<p><b>Setting:</b> online (USA)</p> <p><b>Intervention:</b> internet</p> <p><b>Follow-up:</b> 1½, 3 mnths</p> <p><b>Conclusions:</b> lower rate of unprotected anal sex in medium term</p>	HIV-negative Young MSM (18-24 yrs)	Total 120 mins;  7 modules completed across three sessions that were done at least 24 hrs apart that in total took approx. 2 hrs to complete	NR	NR	consistent benefit of treatment	no difference between groups (4)	NR	No risk of bias	NormA, AttA, Info, SkillA, SelfManTrain

	(3 mnths)									
Rosser (2010)	<p><b>Setting:</b> online (USA)</p> <p><b>Intervention:</b> internet</p> <p><b>Follow-up:</b> 3,6,9,12 mnths</p> <p><b>Conclusions:</b> a marginally significant short term effect of intervention on decreasing unprotected anal intercourse compared to control at 3 months, with no difference in the longer term</p>	MISM (□ 18 yrs)	“Sexpulse” completed 7 days after enrollment	NR	NR	mixed results (5)	NR	NR	Performance bias; Unclear if there is risk of reporting bias	NormA, SkillA, SelfManTrain
Young (2013)	<p><b>Setting:</b> online (USA)</p> <p><b>Intervention:</b> internet</p>	African American and Latino MSM (□ 18 yrs; mean age 31.5 yrs)	internet (Facebook)	NR	consistent benefit of treatment	NR	no difference between groups	NR	Performance bias; Unclear if there is risk of other bias	STI, Info



	(Facebook)  <b>Follow-up:</b> 3 mths  <b>Conclusions:</b> effective for increasing home-based STI testing compared to control									
<b>ONE-TO-ONE COUNSELLING</b>										
Coffin (2014)	<b>Setting:</b> Private counselling rooms (USA)  <b>Intervention:</b> brief counselling + STI test  <b>Follow-up:</b> 3,6 mths  <b>Conclusions:</b> no differences were found between the prevention webpage and control	Substance-using MSM ( $\geq 18$ yrs; mean =33.6 yrs)	1 brief counselling session (30-50 mins) plus rapid HIV test followed by booster counselling session plus HIV test after both 3 and 6 months 4	NR	NR	mixed results (6)	no difference between groups	NR	Unclear if there is risk of reporting bias	STI, SelfManTrain

	condition for the primary outcomes. In subgroup analysis, there was a significant reduction in total number of unprotected anal intercourse (UAI) events and UAI events with three most recent non-primary partners among non-substance dependent SUMSM of color									
Metcalf (2005)	<p><b>Setting:</b> 3 public STD clinics (USA)</p> <p><b>Intervention:</b> booster counselling session</p> <p><b>Follow-up:</b></p>	MSM sub-population (15-39 yrs)	1 booster counselling session (20 mins) 6 months after HIV counselling	no difference between groups	NR	no difference between groups (7)	no difference between groups (7)	NR	Performance bias; Unclear if there is risk of reporting bias	STI, SelfManTrain

	3,6,9,12 mnths <b>Conclusions:</b> no significant difference between intervention and control									
Metsch (2013)	<b>Setting:</b> 9 STD clinics (USA) <b>Intervention:</b> counselling + STI test <b>Follow-up:</b> 6 mnths <b>Conclusions:</b> lower numbers of unprotected partners but not lower numbers of total partners with intervention compared to the information-only control group	MSM sub-population (≥ 18 yrs)	1 individual patient-centered counselling session plus rapid HIV test	no difference between groups	NR	consistent benefit of treatment (8)	no difference between groups	NR	No risk of bias	STI, Condom, Info
Outlaw	<b>Setting:</b> Community	Young MSM (specifically	1 single 30 minute field	NR	consistent benefit of	NR	NR	NR	Detection bias; Attrition	STI, Condom

(2010)	venues for prevention and care services (USA)  <b>Intervention:</b> One to one (community outreach)  <b>Follow-up:</b> none  <b>Conclusions:</b> effective for increasing STI testing	African American men)(18-26 yrs)	outreach session		treatment (9)				bias; Unclear if there is risk of either selection bias (allocation concealment) or risk of performance bias
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**Abbreviations: † MISM denotes men who use the internet to seek sex with men**

**1** For all partners (regardless of serostatus) numbers of unprotected acts decreased from baseline to follow-up for all sexual practices; No of unprotected acts with risky partners decreased more for the intervention group than for the control group for anal intercourse (AI), insertive anal intercourse (IAI), insertive oral intercourse (IOI) and receptive oral intercourse (ROI) but not receptive anal intercourse (RAI) **2** In the 60 days after the intervention, men in the pooled video condition were significantly more likely than men in the control to report full serostatus disclosure (“asked and told”) with their last sexual partner. Significant changes in sexual behavior and HIV testing were not seen at the group level. However, comparing baseline to follow-up, HIV negative men in the pooled video (OR 0.7, 95% CI 0.54-0.91) and webpage condition (OR 0.43, 95% CI 0.25-0.72) significantly reduced UAI at follow-up. HIV-positive men in the pooled condition significantly reduced UAI (OR 0.38, 95% CI 0.2-0.67) and serodiscordant UAI (OR 0.53, 95% CI 0.28-0.96) at follow-up **3** In some months, the intervention arm was significantly higher than the control arm for both unprotected anal/vaginal sex and disclosure outcomes. In sub-analyses of the study completers, disclosure increased in all follow up months compared to baseline and was higher than the control arm in months 4, 6 and 7. Among High Adherers, the intervention arm had higher rates of disclosure in eleven of the follow up months compared to baseline and was higher than the control in months 6 and 7. The intervention arm had greater relative decline in unprotected anal/vaginal sex than the control arm in months 4, 7 and 11. Among high adherers, the intervention arm had greater relative decline in unprotected anal/vaginal sex than the control in months 1, 2, 4, 7 and 11. **4** There was a small non-significant reduction in the number of sex partners in both arms **5** A marginally significant short term effect of intervention on decreasing unprotected anal intercourse was observed compared to control at 3 months, with no difference in the longer term. **6** No difference in sexual behavior was observed between conditions, although within-person effects were found for reduced UAI at follow-up compared to baseline, with men reporting significant reductions in UAI in both the pooled video (OR 0.61) and webpage conditions (OR 0.42). No differences were found between the prevention webpage and control condition for the primary outcomes. No significant intervention

effects were observed for reducing sexual risk behaviors among HIV-negative, episodic substance using men who have sex with men (SUMSM), but did find a reduction in number of unprotected anal intercourse events (UAI) with three most recent non-primary partners in non-dependent, episodic SUMSM. In subgroup analysis, there was a significant reduction in total number of UAI events and UAI events with three most recent non-primary partners among non-substance dependent SUMSM of color. **7** Within the MSM subgroup, participants generally tended to report less sexual risk behavior than the no-booster group participants at the 9-month visit, but the differences were not statistically significant. At 12 months, there was no statistically significant difference between intervention and control **8** The MSM who received counselling reported lower numbers of unprotected partners but not lower numbers of total partners compared with MSM in the information-only group. **9** More participants in the intervention group both undertook testing and returned for test results

Table 4 Summary of Effective and Ineffective Trials for Outcomes of Interest

DELIVERY FORMAT	YOUNG PEOPLE									MSM								
	TOTAL NO. TRIALS	EFFECTIVE TRIALS				INEFFECTIVE TRIALS				TOTAL NO. TRIALS	EFFECTIVE TRIALS				INEFFECTIVE TRIALS			
		Outcome	No of trials	Content consistently included in all studies	Content included in some studies	Outcome	No of trials	Content consistently included in all studies	Content included in some studies		Outcome	No. trials	Content consistently included in all studies	Content included in some studies	Outcome	No. of trials	Content consistently included in all studies	Content included in some studies
Digital	6	STI-test	1 (19)	Info		Behavior	2 (21,27)	Info		6	STI-test	1 (38)	Info		STI-test	1 (33)		
		Behavior	3 (10,24,25)	NormA, SkillA							Behavior	4 (36, 31, 37, 35)	NormA, SkillA	SelfMan, Info	Behavior	1 (33)		
One-to-one counselling	7	STIs	2 (8,17)	STI-test		STIs	2 (16,20)			4	STI-test	1 (30)	STI-test		Behavior	1 (34)		

		STI-test	1 (14)	STI-test		STI-test Behavior	1 (16) 2 (16,11)				Behavior	2(20,32)	STI-test					
<b>Video</b>	5	STIs	1 (23)	Atta, Info, SkillA, PersonTrain		STI-test	1 (7)											
		STI-test	1 (15)	STI-test														
		Behavior	3 (29, 23, 26)	SkillA, PersonTrain	ThreatA, Atta, Info													
<b>Printed materials</b>	2	Behavior	1 (22)		Info, Condom, CondomTr ain	Behavior	1 (9)											
<b>Home test kit</b>	3	STIs	1 (22)		STI-test													
		STI-test	2 (28, 13)	<b>Info</b>														

Abbreviations: Behavior risky sexual behavior; STI-test STI test uptake; STIs Incidence of STIs; Info (Any kind of Information); Norma (Normative Arguments); Atta (Attitudinal Arguments); SkillA (Behavioral Skills Arguments); ThreatA (Threat-inducing Arguments); Condomtrain (Condom Use Skills Training); Condom (condom provision), PersonTrain (Interpersonal Skills Training); SelfMan Self-Management Training; STI-test (STI/HIV Counselling and Testing).

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Table 5: A Mapping of Content Components Found In Effective Interventions

Outcome	Delivery Format	Content consistently included in all studies		Content included in some studies	
		Young people	MSM	Young people	MSM
<b>Reduced STIs</b>	<b>Counselling</b>	STI-test			
	<b>Digital</b>				
	<b>Video</b>	Atta, Info, SkillA, PersonTrain			
	<b>Home test kit</b>			STI-test	
	<b>Printed materials</b>				
<b>STI test uptake</b>	<b>Counselling</b>	STI-test	STI-test		
	<b>Digital</b>	Info	Info		
	<b>Video</b>	STI-test			
	<b>Home test kit</b>	Info			
	<b>Printed materials</b>				
<b>Behavior</b>	<b>Counselling</b>		STI-test		
	<b>Digital</b>	NormA, SkillA	NormA, SkillA		SelfMan Info
	<b>Video</b>	SkillA, PersonTrain		ThreatA, AttA, Info	
	<b>Home test kit</b>				
	<b>Printed materials</b>			Info, Condom, CondomTrain	
<p><b>Abbreviations:</b> <b>Info</b> (Any kind of Information); <b>NormA</b> (Normative Arguments); <b>AttA</b> (Attitudinal Arguments); <b>SkillA</b> (Behavioral Skills Arguments); <b>ThreatA</b> (Threat-inducing Arguments); <b>Condomtrain</b> (Condom Use Skills Training); <b>Condom</b> (condom provision), <b>PersonTrain</b> (Interpersonal Skills Training); <b>SelfMan</b> Self-Management Training; <b>STI-test</b> (STI/HIV Counselling and Testing).</p>					

**Highlights**

- A review of brief interventions with potential to enhance sexual health services.
- Analyses of intervention content and delivery formats.
- Identification of interventions that reduce sexual risk for young people and MSM.
- Interventions reducing STIs among young people were identified but not among MSM.

Abbreviations: STI (sexually transmitted infection); MSM (men who have sex with men)