

# New digital media interventions for sexual health promotion among young people: a systematic review

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**Abstract.** New digital media platforms (e.g. social networking sites, web pages and text messaging) have dramatically changed interpersonal communication and present novel opportunities for health interventions. Due to the high uptake and use of digital media among young people, advances in digital media provide potential new opportunities in delivering health interventions to this audience to reduce sexually transmissible infection (STI) risk. The aim of this study was to assess the effectiveness of sexual health interventions delivered via new digital media to young people (aged 13–24 years). A systematic search was conducted of seven databases for peer-reviewed literature published between January 2010 and April 2017 that evaluated a sexual health intervention delivered to young people (aged 13–24 years). Of 2017 papers reviewed, 25 met the inclusion criteria and were assessed. Sixteen studies used web-based platforms to deliver their intervention. A large proportion of studies (11/25) specifically focused on HIV prevention. Seven studies found a statistically significant effect of the intervention on knowledge levels regarding the prevention HIV and other STI, as well as general sexual health knowledge, but only one-fifth of interventions evaluating intentions to use condoms reported significant effects due to the intervention. Nine studies focused on individuals from an African American background. Although new media has the capacity to expand efficiencies and coverage, the technology itself does not guarantee success. It is essential that interventions using new digital media have high-quality, evidence-based content that engages with individual participants.

**Additional keywords:** adolescent, teenager, social media.

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## Introduction

New digital media, such as text messaging, web pages, social networking sites (SNS) and location-based social mobile applications, have changed information sharing and communication substantially.<sup>1</sup> ‘New digital media’ refers to any user-controlled and shareable and interactive forms of communication.<sup>1</sup> The rise in the use of new digital media is particularly common among adolescents and young adults worldwide. For example, adolescents (aged 10–19 years) account for 35% of China’s 298 million Internet users,<sup>1</sup> whereas in the US, 97% of Americans aged 18–29 years use the Internet on a regular basis.<sup>2</sup> In particular, the use of mobile phones is ostensibly ubiquitous across many populations within developed countries. The anonymity, convenience and accessibility afforded by text messaging, web access and video streaming provides significant potential for innovative

interventions to reach communities and individuals otherwise disconnected from mainstream services.<sup>3–5</sup>

One particular health issue that is of great importance to young people, and one that has been targeted using digital media, is sexual health and sexually transmissible infections (STIs). Today, numerous education interventions, using websites, short message services (SMS) and social networking sites, have been developed to modify the sexual health knowledge and behaviours of adolescents and young adults.<sup>1</sup> The high level of use among youth and adolescents has made new digital media a promising delivery mode for sexual health interventions.

Young people are at high risk of contracting STIs due to increased propensity for risk taking behaviour, impulsivity and experimentation, and greater vulnerability through reduced access to information, services, power and social engagement.<sup>6,7</sup> The popularity of digital technologies, particularly smartphones,

as the often preferred mode for accessing the Internet among this demographic raises the potential for new media to shape the development of targeted sexual health promotion and public health initiatives.<sup>5</sup>

Such technologies enable rapid, inexpensive, highly reproducible and widespread coverage of interventions, allowing for evidence-based programs to be adapted to digital platforms, precisely directed at individuals through interactive, custom-designed interfaces without increasing demands on staffing or training. Digitised programs provide for greater anonymity, repetition, temporal flexibility and client sensitivity, and appeal to a variety of learning needs. They can be easily updated and adapted to particular social and demographic needs, which have been demonstrated across the age range 12–30 years.<sup>7,8</sup> Further, social media and Internet-facilitated communication have enabled the establishment of virtual communities whereby young adults, particularly those often marginalised by society, have the freedom and anonymity to share experiences, learn about sex, initiate meaningful and casual sexual and social relationships and connect with wider networks.<sup>9</sup> The ease, speed and geographical coverage of such networks poses both great challenges for infection control and great promise for health promotion.

Although digital media is recognised as a new and important health communication tool, there is little published evidence about the overall effectiveness of sexual health interventions delivered via new digital media. As with many other prevention interventions, digital platforms have sought to enhance knowledge, increase intentions to use condoms and communicate condom use with partners, improve attitudes to condom use and safer sex, increase self-efficacy and the ability to use condoms, practice safer sex and affect perceived vulnerability to infection. These variables are strongly predictive of consistent condom use and safer sex practice.<sup>7</sup> However, despite evidence of the effectiveness of new digital media interventions to modify sexual health knowledge, attitudes and behavioural intentions of adolescents, demonstrated longer-term behaviour change is more limited.<sup>1</sup>

Nonetheless, new digital media continues to attract great interest for its significant population reach, attractiveness for young people, interactive features, efficiency at disseminating messages and connectivity between and within communities of peers.<sup>6,10</sup> A systematic review by Guse *et al.*<sup>1</sup> found that digital media interventions had significant potential to enhance the sexual health knowledge of adolescents or young adults (aged 13–24 years), particularly in relation to HIV and other STIs. Like many authors, Guse *et al.*<sup>1</sup> advocated for the great potential of digital media to engage and support youth sexual health.

The review by Guse *et al.*<sup>1</sup> was conducted at a time when the use of digital media was only emerging. Since 2011 there has been a further increase in the use of digital media and an emerging body of literature using digital media interventions for sexual health promotion among adolescents and young adults. The primary aim of this systematic review was to assess the current effectiveness of new digital media interventions to enhance sexual health in those aged 13–24 years. The findings will be beneficial to both researchers and clinicians in designing effective digital

media interventions that focus on sexual and other health issues among adolescent and young adult populations.

## Methods

### *Literature search*

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. All researchers built up a search strategy, which incorporated different keywords, their synonyms and various spellings. A search was conducted of peer-reviewed literature published between January 2010 and April 2017 to identify articles that provided an evaluation of a sexual health intervention delivered to young people (aged 13–24 years) through a new digital media platform. In order to gather a range of literature, databases and search terms were identified based on their relevance to the search topic. Seven databases were interrogated: Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medline, PsycINFO, SocINDEX, Informit, PubMed and Scopus. Due to inconsistent definitions, broad search terms were used. Each database search was conducted by combining terms into three separate categories: population (*adolescen\**, *teen\**, *youth\**, *young adult\**), intervention (*social media*, *social network\**, *SNS*, *internet\**, *digital media\**, *mobile phone\**, *cell\* phone\**, *text messag\**, *technolog\**, *new media\**, *Online\**, *Web\**) and outcome (*sex\* health*, *sex\* behaviour\**, *sex\* behavior\**, *sex\* knowledge*, *sex\* attitude\**, *attitude\* to\* sex\**, *knowledge of sex\**, *sex\* understand\**, *sex\* education\**). Where possible, database-specific terms, such as MeSH (PubMed) and CINAHL headings, were supplemented with similar terms and phrases. The literature search and studies included in this systematic review are shown in Fig. 1.

### *Inclusion and exclusion criteria*

In all, 2017 papers were identified through seven electronic databases and processed using Endnote X7 software (Clarivate Analytics, Philadelphia, PA, USA). After duplicates were removed, eligible papers were independently identified by two authors (EW, CG) based on titles and abstracts being read against inclusion criteria. Papers were included in the review if a substantial number of participants were aged 13–24 years and the paper described an evaluation of the effect of an intervention on sexual health knowledge, attitudes and/or behaviours. Studies were included only if 50% or more of the sample size comprised participants in the defined age group. In addition, papers that evaluated the feasibility, usability and acceptability of new digital media interventions on sexual health were included. In addition, to be eligible for inclusion, papers had to be full text, peer reviewed and published in the English language. Editorials, conference papers and other non-peer-reviewed publications were excluded. Because the purpose of the present review relates primarily to communicable disease, papers that focused on gender and sexual identity, family planning and sexual dysfunction were also excluded.

If eligibility was unclear, the study was retained for a second evaluation by another reviewer (AS). During the second stage, the full text of each included study was reviewed to confirm

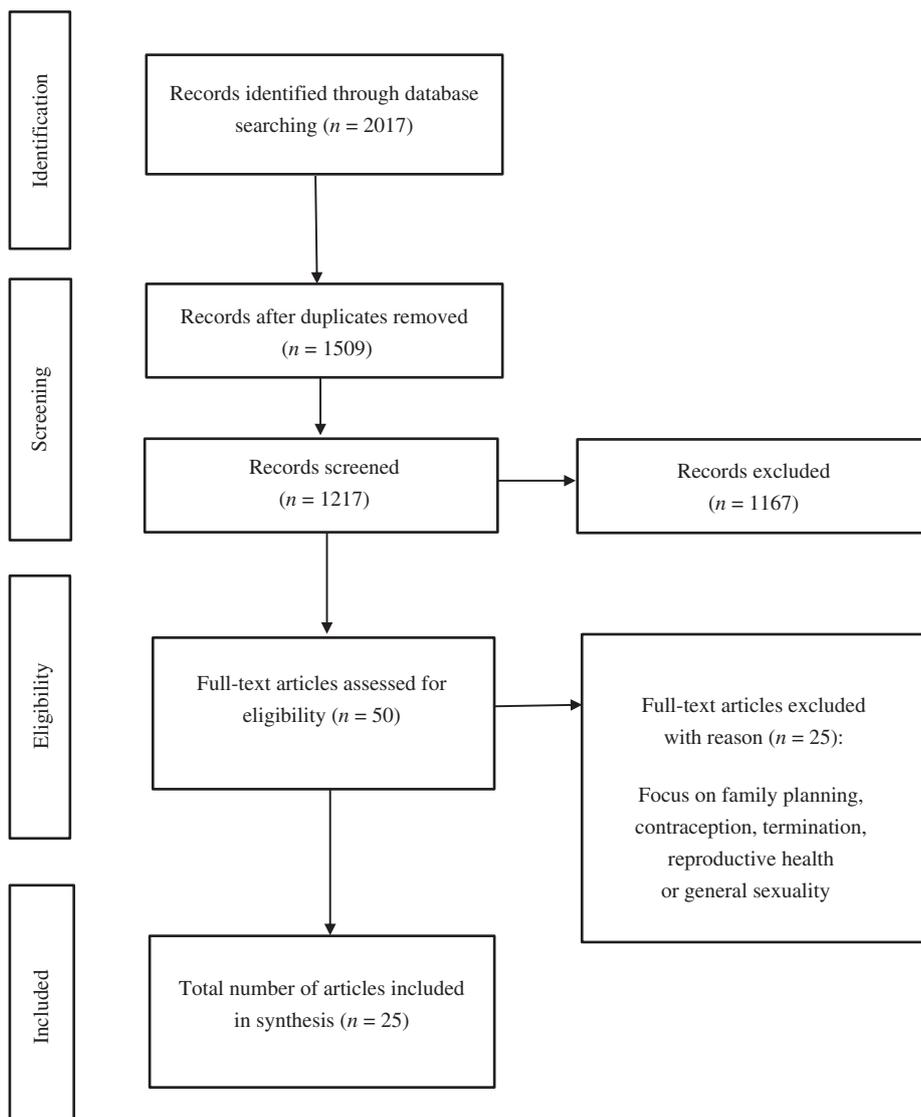


Fig. 1. Inclusion flowchart.

eligibility. Disagreements on eligibility were assessed by a third reviewer (AS) to determine the final decision regarding eligibility. Data from the included papers were extracted using a standardised pro forma, which collected data on year of publication, authors, country, study design, participant number, population, aim and type of intervention, outcome measures, evaluation methodology, overall results, reported facilitators and barriers and study limitations. Furthermore, these study outcomes were classified into different themes with a range of subcategories within each theme: (1) behaviour (number of sexual partners, number of unprotected sexual acts, frequency of condom use, negotiation skills for condom use, sex under the influence of alcohol and other drugs, testing seeking behaviour); (2) Self-efficacy (condom use); (3) Skills and Abilities (sexual communication and risk assessment); (4) Intentions (to use condoms); (5) Attitudes; (6) Knowledge (HIV, STI, general sexual health); (7) Efficacy of the Intervention (feasibility, acceptability, usability,

satisfaction); and (8) Well-being (mental health, sexuality, self-acceptance). Appendix 1 provides a summary of the studies (n = 25) included in the systematic review.

**Results**

*Population of interest*

There was substantial variability among the studies in relation to setting, sexual preferences, recruitment methods and outcomes measured. Although 16 of 25 studies recruited subjects either from an education setting (n = 7;<sup>7,11-16</sup> e.g. high schools, middle schools and universities) or a health setting (n = 9;<sup>3-5,8,17-21</sup> including sexual health clinics and hospitals), the remaining nine studies were defined by the recruitment method rather than a particular physical setting. These nine studies recruited participants directly online through new digital media, such as Facebook or location-based social mobile applications.<sup>4,8-10,13,22-26</sup> Many of the studies used multiple

methods of recruitment, with some (6/25)<sup>4,5,9,12,14,15</sup> extending the reach of recruitment through the use of shopping mall and community notice boards, and through collaboration with community-based organisations.<sup>5,6,15</sup> One study recruited participants purposively from a larger related study.<sup>27</sup>

Most (22/25) of the included studies were conducted in industrialised country settings. Within the US, African American communities were the primary focus.<sup>3,4,7,8,12,17,20,21,27</sup> One intervention was delivered to a Latino/Hispanic population.<sup>13</sup> The three studies conducted in low- to middle-income countries were based in Chile, Uganda and Thailand.<sup>11,15,20</sup>

Sexual identity and preference were also used as a basis for study, with seven interventions focusing on members of the men who have sex with men (MSM) and wider lesbian, gay, bisexual and transgender (LGBT) community.<sup>4,8-10,19,23,24</sup> In 13 studies, participants were predominantly male, with eight of the interventions focusing solely on men.<sup>4,8-10,12,19,20,24</sup> Women were the sole focus of five studies,<sup>3,5,12,17,21</sup> and women were the predominant participants in 11 of the 25 studies.<sup>3,5,12,13,15,17,18,21,25-27</sup> In two studies, the prioritisation of youth focused on the related issue of substance abuse disorders.<sup>7,9</sup>

### *Intervention design*

Although participants' age ranged from 12 to >50 years, most participants were in the range 15–24 years ( $n = 17$  studies).

Of the 25 studies, 11 were randomised control trials,<sup>4,5,7,11,16,17,19,21,22,24,26</sup> six used a pre-post test evaluation design,<sup>6,9,12-14,23</sup> three were uncontrolled longitudinal studies<sup>6,10,13</sup> and the remaining studies comprised a mixture of qualitative cohort, observational and mixed methods.<sup>3,15,18,27</sup> Thirteen of the studies included a process evaluation of the intervention, six of which comprised process evaluation only with no other outcomes reported.<sup>5,6,8,11,20,27</sup> Sample sizes ranged from <20 to >7500 participants, with three studies reporting >1000 participants.<sup>16,18,22</sup>

Although HIV was the major preventive theme for a large proportion (11/25) of studies,<sup>4,5,7-9,11,12,17,19,21,27</sup> many (12/25) based their intervention on sexual health in general.<sup>3,6,10,13,15,16,20,22-26</sup> One study each focused on chlamydia or gonorrhoea.<sup>14,18</sup> Follow-up frameworks were relatively short, with six studies providing for follow-up beyond 3 months<sup>5,8,11,13,14,17</sup> and only two continuing follow-up for 12 months after the intervention.<sup>6,14</sup> Both these studies involved web-based campaigns that did not require a recruited cohort of participants.

A large majority of studies used a web-based platform for their intervention ( $n = 16$ ). These web-based interventions ranged from complex, individually tailored, multimedia modules to more simplified educational modules. Five of the studies used SMS platforms,<sup>3,18,22,25,27</sup> including mobile phone messages and web-based instant message services. Transmedia 'edutainment', such as webisodes of a serialised drama, were used in three interventions.<sup>5,10,13</sup> A small number of interventions used social networking sites, often as an accompaniment to a web-based platform or for live chat purposes.<sup>6,7,10</sup> Media variety across multiple platforms (e.g. videos, social media, interactive elements, live chat and

quizzes) was also associated with stronger positive responses from participants and improved outcomes.<sup>4,17,24</sup> Yet, for some studies, the frequency of intervention or online promotion required to generate a response raised issues about transition from research to practice.<sup>14,19</sup> The reinforcement of online interventions through community promotion and engagement was identified as an important consideration.<sup>6</sup>

### *Outcomes*

Specific details related to main outcome measures and sample size are summarised in Appendix 1. In general, outcome evaluation focused on upstream behavioural determinants of infection risk, with an emphasis on knowledge and practice of condom usage. These behavioural attributes ranged from reported actual usage through to self-efficacy of condom use.

Three interventions reported non-significant behavioural outcomes, specifically condom use.<sup>7,22,26</sup> In other studies, Billings *et al.*<sup>17</sup> found that women who enrolled in a web-based multimedia HIV intervention reported an increase in condom use compared with the control group. Another study of a computer-based HIV intervention adapted from an existing evidence-based program<sup>21</sup> reported a higher percentage of condom-protected sex acts compared with the control group, with participants more likely to use condoms consistently for vaginal and oral sex. Similarly, a web-based delivery of a pre-existing evidence-based program<sup>12</sup> led to a significant increase in self-efficacy related to condom usage. Self-reported condom use increased significantly and the number of sexual partners decreased for all participants of a theory-based, tailored intervention<sup>4</sup> from baseline to the 1-month follow-up. However, findings from an SMS-based mobile phone intervention<sup>22</sup> demonstrated that although the intervention group reported higher levels of sexual health knowledge, there was no significant change in STI testing behaviour, improvement in condom use or reduction in partner numbers.

Finally, of the five studies evaluating intervention effects on intention to use condoms, one study reported significant effects due to the intervention.<sup>13</sup> One study delivering an interactive, customisable web-based intervention with and without an educator<sup>7</sup> reported increased intention to use condoms in both study arms. Three of the six studies evaluating the effect of an intervention on attitudes reported significant increases in positive attitudes towards condom use and engaging in safe sex discussions.<sup>10,13,15</sup> Again, Marsch *et al.*,<sup>7</sup> who used an interactive, customisable, web-based program with and without an educator, found that both arms of study reported significantly more positive attitudes towards engaging in safe sex practices.

Of the studies reviewed, outcomes related to knowledge centred on HIV and STI prevention, correct condom use and general sexual preventive health. Of the 12 studies evaluating knowledge-based outcomes, seven<sup>9,12,13,15,21-23</sup> found a significant effect on knowledge relating to HIV, STIs or general sexual health. However, in studies where both the intervention and control arms received relevant education in some form,<sup>7,19</sup> an increase in HIV or STI knowledge was reported equally across both arms. Similarly, in another study in which the control group was offered

standard web-based HIV information compared with a theory-based tailored intervention,<sup>4</sup> there was no significant increase in knowledge despite increases in protective behaviours among the intervention group. Billings *et al.*<sup>17</sup> also found no significant evidence of increased knowledge despite improvements in condom usage.

Six of the 25 studies only considered process outcomes relating to the overall acceptability, feasibility and satisfaction with the intervention.<sup>5,6,8,11,20,27</sup> In all but one study,<sup>8</sup> acceptability and satisfaction with the intervention was rated high. Development of programs via ongoing consultation with and active participation by particular communities also led to greater engagement, acceptability and satisfaction.<sup>6,8,20</sup>

Of the five studies that evaluated the effects of the intervention on well-being, one yielded a statistically significant decrease in levels of worry among those using an SMS or instant messaging service about asking questions concerning reproductive health.<sup>25</sup> Hightow-Weidman *et al.*<sup>4</sup> found a reduction (non-significant) in mean scores on the Center for Epidemiologic Studies Depression Scale (CES-D) among participants in the intervention compared with control group. Likewise, although a study of a live chat intervention delivered via Facebook<sup>9</sup> reported a reduction in depressive symptoms and gay-related concealment behaviours, the effect was not statistically significant, although significant increases in protective behaviours were reported. Another study of a theory-based multimedia intervention<sup>23</sup> reported significant improvements in behaviour and knowledge, but only a small effect size for self-acceptance (e.g. internalised homophobia).

Of the four studies that evaluated sexual communication skills,<sup>15,17,20,26</sup> only one<sup>17</sup> reported a statistically significant increase in sexual communication by participants to assess the HIV risk of partners compared with the control group.

Many (15/25) studies also reported on outcomes related to sexual behaviour, including the number of sexual partners,<sup>12,17,22</sup> the number of unprotected sex acts,<sup>9,12,15,19,21,23,24</sup> sex while under the influence of alcohol or drugs,<sup>9</sup> seeking STI testing<sup>6,14,16,18,22,26</sup> and condom use, including frequency<sup>12,15,17,21,22,26</sup> and self-efficacy.<sup>4,12,15,19,21,26</sup> Twelve studies reported on knowledge-based outcomes, such as improved knowledge and prevention regarding HIV, STIs and general sexual health.<sup>4,7,9,10,12,13,15,17,19,21–23</sup> Attitudes and intentions towards condom use were measured in six studies.<sup>4,7,10,13,15,19</sup> Sixteen studies also considered process outcomes relating to the quality of the interventions, including feasibility, acceptability, usability and participant satisfaction.<sup>3–6,8–11,13,14,18,20,23,25,27</sup> Five studies also considered outcomes relating to well-being, such as sexuality, self-acceptance and levels of worry.<sup>4,9,12,23,25</sup>

Several studies did not report the number of human participants, rather reporting the number of SMS or instant messaging transcripts analysed or the number of website views within a specific time frame.<sup>10,14,25</sup>

## Discussion

The rapid development and uptake of new digital media presents significant potential for influencing health behaviours via health education, social marketing and health promotion

interventions. New digital media have already been used in a range of health contexts, including chronic disease,<sup>28</sup> winter preparedness,<sup>29</sup> general school health,<sup>30</sup> physical activity,<sup>31</sup> substance abuse,<sup>32</sup> mental illness,<sup>32,33</sup> dietary behaviour change<sup>34,35</sup> and breastfeeding.<sup>36</sup> Digital media have also been evaluated for efficacy in enabling health promoting capacity through processes such as information seeking<sup>37</sup> and holistic self-participatory care.<sup>38</sup> Further, these media also have been used in specific disease contexts, such as obesity<sup>39</sup> and breast cancer.<sup>40</sup>

This systematic review focused on the role of new digital media on sexual health knowledge, attitudes and behaviours of 13–24 year olds. The findings reveal a large diversity in intervention designs, settings, populations and evaluation strategies of new digital media in this age group. We believe that this diversity reflects, in part, the expanding range of new digital media available for sexual health promotion in young people. Indeed, as a result of the rapid rise in technology and mobile phone usage over the past decade, new digital media have become popular platforms for reaching young adults, particularly around health-related behaviours. Several key observations emerge from the diversity of research identified in this systematic review.

An interesting observation from our review was that programs that were web-based adaptations of an existing prevention program,<sup>12,19,21</sup> were theory based or had been developed from models of behaviour change<sup>4</sup> appeared effective regardless of the digital media mode used. Although our sample size was small, this was particularly highlighted for interventions tailored for specific groups. Customised messages towards particular audiences enhanced engagement, knowledge uptake and self-reported protective behaviours.<sup>19</sup> The advantages of using a digital platform centred on interactivity with subjects and providing real-time personalised responses to specific needs, risks and concerns. Customisable delivery to many people was an added dimension. The iterative process of the development of programs via ongoing consultation with and active participation by particular communities also led to greater engagement, acceptability and satisfaction,<sup>6,8,20</sup> and was considered integral to successful outcomes. Although intervention delivery across a variety of media platforms was associated with improved outcomes,<sup>4,17,24</sup> some studies noted that the intervention frequency may be integral to successful transition from research to practice.<sup>14,19</sup> In a similar context, community engagement with interventions emerged as an important consideration.<sup>6</sup>

Many interventions evaluated self-reported satisfaction with regard to acceptability or feasibility of programs,<sup>5,6,8,11,20,27</sup> levels of knowledge,<sup>4,7,13,15,17,19,22,23</sup> self-reported numbers of sexual partners<sup>12,17,22</sup> or acts of unprotected sex,<sup>9,12,15,19,21,23,24</sup> self-reported intentions to use condoms or practice safe sex<sup>4,7,13,26</sup> or self-reported use of condoms.<sup>12,15,17,22,26</sup> However, few measured actual group behaviour change, such as testing or service access.<sup>16,18,22,26</sup> Where a control group was used, an intervention effect was often not detected.<sup>7,19</sup> The paucity of intervention effects detected by this review may reflect the inherent difficulty in measuring sexual behaviours objectively. It may also indicate that the short-term follow-up

of most reviewed studies may not allow sufficient time for measurable changes in complex behaviours to have occurred. However, Wakefield *et al.*<sup>41</sup> argue that behaviour change may also occur indirectly, because health messages can set an agenda and increase discussion about a particular health issue within an individual's social environment, which, in combination with individual exposure to the message, may reinforce (or undermine) a specific change in behaviour. This reinforces the need for trials with longer-term follow-up and more erudite methodologies to measure actual sexual risk behaviours.

Significant weaknesses were highlighted for many of these studies, either individually or in combination. These included small sample size, the absence of a control group comparison, a short study follow-up, reliance on self-reported behaviours and consequent recall bias, lack of randomisation, poor baseline measurements, low response rates to follow-up, incidental control group exposure to interventions, a lack of specific outcomes and difficulty in identifying the effective elements of complex interventions. Although these are all limitations common to many health promotion contexts, they nonetheless compound the difficulty of interpreting study outcomes. Further, the complexity of the technology and potential for malfunction, damage or poor access was a significant consideration for some studies.<sup>5,11–13,17,22</sup>

Evaluation was also limited where large broadcast interventions using social networking sites or SMS messaging could only offer aggregated data, restricting more specific analysis of demographic trends.<sup>6,10,13,25</sup> Certainly, some studies addressed this through mixed-methods approaches to assess levels of reach, engagement and interaction.<sup>10</sup>

This systematic review itself has several limitations and potential biases. Studies were limited only to those published in English and, given the focus on young people (aged 13–24 years), many online or digital interventions focusing on predominantly older people were excluded, but may nonetheless be relevant to this age group. Given that this field has emerged only recently, many studies have likely not yet been evaluated or published. Further, the search term 'new media' may not yet be sufficiently ubiquitous to have covered all relevant published studies. The term 'new media' may also lack sufficient precision, given the nature of this rapidly changing communication environment. In the present review, the search term allowed for the inclusion of a wide range of digital platforms embracing the web, social media, mobile communications, video and personal computer. With regard to other search terms, such as 'safe sex' or terms related to contraception, their omission may have excluded relevant papers. Our search was focused on interventions directed at infection prevention and consequently sought to exclude papers related to pregnancy prevention, sexual assault and mental health strategies promoting strengthened sexual identity. We also excluded study protocols in our search criteria. This may have further reduced the range of suitable papers.

The broad range of studies included in this review, with their diversity of methods, populations and objectives, precludes any easily drawn comparisons or conclusions. The small number and large diversity of study designs compromise the stratification of studies to account for samples that were sexually active or inactive, engaged in formal or informal

education, or living in high- or middle- to low-income countries, further weakening contextual analysis.

## Conclusion

This review highlights the broad potential for digital media to enhance health promotion and service delivery towards better sexual health. There is significant scope for these technologies to interact in real time with participants and create customised programs,<sup>16,26</sup> to facilitate networking among participants and health specialists<sup>4,6,9,10,20,25</sup> and to reach large numbers at times and places convenient to the individual.<sup>5,12,13,19,24</sup> Although new media has the capacity to expand efficiencies and coverage, the technology itself does not guarantee success. As with any delivery platform, high-quality, evidence-based content that engages with individual participants is essential. The rapid pace of change with the various digital platforms will create extra challenges for determining best practice. An important challenge for public health is that the rapidity of change may outpace the currency of evaluation and publication, creating a space for many interventions to flourish without solid evidence and for effective interventions to lose relevance. Such challenges compound the need for ongoing and timely research to monitor and evaluate these new trends while not losing sight of the general evidence-based principles that underlie all effective health promotion.

## Conflicts of interest

The authors declare that they have no conflicts of interest.

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**Appendix 1. Summary of studies included in the systematic review**

BART, Becoming a Responsible Teen; CHOP, Children's Hospital of Philadelphia; CT, *Chlamydia trachomatis*; ELH, East Los High; HMP, HealthMpowerment.org; IM, instant messaging; IMB, information-motivation-behavioural; LGBT, lesbian, gay, bisexual and transgender; MCP, mobile cell phone; MSM, men who have sex with men; NGO, non-governmental organisations; QAF, Queer as F\*\*k; QSE, Queer Sex Ed; RCT, randomised control trial; SNS, social networking sites; STI, sexually transmissible infection

Study	Study population, sample size, study design	Intervention	Outcome measures	Evaluation	Results	Limitations (identified by authors of present study)
Billings <i>et al.</i> <sup>17</sup>	USA, 83 African American women (18–50 years); RCT	Computer-based intervention: Safe Sistaah (fully audio-narrated, multimedia online training modules); 45 participants randomly assigned to use intervention within 1 month Control: delayed HIV education; control participants were allowed access to modules upon study completion	Self-reported condom use for the past 60 days (at baseline) or 30 days (at follow-up) Sexual communication (whether they had assessed the HIV risk of their partner) and safer sex intentions (intent to decrease number of partners) HIV prevention knowledge Attitudes about Safe Sistaah were measured at 1-month follow-up	Baseline survey and follow-up survey conducted online or via telephone	Participants assigned to the online HIV behavioural condition were uniformly positive about their overall experience and usability of the program Across the entire study period, women assigned to the intervention condition significantly increased their condom use relative to controls. Relative to controls, women in the intervention group significantly increased their sexual communication across the entire study period ( $F = 5.126$ , $P = 0.027$ ) No evidence that the program was effective at increasing HIV knowledge, safer sex intentions or self-efficacy to refuse unsafe sex	Relied on self-reported condom use Control: delayed HIV education; control participants were allowed access to modules upon study completion Required participants to have access to a computer and Internet
Broadus <i>et al.</i> <sup>3</sup>	USA, African American women (18–25 years), process evaluation: mixed methods (focus group) and quantitative study (survey)	3 focus groups, 45–90 min	Themes identified in focus group discussions regarding advantages and disadvantages of text-based intervention	Thematic analysis of focus group discussion Survey of STI clinic attendees	Convenience, ubiquity, privacy, avoidance of stigma were advantages of the text message-based intervention Significant ( $P < 0.05$ ) changes to potential barriers found for privacy, discomfort discussing sensitive topics and willingness to participate; however, participants identified that learning from others' experience was a benefit of face-to-face	Lack of counterbalancing for order in presentation Some participants in Study 1 may have participated in Study 2 Storyboards in both studies presumed participants would not know each other This was a scenario-based discussion on an intervention, and no actual intervention was delivered

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Appendix 1. (continued)

Study	Study population, sample size, study design	Intervention	Outcome measures	Evaluation	Results	Limitations (identified by authors of present study)
	12 (Study 1)	Participants in focus groups were guided through a storyboard of a face-to-face group intervention and then a text message-delivered intervention based on an evidence-based intervention, SISTA (Sisters Informing Sisters on Topics about AIDS), designed for young adult African American women	Study 2 sought to assess perceptions regarding lack of social privacy, convenience, comfort with sexual topics, benefit of sharing experiences, enjoyment of the intervention and propensity to teach others			
	102 (Study 2)	Survey based on themes identified in focus groups was then delivered to larger group to assess willingness to participate in interventions and preferences for delivery				
Carpenter <i>et al.</i> <sup>24</sup>	USA, 112 young MSM (mean age 26.3 years), RCT	Intervention: participants randomly assigned to online safe sex intervention or control website. The website consisted of seven brief (total 90 min) motivational, informational and skills training modules that used interactive exercises and multimedia Control: a stress-reduction training program customised for young MSM	Self-reported sexual behaviour (reduction in unprotected sex acts)	Usability and acceptability of intervention was evaluated in a pilot test Baseline questionnaire occurred at first login on the site. Once participants completed the tutorials, they were given a satisfaction questionnaire. For follow-up assessment, participants were sent an email reminder 3 months after completion with directions to a site with the questionnaire	Numbers of unprotected acts decreased from baseline to follow-up for both groups for all sexual practices Numbers of unprotected acts with risky partners decreased more for the intervention than control group ( $F = 3.25, P = 0.01$ ) Across all partner types, the control group reported a reduction in sexual risk behaviours comparable to that of the intervention condition	Low rates of participation by minorities and those of lower socioeconomic status (higher HIV risk). No testing of knowledge change

Cornelius <i>et al.</i> <sup>27</sup>	USA, 11 African Americans (mean age 15.4 years), qualitative cohort study	<p>Intervention: adolescents attended seven weekly BART face-to-face sessions, then received daily multimedia text messages (pictures, videos and text messages) for 3 months. Text messages included URL links to education</p> <p>This study was part of a larger study examining the feasibility of HIV prevention intervention using text messaging</p>	Reported perceptions of the MCP-based intervention	Focus group interview	Participants identified ease of use, anonymity, confidentiality and support on demand, regardless of location, as advantages 10 participants identified that they would prefer MCP-based intervention compared with a combination of face-to-face and MCP-based intervention. Participants said they would consider participating in an MCP-based intervention with their parents	Small purposive sample of adolescents already participating in larger text messaging-enhanced project No randomisation
Danielson <i>et al.</i> <sup>12</sup>	USA, 41 African American women (13–18 years)	<p>Intervention: SiHLE#eb (Sistas Informing, Healing, Living, and Empowering), an HIV prevention intervention (adapted for delivery via a web-based platform from the original SiHLE intervention)</p> <p>Pre-existing, evidence-based and culturally tailored HIV/STI prevention program (SiHLE) targeting African American adolescents.</p> <p>Participants were given 30 days to access the site and complete four 1-h interactive, video-based modules.</p> <p>Participants were sent weekly reminders to complete modules</p>	Changes in sexual behaviours (decreased number of new sexual partners), condom use and self-efficacy (self-reported decrease in incidence unprotected sex and increase in consistent and correct condom use), improved partner communication (self-report confidence in discussing partner's STI status)	Baseline survey and 3-month follow-up were completed face-to-face using a questionnaire. Pre-existing, evidence-based and culturally tailored HIV/STI prevention program (SiHLE) targeting African American adolescents. Participants were given 30 days to access the site and complete four 1-h interactive, video-based modules. Participants were sent weekly reminders to complete modules	Nearly two-thirds of the recruited sample (63.40%, $n = 26$ ) completed the full website. Among completers of the website, knowledge improved significantly, and condom use self-efficacy increased significantly ( $P < 0.01$ )	No control group for comparison No examination of acceptability Outcomes measured were mainly knowledge based; problematic because main outcome desired was behaviour change

Appendix 1. (continued)

Study	Study population, sample size, study design	Intervention	Outcome measures	Evaluation	Results	Limitations (identified by authors of present study)
Dowshen <i>et al.</i> <sup>6</sup>	USA, young people (13–17 years)	Intervention: youth-driven social media campaign <i>KnowUsShould2</i> : health behaviour theory based, developed by CHOP Combined traditional print, T-shirts and radio with new media (Facebook, Twitter, Instagram and YouTube), community outreach and partnership	Feasibility to reach youth in target age range through various multimedia and engage them in campaign activities Knowledge about and increase testing for STI/HIV	Tracking website and social media usage throughout campaign using Google Analytics, number of 'Likes', Facebook Insights, number of followers, site visits Online survey of knowledge and attitudes towards STI testing after 9 months from campaign launch Comparison of STI testing rates at family planning clinics during the 1-year period prior to vs 1 year after campaign launch	Approximately 6000 visits to the Facebook page and 1500 youth reached by social media in the first 6 months Facebook recorded 128 'Likes', Twitter had 46 followers, YouTube had 390 views and Instagram had 42 followers Youth input at all phases of development is integral to acceptable messaging Spikes in social media activity increased after community events 104 responses to survey 46% of youth had never tested, but 70% intended to test in the next 6 months Total number of CT tests conducted and positive results did not differ before and after the campaign, but there was a large increase (three- to fourfold) in the proportion of visits at which syphilis and HIV were tested after the campaign ( $P < 0.01$ ) Overall positive participant attitude to testing Overall positive participant attitude to testing STI testing at CHOP family planning clinics increased from 4386 (before campaign) to 4628 during the campaign. The proportion of 13–17 year olds being tested increased	Unable to determine number of unique visits to website Fear of parents finding out about testing, hence low level of 'Likes' or 'followers' Unable to determine whether the campaign changed knowledge Contamination by other programs, campaigns or other factors affecting testing rates Generalisability may be limited given the study took place in a single large urban area Unable to track actual testing behaviour of individuals who participated in the campaign. Data for testing rates from other clinics was not available Unable to tell when the website survey was completed during the visit to the website

Dukers-Muijters <i>et al.</i> <sup>18</sup>	Netherlands, 1072 young heterosexuals (16–25 years), controlled observational study	Intervention: SMS reminder system inviting STI clinic users to retest (3–20 months after initial test). If participant responded, they were sent a free home collection test kit and an extra kit to give to a friend CT-positive indices ( $n = 536$ ) were those who had tested positive for chlamydia at most recent clinic visit. A random selection of CT-negative indices (tested negative) was created to match (sex and age) the positive group	Proportion of test requests among invited participants Samples returned for testing among both invited indices and among indices who requested a test Positivity among tested indices, tested peers and among indices who requested a test	Questionnaire included in test kits sent out	Of 1072 people invited to retest, 34.4% ( $n = 369$ ) requested a test; of these, 55.8% ( $n = 206$ ) retested In total, 21 indices (10.2%) tested CT positive upon retesting. The majority of positives (71.4%, $n = 15$ ) had received extra SMS reminders to request or return the test kit in addition to the initial invitation SMS Acceptance of CT retesting was highest in CT-positive indices ( $P < 0.001$ )	Loss of resources when kits were requested and sent to participant but then never returned. No randomised control group, therefore unable to determine whether SMS and home test is more effective than an approach with no recall It is unknown to what extent retesting was conducted elsewhere
Giorgio <i>et al.</i> <sup>25</sup>	USA, 32 SMS text message and 589 IM conversations; predominantly 18–24 years, process evaluation	Intervention: national sexual and reproductive health hotline accessed through Planned Parenthood Federation of America website through IM service or by sending a SMS text message. Participants interact with live, trained customer service agents	Self-report decreased level of worry Success in reaching target population, whether user characteristics vary by mode (IM vs text), and whether mode is associated with reaching individuals with high levels of worry or reducing worry after chat	Users asked to report how worried they felt about their question. Level of worry was assessed twice: first in the prechat survey and again in the postchat survey	Differences between the IM and text message users reveal that each mode appeals to a different population Among the users who completed the survey, most found this service to be very helpful (61.91%). Levels of worry were lower after chat Results indicated that the SMS texting service was more likely to be used by younger users and racial minorities than the IM service	The IM services attracted far more users than the SMS texting service (27 939 vs 4650 respectively) due to differences in advertising Evaluation was limited to basic demographics, program helpfulness and levels of worry before and after chat
Gold <i>et al.</i> <sup>22</sup>	Australia, 7606 young people (16–29 years), RCT	SMS-based intervention: participants randomised to receive text messages about either safe sex or sun safety fortnightly over a 4-month period	Changes in sexual health knowledge Frequency of condom use Proportion of participants recently seeking testing for STIs	Baseline and follow-up surveys Online questionnaire completed on mobile phone after participants were sent an SMS advertising the survey	Those who received sex messages had higher sexual health knowledge compared with sun group (follow-up only and repeated-measures analysis; $P = 0.05$ )	Inability to distinguish the group to which participants were assigned at baseline Small numbers completed both questionnaires

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<p>Develop theory-based content and features Interactive and personalised features that were clear and concise; too long navigating a site was a deterrent Regular updates of content were important</p>	<p>90% retention rate (22 and 23 in the intervention and control groups respectively)</p>	<p>Participants who used the HMP website reported high levels of user satisfaction and interest and low levels of website difficulty and frustration</p>	<p>Trend to greater behavioural intentions to use condoms and engage in preparatory condom use in the intervention (<math>P=0.10</math>)</p>	<p>Self-reported condom use increased significantly among all participants from baseline to 1-month follow-up</p>	<p>Number of log-ins, knowledge, attitudes and self-efficacy remained the same as in the control group; sexual behaviour risks improved across both groups</p>
<p>Study relied on self-reports of sexual risk behaviour; open to recall bias Only recruited a convenience sample who had Internet access; unable to determine characteristics of those declining to participate and the generalisability of the findings Control group was able to visit a variety of websites, therefore not a uniform group Need to integrate website into mobile communications</p>	<p>Study relied on self-reports of sexual risk behaviour; open to recall bias</p>	<p>Only recruited a convenience sample who had Internet access; unable to determine characteristics of those declining to participate and the generalisability of the findings</p>	<p>Control group was able to visit a variety of websites, therefore not a uniform group</p>	<p>Need to integrate website into mobile communications</p>	<p>Difficulty in accessing reliable data speeds Phones were stolen or damaged; 55 of 161 phones still operating after 1 year</p>
<p>Users felt the site was useful, relevant and filled the void in prevention needs</p>	<p>96.5% of participants in the video intervention group enjoyed watching the video on the cell phone and said videos were easy to access</p>	<p>6-month study with follow-up assessments at 3 and 6 months</p>	<p>Computer log monitors viewing of episodes and streaming errors</p>	<p>Satisfaction with technical performance and experience of watching video on smartphone</p>	<p>Intervention: 12-episode soap opera video series 'Love, Sex, and Choices', streamed to study-provided smartphones</p>
<p>Intervention: novel, theory-based, tailored Internet intervention, HMP, developed for young Black MSM based on integrated model of behaviour incorporating several theories of health behaviour</p>	<p>Key interactive features of site include live chats with HIV expert, interactive quizzes, personalised health and 'hook-up/sex' journals and decision support tools for assessing and modifying risk behaviours</p>	<p>Control: provided a list of five other websites that provide general HIV/STI information</p>	<p>Intervention: 12-episode soap opera video series 'Love, Sex, and Choices', streamed to study-provided smartphones</p>	<p>USA, 238 women (18-29 years), RCT, process evaluation</p>	<p>USA, 50 African American MSM (18-30 years), RCT</p>
<p>Sexual behaviours Intervention satisfaction Intentions Attitudes Condom use self-efficacy HIV/AIDS knowledge Depression Motivation for engaging in safer sexual behaviours in the next 3 months Participants' overall reaction (satisfaction) to the website</p>	<p>Baseline and follow-up surveys (1 and 3 months)</p>	<p>Sexual behaviours Intervention satisfaction Intentions Attitudes Condom use self-efficacy HIV/AIDS knowledge Depression Motivation for engaging in safer sexual behaviours in the next 3 months Participants' overall reaction (satisfaction) to the website</p>	<p>6-month study with follow-up assessments at 3 and 6 months</p>	<p>Computer log monitors viewing of episodes and streaming errors</p>	<p>USA, 50 African American MSM (18-30 years), RCT</p>
<p>Intervention: novel, theory-based, tailored Internet intervention, HMP, developed for young Black MSM based on integrated model of behaviour incorporating several theories of health behaviour</p>	<p>Key interactive features of site include live chats with HIV expert, interactive quizzes, personalised health and 'hook-up/sex' journals and decision support tools for assessing and modifying risk behaviours</p>	<p>Control: provided a list of five other websites that provide general HIV/STI information</p>	<p>Intervention: 12-episode soap opera video series 'Love, Sex, and Choices', streamed to study-provided smartphones</p>	<p>USA, 238 women (18-29 years), RCT, process evaluation</p>	<p>USA, 50 African American MSM (18-30 years), RCT</p>

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Study	Study population, sample size, study design	Intervention	Outcome measures	Evaluation	Results	Limitations (identified by authors of present study)
		Control: 12-weekly text-based HIV risk reduction messages			94.8% reported that using the cell phone made them feel like they were watching the video in privacy, and that it felt good to watch the video on the phone wherever they went 91.4% wanted to continue watching the videos	Video-capable smartphones not readily available Asynchronous audio and video
Kasatpibal <i>et al.</i> <sup>20</sup>	Thailand, 41 MSM (mean age 19 years), process evaluation	Pilot the development of web-based prevention messages for MSM in countries that previously did not have the Internet infrastructure to support such a service	Computer and Internet literacy in seeking information and knowledge Internet access (in terms of difficulty/easiness) Frequency of Internet use	Completed initial survey on website. Completed knowledge and risk surveys at end of study Internet usage monitored throughout Satisfaction levels of participants	Moderate to high satisfaction with site design, content, ease of use, information obtained and benefits from using site. Previous report that it did reduce risk behaviour and increased knowledge MSM involved continuously in design of website to make it relevant and attractive Nurses integral with linking MSM community to web experts	Lack of anonymity Small sample size The results may not be applicable in other locations or with MSMs who are not open about their sexual orientation
Leluti-Weimberger <i>et al.</i> <sup>9</sup>	USA, 41 young MSM (18–29 years), pre-post design	Intervention: live chat intervention delivered on Facebook (MiCHAT), adapted from an in-office motivational interviewing intervention for HIV prevention via live chat Internet delivery to non-treatment-seeking young MSM Eight 1-hour motivational interviewing and cognitive behavioural skills-based online live chat intervention sessions No control group	Condomless anal sex with casual sex (overall and under the influence of drugs/alcohol) Number of days of drug use collected using 30-day timeline follow-back interview. Psychosocial outcomes: participants self-administered several online measures related to the IMB model (motivation to change behaviour, behavioural self-efficacy skills, and gay-related stigma and mental health)	Outcomes of interest were collected using telephone baseline assessment and immediate post-intervention follow-up (~3 months later) Online survey to assess psychosocial characteristics following telephone interview	Participation associated with reduction in drug use in past month, condomless anal sex and sex under the influence of drugs, and increases in knowledge of HIV risks at 3-month follow-up ( $P = 0.05$ ) Overwhelming positive evaluation of program and impact Reported that intervention helped consider their values, health risks and goals No change in motivation or self-efficacy for change	Concerns over privacy and confidentiality contributed to the development of the program Small sample size Lack of control group Longer follow-up assessments were not included, therefore unable to determine durability of intervention effects Moderate effects could be due to pre-post intervention assessments

<p>Reliance on text communication hampered speed of communication for some, lack of non-verbal cues and variability in writing proficiency</p> <p>Findings limited to cross-sectional study</p> <p>Behavioural outcome limited to whether participants ordered an at-home STI testing kit, not other testing behaviours</p>	<p>USA, 1065 sexually active college students (18–26 years), RCT</p>	<p>RCT compared the effectiveness of a tailored web-based STI testing intervention (RU@Risk) with that of a non-tailored educational site (control group). The tailored intervention was designed to incorporate various tailoring tactics, such as personalisation, individualised feedback and content matching, to enhance message relevance. After reviewing the tailored or control website, all participants were given an opportunity to order a free, at-home STI test kit</p>	<p>Topic involvement</p> <p>Perceived risk</p> <p>Perceived personal relevance</p> <p>Attention</p> <p>Elaboration</p> <p>Behavioural intentions</p> <p>STI test kit ordering behaviour</p>	<p>Completion of a pre-test, then randomly assigned to tailored or non-tailored website, completed a post-test, then offered free test kit</p>	<p>Perceived risk of STIs increased from pre-test to post-test only in tailored intervention. Exposure to tailored website increased perceived personal relevance, attention to and elaboration of the message, greater perceived risk of STIs and intentions to get tested. Participants in the tailored website were 1.5-fold more likely to order a test kit</p>	<p>Advertising and promotion of the campaign was limited by budgetary constraints</p> <p>Service generally only received hits when it was heavily promoted during a community outreach event</p>
<p>Mann <i>et al.</i><sup>14</sup></p>	<p>Canada, Ottawa Public Health's Sexual Health Centre website, 15–29 years</p>	<p>Intervention: Internet-based campaign using bilingual, youth-friendly website and texting service 'Get tested Why Not'. Clients download a requisition form for chlamydia and gonorrhoea testing and submit a sample at one of 26 laboratories across Ottawa</p>	<p>Website hits, website traffic, referral sources, number of texting hits, number of requisitions submitted, basic demographic detail, results of pathology testing, referral sources</p> <p>Effects of the campaign on individual knowledge and intended behaviour change</p>	<p>Evaluated at 6 and 12 months after implementation using quantitative and qualitative methods</p> <p>Google analytics</p> <p>Monthly texting reports</p> <p>Sexual Health Centre's client database</p>	<p>In 1 year, 13 385 website hits, 82% were unique visits, 732 hits per month and 104 specimens submitted for chlamydia and gonorrhoea testing</p> <p>57.6% (60) were submitted by target population (15–29 years) and 3.9% were reactive</p> <p>Online survey only answered by 1.3% of visitors</p>	<p>Online survey only answered by 1.3% of visitors</p>

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Appendix 1. (continued)

Study	Study population, sample size, study design	Intervention	Outcome measures	Evaluation	Results	Limitations (identified by authors of present study)
Marsch <i>et al.</i> <sup>7</sup>	USA, 56 substance-using adolescents (12–18 years), RCT	Facebook and Twitter used to build awareness combined with traditional advertising. Launch of sexual health website in Ottawa Public Health's Sexual Health Centre Intervention: participants randomly assigned to intervention or control. Intervention group completed the session with the educator but were also given access to an interactive, customisable web-based HIV prevention program for youth in treatment for substance abuse Control: participants completed a 1-h session with a HIV prevention educator	Improved prevention knowledge Intention to engage in safer sex practices Attitudes about safer sex	True/false questionnaire to assess participants' knowledge Participants were asked to indicate the extent to which they found their prevention intervention useful Completion of surveys pre-intervention as well as post-intervention (1 and 3 months after)	55% ( <i>n</i> = 78) stated they would change their behaviour, 31% would ask a partner to test and 30% would increase their frequency of testing; 9% ( <i>n</i> = 13) heard about the campaign from social media Individuals who received both the educator-delivered and web-based intervention experienced significant increases in HIV/STI prevention knowledge at the initial post-intervention time point with such gains maintained at all post-intervention assessment time points. Both groups reported significant increases in their intentions to use condoms during sex. Both groups reported significant increases in their intentions to limit their number of sex partners. Participants in enhanced condition experienced significantly greater increases in their perception of the importance of carefully choosing sex partner No increases in participants' positive attitudes about condoms	Modest sample size Limited follow-up period

Mevisse <i>et al.</i> <sup>26</sup>	Netherlands, 171 university and college students (18–25 years), RCT	Intervention: tailored web-based intervention guided by theoretical frameworks Intervention customised to communicate personalised risk information Compared with non-tailored intervention (simplified version asking sexual risk questions but no tailored feedback or personalised consultant) and control of no intervention	Risk perception, attitudes, perceived normative beliefs, self-efficacy and intention towards condom use and STI testing Behavioural measures: condom use and STI testing	Cognitive effects assessed directly after intervention. Behavioural effects assessed 3 months later using emailed online survey	Tailored intervention was efficacious in influencing perceived susceptibility to STIs and STI testing intentions immediately after intervention and reducing rates of unprotected sex at 3 months; did not affect testing rates Risk perceptions were higher after tailored intervention but no difference for other cognitive determinants. Attitude, perceived normative beliefs and self-efficacy were relatively high for all groups	Difficult to define target group (i.e. 'early relationship') Unable to control how long people stay on the site, or assess how people interact with site
Mustanski <i>et al.</i> <sup>19</sup>	USA, 102 young MSM (16–20 years), RCT	Intervention: participants completed seven online tailored modules across three sessions of a prevention program, Keep it Up! Module content was developed using the IMB skills model of HIV risk behaviour change Control: accessed HIV-related modules but the control condition included HIV information that was available at the time on many existing websites; it was didactic, not tailored to user characteristics, non-interactive and focused exclusively on HIV/STI facts	Number of unprotected sex acts, condom errors and problems HIV knowledge, and attitudes towards HIV risk and prevention	All online questionnaires Baseline assessment Immediate post-test Follow-up after 6 week booster session 12 weeks post-intervention completion	Both intervention and control were reported as valuable and acceptable to participants. Intervention group had small decrease in rate of unprotected anal sex from baseline to 12-week follow-up, whereas the control group showed increase Both arms showed large increase in HIV knowledge Program positive on both quantitative and qualitative responses Participants' self-reported program helped change behaviours to reduce HIV infection risk	Study design did not identify effective elements of the intervention Participants completed modules under highly controlled conditions, including reminder emails, telephone calls and participant incentives; therefore, difficult to generalise outside of funded clinical trial All outcomes were measured using self-report

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Appendix 1. (continued)

Study	Study population, sample size, study design	Intervention	Outcome measures	Evaluation	Results	Limitations (identified by authors of present study)
Mustanski <i>et al.</i> <sup>23</sup>	USA, 202 young LGBT (18–24 years), mixed methods	Participants recruited via targeted social media Intervention: participants completed QSE, an online, multimedia sexual health intervention consisting of modules (developed using IMB model). Each module ended with a quiz to reinforce learning, not as an outcome assessment	Sexual orientation identity and self-acceptance (e.g. coming-out self-efficacy), sexual health knowledge, relationship variables (e.g. communication skills) and safer sex Number of sexual partners, unprotected vaginal or anal sex acts with all partners and unprotected vaginal or anal sex acts with casual partners Acceptability of and engagement with the intervention	Pre-test and Post-test survey HIV-Risk Assessment for Sexual Partnerships Participant engagement via logged length of time spent on modules Post-test survey ( $\geq 2$ weeks after intervention)	Participant attitudes towards QSE were extremely positive indicating they learned more from this program than in school-based sex education and they appreciated the comprehensive and LGBT-specific approach The largest effect sizes were in the areas of knowledge of sexual functioning, HIV and STIs and contraceptives ( $P < 0.001$ ) On average, participants took 107.8 min to complete the intervention	The study used a pre-post change design rather than an RCT All outcomes were self-reports of knowledge and self-efficacy
Pedrana <i>et al.</i> <sup>10</sup>	Australia, mixed methods process evaluation using an uncontrolled longitudinal study design	QAF is a drama series with health messages delivered through short webisodes posted on Facebook and YouTube with an accompanying online narrative	Level of reach to MSM Increase in knowledge and attitudes Acceptability of and engagement with the intervention	Interviews were conducted face to face Series of focus groups conducted to provide in-depth information on engagement and interaction Combination of evaluation methods (usage statistics, diary scrapbook, focus groups) provided mix of qualitative and quantitative data enabling assessment of reach, interaction and engagement	32 Webisodes attracted over 30 000 views (predominantly 18–54 years) QAF Facebook page by April 2011 has 2929 predominantly male fans Ongoing and increasing participant engagement across the series Majority of participants reported first finding out about QAF from Facebook advertisements QAF Facebook page provided impetus and space for online discussions with peers Content was realistic, relatable and subtle, high-quality production values, edutainment and engaging video drama series. Credibility of content was integral	Usage data not always complete nor raw data provided, thus limiting further analysis or comparison across SNS Small number of participants in the diary scrapbook and focus group Limited resources for detailed quantitative content analysis of QAF Concerns about privacy and the public nature of Facebook

Villegas <i>et al.</i> <sup>15</sup>	Chile, 40 women (18–24 years), prospective cohort study; pre-post test study	Intervention: I-STIPI (Internet-based STI and HIV prevention intervention) website consisted of four online modules	Measure preliminary efficacy on STI and HIV related outcomes (i.e. STI knowledge, attitudes to condoms, condom use, violence in relationships, self-efficacy for STI and HIV prevention, sexual risk taking, risky sex acts)	Two structured online questionnaires: baseline before participation and immediately after participation ~1 month after assessment	Facebook page not visible and webisodes posts did not have engaging additional content Participants said they lost interest after a few episodes Significant increase in STI- and HIV-related knowledge ( $P < 0.001$ ), attitudes towards use of condoms ( $P < 0.05$ ), perceived self-efficacy for STI/HIV prevention ( $P < 0.05$ ) and reduction of risky sexual behaviours with uncommitted partners ( $P = 0.01$ ) No significant difference between baseline and 1 month after baseline in the Traditional Gender Role (TGR) subscale subscale Violence in relationship subscale, and the norms about the use of condoms scale No statistically significant differences in the risky sex acts subscale, the risky anal sex subscale and the intimate partner violence as an STI- and HIV-related risk factor	Pilot study with a small sample that used a pre-post test design (does not control for confounding variables that can affect results of study) Women's self-report could influence results and unable to assess proportion of women who may reject this intervention Use of a convenience sample Lower reliability of two scales (General Knowledge Subscale of the Sexually Transmitted Disease Knowledge Questionnaire and Perceived Self Efficacy for HIV Prevention)
Wang <i>et al.</i> <sup>13</sup>	USA, 202 Latino-Hispanic young people (75% were aged 12–23 years)	Intervention: ELH, a transmedia program designed as edutainment to tackle sexual and reproductive health issues and targeted at Latina adolescents.	Improved viewer engagement in target audience Viewer changes in knowledge, attitudes and behavioural intentions	Analytics tracking assesses audience reach (Google Analytics), a viewer survey to assess narrative engagement, a laboratory experiment with non-viewers of ELH to compare the effect of transmedia edutainment with other forms of narrative presentation	After watching ELH, willingness to be tested for STI/HIV and pregnancy was higher, as was the resolve to recommend testing to others. Half the participants reported learning at least one fact about correct condom use	The analytics tracking data were aggregated; hence, no individual demographic information or actual health-seeking behaviour could be directly attributed to the program

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Study	Study population, sample size, study design	Intervention	Outcome measures	Evaluation	Results	Limitations (identified by authors of present study)
Wingood et al. <sup>21</sup>	USA, 135 African American women (21–29 years), RCT	Viewers watched the 24-episode series on a web streaming site and then 'nudged' to the ELH website to access narrative extensions that presented specific scenarios (e.g. correct condom use), resource pages and directions to local health clinics	Consistent condom use during every episode of vaginal intercourse	Social network analysis and content analysis to understand the social dynamics, message framing and user-generated content on ELH social media presence, and participant observation and in-depth interviews with young Latino couples Participants accessed an embedded online survey on the ELH website (it was promoted on social media)	During the 9 months of tracking (after Season 1), the ELH website attracted 215,964 visits from 123 728 unique visitors, with 870 684 page views and an average of 9.2 min per viewing session All NGO partners with hyperlink on the ELH site noticed increased traffic, especially around episode premiere	Small sample size for laboratory experiment Required high bandwidth Internet access to stream episodes
		Intervention: computer based HIV intervention, SAHARA (a computer-delivered intervention targeting HIV-positive African American women), adapted from Centers for Disease Control and Prevention (CDC)-defined evidenced-based HIV intervention for African American women known as SISTA. Program was guided by social cognitive theory, theory of gender and power Two 60-min interactive computer-based HIV intervention sessions, followed by 15 min small group		3-month follow-up assessment	At 3 months after intervention, participants: • were more knowledgeable about HIV/STI prevention ( $P < 0.001$ ) • reported higher scores on the measure of condom use self-efficacy vs comparison ( $P < 0.05$ ) • reported a higher percentage of condom-protected sex acts vs comparison ( $P < 0.05$ ) • were more likely to use condoms consistently for vaginal sex and were more likely to use condoms for oral sex ( $P < 0.05$ )	Reliance on self-reported data, small sample size, short study follow-up

session implemented by health educator  
 Control group: participants received a 1-h group session consisting of 15 min general health information and 30 min video on importance of HIV prevention for African American women

<p>Ybarra <i>et al.</i><sup>11</sup></p>	<p>Uganda, 366 school students (mean age 16.1 years), RCT</p>	<p>Internet-based CyberSenga sexuality education program                  Intervention: 50% of participants randomly assigned to complete five to six 1-h online tailored education modules over 5 weeks                  Control: participants received no interaction beyond the standard HIV programming offered at the school (no detail given)</p>	<p>Feasibility measured by process measures logged by program staff                  Acceptability measured by quantitative questions in survey and focus groups</p>	<p>Surveys at baseline and 3 and 6 months after intervention                  3-month post-intervention survey included 12 quantitative questions about intervention experience                  Six 1-hour focus groups (intervention participants only) were held to assess overall experience</p>	<p>Feasibility: 95% (<math>n = 173</math>) of intervention participants completed all five modules and only 17% deviated from the intended schedule; 89% of focus group participants mentioned the possibility of accessing the program if it were available online in the future                  Acceptability: at 3-month follow-up, 94% of intervention group somewhat or strongly agreed that they learned a lot, 93% said they were very likely to recommend the program to their friends and 77% somewhat or strongly agreed the program had too many lessons. Most agreed the content was easy to understand (95%) and that they had gained skills to help them keep healthy (95%)</p>	<p>Long-term public access to this program is not yet possible due to poor access to technology (in Mbarara) and software complications                  Most participants did not have an email address and lacked experience creating and remembering passwords                  Intervention delivery affected because of conflicting school and participant schedules</p>
				<p>Some participants reported finding the topics 'disgusting'. More than two in three youths said that the program talked too much about sex and condoms</p>		