



Review article

## Technology-Based Interventions to Reduce Sexually Transmitted Infections and Unintended Pregnancy Among Youth



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### A B S T R A C T

**Purpose:** Technology-based interventions to promote sexual health have proliferated in recent years, yet their efficacy among youth has not been meta-analyzed. This study synthesizes the literature on technology-based sexual health interventions among youth.

**Methods:** Studies were included if they (1) sampled youth ages 13–24; (2) utilized technology-based platforms; (3) measured condom use or abstinence as outcomes; (4) evaluated program effects with experimental or quasi-experimental designs; and (5) were published in English.

**Results:** Sixteen studies with 11,525 youth were synthesized. There was a significant weighted mean effect of technology-based interventions on condom use ( $d = .23$ , 95% confidence interval [CI] [.12, .34],  $p < .001$ ) and abstinence ( $d = .21$ , 95% CI [.02, .40],  $p = .027$ ). Effects did not differ by age, gender, country, intervention dose, interactivity, or program tailoring. However, effects were stronger when assessed with short-term (1–5 months) than with longer term (greater than 6 months) follow-ups. Compared with control programs, technology-based interventions were also more effective in increasing sexual health knowledge ( $d = .40$ ,  $p < .001$ ) and safer sex norms ( $d = .15$ ,  $p = .022$ ) and attitudes ( $d = .12$ ,  $p = .016$ ).

**Conclusions:** After 15 years of research on youth-focused technology-based interventions, this meta-analysis demonstrates their promise to improve safer sex behavior and cognitions. Future work should adapt interventions to extend their protective effects over time.

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### IMPLICATIONS AND CONTRIBUTION

This meta-analysis demonstrates that technology-based interventions can effectively promote sexual health among youth. Compiling data from 16 studies, technology-based interventions were shown to improve condom use, abstinence, safer sex knowledge, and safer sex attitudes and norms. Effects were robust across many factors (e.g., age, gender, and dose) but were stronger with shorter term follow-up.

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**Disclaimer:** The content, interpretations, and conclusions of this study are those of the authors and do not necessarily reflect the views of the National Institutes of Health or the National Science Foundation.

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The risk of unplanned pregnancy and sexually transmitted infections (STIs), including HIV, is high among youth. Youth ages 13–24 comprise nearly half of the 20 million new STI cases and more than 20% of new HIV diagnoses each year in the United States [1,2]. Adolescents and young adults account for 45% of all new HIV infections worldwide [3]. Rates of unintended pregnancy are also elevated among youth, with girls ages 15–19 having higher rates of unintended pregnancy than girls and women in any other age group [4,5]. Further, complications from childbirth

are the second leading cause of death among 15- to 19-year-old girls worldwide [5].

Efforts to provide youth with sexuality education to reduce HIV/STIs and unintended pregnancy have been underway for decades [6,7]. Only recently, however, has a movement emerged toward utilizing technology-based platforms for sexual health program delivery [8–10]. Technology-based interventions have been alternatively referred to as eHealth, mHealth, digital media, or new media interventions, and typically utilize computers, smartphones, text messaging, and/or other web-based platforms. As digital tools have become increasingly accessible and sophisticated in their functionalities, many researchers have heralded the promise of technology-based interventions to improve sexual health [8–10]. Compared with traditional interventions, new media approaches may allow for broad reach at relatively low costs, improved fidelity during intervention delivery, greater privacy and comfort for teens learning about sensitive topics, and increased capacity for individually tailoring prevention messages [11,12]. Additionally, such tools may provide fruitful means for engaging today's digitally native youth, among whom the ubiquitous use of technology plays a central role in key developmental tasks [13,14].

The promise of new media tools has prompted a recent proliferation of technology-based interventions targeting sexual health among youth. Although recent systematic reviews have highlighted potential impacts and limitations of these interventions [15–17], little is known regarding their combined efficacy. Determining whether and through what mechanisms technology-based interventions promote youth sexual health is critical, as such knowledge can inform future interventions and justify the allocation of resources to their development.

To date, there have been only three published meta-analyses across adolescent and adult populations that provide insights into the efficacy of technology-based interventions for sexual health. The first meta-analysis focused on interventions to reduce HIV infection and included 12 randomized controlled trials published between 2002 and 2008 with participants of any age [18]. This study found a small but significant overall increase in condom use among participants who completed a technology-based intervention compared with those who were randomized to a control group, with an effect size that was comparable with similar in-person interventions ( $d$  across studies = .26). These effects were stronger when interventions included individualized tailoring (i.e., materials matched to the needs of specific participants) and had a greater number of sessions. The second meta-analysis focused exclusively on programs employing computer-based administration, finding that such interventions were effective in improving sexual health knowledge, sexual self-efficacy, safer sex intentions, and safer sexual behavior among adolescents and adults [19]. The third meta-analysis identified significant effects of new media interventions for increasing condom use and STI testing within nonclinical populations [20]. Importantly, this meta-analysis found that interventions produced the largest effect sizes when they targeted female adolescents [20].

Despite these preliminary findings, at least three critical gaps inhibit our ability to draw conclusions about the overall efficacy of technology-based sexual health programs for youth. First, there are currently no meta-analyses focused exclusively on youth, even though youth are at heightened risk of unplanned pregnancies and STIs [3,4,21,22] and are also some of the most frequent users of new media technologies [13,23]. Second, no meta-analyses have included abstinence as a behavioral outcome.

Abstinence can be a developmentally appropriate objective of comprehensive sexuality education—particularly in programs targeting early adolescent populations. Third, prior meta-analyses and systematic reviews of technology-based sexual health programs have only included studies published through 2014 [15,16,18–20,24]. Given the rapidly changing landscape of technology and the many new interventions introduced each year, an updated review of the literature is warranted.

Thus, the goal of this meta-analysis is to synthesize the growing literature on technology-based sexual health interventions among youth ages 13–24 and to determine their overall efficacy on two key behavioral outcomes: condom use and abstinence. Additionally, we will examine a number of secondary outcomes identified as important components of safer sexual decision-making within health behavior theories [25] that have guided many intervention efforts in this area. These outcomes include safer sex attitudes, norms, self-efficacy, behavioral intentions, and sexual health knowledge. Finally, we will examine whether characteristics related to the intervention recipients (age, gender, country) or the intervention design (delivery method, use of tailoring, program interactivity, follow-up duration) moderate the effectiveness of technology-based interventions on sexual health outcomes.

## Methods

### Search strategy

We conducted a comprehensive search of *Medline*, *PsycINFO*, and *Communication Source* databases to extract relevant studies published through May 2017. We used the following combination of key words, with asterisks used as “wild cards” to find any variations: (*adolescen\** or *teen\** or *youth* or *middle school* or *high school*) AND (*sexual health* or *safe\* sex* or *sex\* education* or *sexually transmitted disease* or *sexually transmitted infection* or *STD* or *STI* or *HIV* or *AIDS* or *pregnancy* or *reproductive health* or *condom\** or *contracept\** or *protected sex* or *unprotected sex*) AND (*intervention* or *program* or *education* or *trial*) AND (*technology* or *internet* or *web-base\** or *computer-base\** or *online* or *social media* or *social network\** or *SNS* or *eHealth* or *mHealth* or *electronic health* or *mobile health* or *texting* or *text messag\** or *digital media* or *new media* or *gaming* or *SMS* or *mobile phone* or *cell phone* or *phone app\** or *Facebook* or *Twitter* or *Instagram* or *instant message* or *web 2.0* or *media 2.0*). Additional studies of potential relevance were located by examining prior reviews and meta-analyses [15–20,24]. We also examined the reference lists of all included articles to search for additional studies. This search produced an initial 1,932 scientific articles.

### Selection criteria

Studies were included if they met the following criteria: (1) focused on youth between ages 13–24 (i.e., mean sample age 13–24 and no participant older than 29); (2) utilized technology as the primary mode of delivering an HIV/STI or pregnancy prevention intervention (studies that utilized technology but also included extensive in-person components were excluded [26,27]); (3) included a behavioral outcome measure of either condom use/unprotected sex (referred to as “condom use” in this paper; the effect sizes for unprotected sex were recoded so that the direction of effect always indicated greater protection) or abstinence/delayed intercourse (referred to as “abstinence”); (4) evaluated

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