Electronic Media and STI Prevention

9

Cornelis A. Rietmeijer and Mary McFarlane

Introduction

The past 15 years have seen an incredible growth in the number of people worldwide who have access to the Internet whether through fixed or mobile devices. By the end of the first decade of the new millennium, the large majority of Americans were online in one way or another while the number of people living in developing countries are increasingly gaining access as well, mostly through the use of mobile telephones. The digital divide, meaning the discrepancy in access to the Internet and mobile telephony across social, demographic, and geographic strata, still exists but is rapidly closing. In a 2010 survey among adults in the USA, the Pew Research Center found that 80% of white, non-Hispanic adults used the Internet compared to 69% of blacks and 66% of Hispanics [1]. Conversely, Hispanics are leading whites in the use of mobile phone technology. In 2011, more than 87% of English-speaking US Hispanics owned a cell phone, vs. 80% of non-Hispanic whites. Another Pew study found that, compared to the general American population, Hispanics use their cell phones more often, and they use more features on their phones [2]. In developing countries the use of the Internet and mobile telephones is also rapidly increasing. In 2010, approximately 11% of African adults used the Internet. While considerably lower than the US, there has been a 25-fold increase of Internet use in Africa between 2000 (4.5 million users) and 2010 (111 million users), by far the fastest growth in the world [3].

Simultaneously, another shift has taken place. Originally the Internet was mostly a large repository of information that could be tapped in increasingly clever ways, but the transfer of information was mostly unidirectional, i.e., from the World Wide Web to the end user. In the past 10 years, though, the Internet has become a two-way street, where the uploading of (personal) information has become at least as important as the downloading of data. This has set the stage for the formation of online social networks on websites like MySpace, Facebook, Twitter, YouTube, as well as professional networking sites like LinkedIn, and closer to the STI field, STD Prevention Online (www.stdpreventiononline.org). The efficient way provided by the Internet to allow people to reach other people for a virtually endless range of purposes, may have

C.A. Rietmeijer, M.D., Ph.D., M.S.P.H. (✉)
Rietmeijer Consulting LLC
533 Marion Street, Denver, CO 80218, USA
e-mail: kees@rietmeijer.us

M. McFarlane, Ph.D.
Division of STD Prevention, Centers for Disease Control and Prevention, 1600 Clifton Rd., NE, MS E-02, Atlanta, GA 30333, USA

S.O. Aral, K.A. Fenton, and J.A. Lipshutz (eds.), *The New Public Health and STD/HIV Prevention: Personal, Public and Health Systems Approaches*, DOI 10.1007/978-1-4614-4526-5_9,

both negative and positive implications for public health. Thus, worries about the Internet facilitating sexual relationships and propagating sexually transmitted infections (STI), including HIV transmission, as well as the contrasting enthusiasm to use the new media as a highly efficient tool for STI/HIV prevention and care could have been anticipated from the beginning.

The purpose of this chapter is four-fold: (1) to provide an updated overview of the scientific literature that has covered the Internet as an environment for STI/HIV risk, prevention and care; (2) to place the major findings from this literature in an explanatory context; (3) to propose avenues for future research and development of innovation at the interface between electronic media and the prevention and care of STI/HIV; and (4) to suggest the role of new technologies in shaping a new approach to public health.

Risk

The use of the Internet for sexual purposes has been well established. While statistics have been difficult to verify, some estimate that the Internet accounts for US$ 2.5 billion in pornography sales annually and is an increasingly important component of the overall pornography industry [4]. Globally, there are an estimated four million pornographic Websites (about 12% of all Internet sites) and over 25% of Internet searches are for pornographic material. More than 25% of US men and over 10% of women admit to using *work* computers to view pornography on the Internet [5]. Of course, viewing sexual explicit material whether online or offline does not cause transmission of STIs and since watching porn predominantly leads to masturbation, it could even be considered "safe sex." Perhaps this is why, published despite its extensive use, there has not been much in terms of scientific exploration of pornography in relation to STI risk or prevention.

However, pornographic sites or social networking sites can also be used to find sex partners and the use of the Internet for this specific purpose has been the topic of intense research interest ever since a string of syphilis infections was linked to an online sexual network and published in a major medical journal [6]. Since then, numerous studies have been published about online sex seeking and associated risks for STI and HIV transmission, particularly among men who have sex with men (MSM) [7–11]. The general conclusion from these studies appears to be that the Internet may act as a risk-enhancing environment for two reasons: first, people who have Internet partners are more likely to engage in high risk sex acts and second, the efficiency of finding sex partners online increases the absolute number and potential concurrency of sex partners. In terms of the Anderson–May equation [12] both the "β" and "c" factors are increased with consequent effects on R_0. Moreover, even if sex with Internet partners would be equally protected as sex with offline partners (i.e., β stays the same), the absolute number of sex acts and thus the number of unprotected sex acts would increase, and with that the increased risk for STI/HIV transmission.

However, there have been considerable limitations to the early studies. Importantly, some of the studies showing higher risks among MSM who had online partners had as comparison groups MSM who did not have such partners. Thus, to the extent that lower-risk MSM were over-represented in the latter group, having online partners may have simply been a marker for high-risk behaviors and not necessarily a cause [13, 14]. Subsequent studies that examined online versus offline risk behaviors among MSM who had both types of partners, painted a more nuanced picture. A study from the UK, for example showed that HIV positive men who met other positive men online were more likely to engage in unprotected anal intercourse than HIV positive men who met other positive men offline (see discussion on serosorting below). However, regardless of HIV serostatus, MSM were just as likely to have unprotected anal intercourse with partners met online or offline if these partners were serodiscordant or of unknown HIV status [15]. Similarly, a more recent study from the USA showed no association between unprotected anal intercourse and source of partner recruitment, offline or online, among MSM recruited in bars and other gay venues as part of the National HIV Behavioral Surveillance System. While MSM

reported slightly higher levels of unprotected anal intercourse with online partners, this association disappeared after controlling for multiple (online and offline) partnerships. Furthermore, men reported higher levels of risk with serodiscordant partners met offline than with partners met online, but this finding was limited to men who reported both online and offline partners [16].

Most of the studies on the relationship of Internet sex seeking and STI/HIV risk have investigated (self-reported) risk behaviors but not actual STIs, and most of them have focused on MSM. While some studies have found a relationship between history of STIs and online risk behaviors [17, 18], there is only one published study to date that has assessed the prevalence of gonorrhea or chlamydia in relation to both recent and longer term histories of online partnering among visitors of an urban STI clinic—and did not find any association for MSM. Interestingly, while internet sex partnering was far less common among heterosexual men and women in this study, there was actually a lower risk for prevalent STIs among heterosexual men and women who reported online sexual partnerships [19]. Explanations for this preventive effect include the possibility that the formation of online partnerships may include more or less intensive communications including risk negotiations before an offline, in-person contact is made. Conversely, typical offline venues such as bars, parties, and bath houses may not be conducive to such negotiations [20]. That these types of negotiations do not invariably result in higher levels of protected sex is illustrated by a special case of sexual behavior negotiation: (HIV) serosorting. Serosorting can be defined as making decisions about protected or unprotected sex based on the (perceived) concordant HIV serostatus of the sex partner. Studies indicate that the Internet may facilitate serosorting, and Internet sex partnering may be particularly common about HIV-infected persons who are looking for seroconcordant partners [21, 22]. Serosorting among HIV-negative persons may be problematic because seronegativity among prospective sex partners cannot be taken for granted, as it depends on when the last negative HIV test occurred and on the veracity of self-reported status. Among HIV seropositive persons, these factors may be less of an issue and serosorting in this group may more likely result in "true" seroconcordant relationships. Foregoing protection in such relationships may be defended on the basis that no further HIV transmission occurs and serosorting as an effective public health prevention strategy is currently under debate [23–25]. Still, there is concern that serosorting among HIV positive persons may result in superinfection with other (potentially resistant) HIV strains and also in transmission of other STIs [25]. In fact, the current epidemic of syphilis among MSM may in part be the result of HIV serosorting.

While the use of the Internet as a communication tool has predominantly taken off among older adults, the use of text messaging is the medium of choice among adolescents and young adults. According to a recent survey by the Pew Research Center's Internet and American Life Project, 75% of 12–17-year-olds in the USA own cell phones and 72% of all adolescents (88% of cell phone users) use text messaging regularly. Texting is by far the most common form of communication among teens: 54% contact friends daily via text messaging compared to 38% who call on a cell phone, 33% who talk face-to-face, and 11% who send an e-mail. A typical teen in this study sends about 50 texts a day. After texting, the sharing of photos is the most popular feature of cell phone contacts. However, teens also experience negative effects of texting, including being bullied or harassed (26% of respondents). A small proportion (4%) of respondents admitted to "sexting," i.e., sending sexually explicit texts or photos; however, 15% reported to have received "sexts" [26]. As with sex seeking on the Internet, there is considerable concern about sexting and some have even considered legislation against it [27]. However, there are no studies to date that link sexting to sexual risk behaviors and STI transmission. Indeed, in a recent study among young Hispanic women, Ferguson found no evidence that sexting behaviors (reported by 20% of the sample) were associated with other high-risk sexual behaviors [28].

So, what is one to conclude? Does the Internet enhance risk behaviors, is it equivocal to risk behaviors, or might it indeed reduce risks, at least for some? One way out of this conundrum may be to see online sex seeking and sex partnering as a complex behavior with both potential risk increasing and risk reducing consequences. The problem is that the studies to date do not provide the level of detail needed to help us better understand online sex partnering. To the extent that online partnering is becoming increasingly common, not only among adolescents and young adults, but increasingly so among older adults, especially those recently divorced or widowed, more research is clearly needed to inform not only potential risks, but also the potential benefits of online partnering and ways that interventions may be developed to lower the former and boost the latter.

Prevention

With the recognition of the Internet as a potential risk environment for HIV/STI risk behaviors came the realization that this emerging risk "venue" could also be used to target prevention messages to those engaging in risky behaviors online. Over the past decade, numerous interventions have been deployed that can be broadly divided in two categories: (1) creation of prevention-oriented Websites that draw potentially at-risk people into education and other prevention activities; and (2) outreach into Websites where online partnering is occurring, e.g., chat rooms of sex-oriented Websites. Generally, the challenge of the former approach is to entice and engage high-risk individuals into meaningful risk reduction activities on Websites that many and perhaps the most at-risk individuals have little incentive to visit. The challenge of the second approach is to negotiate the fine line between gaining access to sex-seeking Websites in a sufficiently unobtrusive way that such presence will be tolerated by site patrons and owners while still offering sufficiently effective interventions to have an impact on risk-taking behaviors.

In their simplest form, prevention Websites, whether stand-alone or in conjunction with other services (e.g., STI clinic or family planning Websites) offer information on HIV and STIs and ways to prevent these infections such as safer sex and regular testing. There are numerous Websites that could serve as examples, including the public Websites of the Centers for Disease Control and Prevention (www.cdc.gov/nchstp) and the American Social Health Association (www.ashastd.org). These sites are generally well-maintained, regularly updated and relatively easy to navigate. However, the information stream is one-directional, there is little or no targeting of information to the individual requesting the information, and the focus of the sites is generally on the provision of information rather than individual-level prevention. Yet, the development of the Internet in recent years, especially its potential for interactivity, has promised the possibility of developing online interventions using the unique characteristics of the Internet, including its ability to quickly process a large amount of data and to execute complex algorithms resulting in a virtually endless array of possible outcomes. For example, to the extent that offline research, including Project RESPECT, had shown that individualized prevention plans based on a person's unique sexual history result in reductions in risk behavior lowering the incidence of subsequent STIs [29], the development of an online version of such an intervention that would create highly individual intervention plans based on computer algorithms driven by an online self-administered questionnaire was technically possible. The fact that this process could be entirely automated with costs largely limited to up-front development coupled with the virtually unlimited reach of the Internet, added to the appeal to develop such interventions. Moreover, a number of computer-based (but not online) interventions had demonstrated technical feasibility as well as efficacy in terms of behavioral modification, including condom use following the intervention [30].

However, there have been relatively few randomized studies of interactive online prevention

interventions and the results have been mixed [31]. For example, preliminary results from a study among MSM in the Netherlands, showed efficacy in changing self-reported behaviors among men who were exposed to tailored messages based on computer algorithms when compared to control conditions [32]. An early US-based study also showed some efficacy, but the retention of study subjects in the study was too low to allow the authors to arrive at meaningful conclusions [33]. Retention of samples recruited online has been a challenge in other studies as well and is one of the major impediments in online research. However, retention was good in a more recently published US-based randomized intervention study among 650 MSM, demonstrating a modest, borderline statistically significant reduction in unprotected anal intercourse among men exposed to the highly interactive online intervention after 3 months, but no lasting intervention effect after 12 months [34]. Another, smaller study among MSM demonstrated risk reduction in both intervention and control conditions, however, greater risk reduction with high-risk partners in the online intervention group [35]. An online randomized controlled trial among youth showed very slight increases in social norms supporting condom use behaviors among an online recruited sample but not in a clinic-recruited sample. However, no behavior change in terms of actual increased condom use was observed in this study [36]. HIV testing behaviors among MSM were enhanced in yet another online intervention trial [37], and an intervention among MSM by Bowen et al. demonstrated the short-term efficacy on behavioral predictors, including knowledge, self-efficacy and outcome expectations immediately after the online risk reduction intervention and 1 week later. Finally, a randomized controlled online intervention among MSM in Hong Kong did not show any efficacy [38].

While to date, we are not aware of any of the above-described interventions that have been sustained beyond the study phase, outreach interventions in chat rooms and other sex-seeking environments have been implemented and are ongoing in a number of places (including the popular gay Websites ManHunt and Adam-for-Adam) despite the fact that the efficacy of such interventions has not been studied. The genesis of these interventions, however, is different in that they have mostly originated from health departments extending their HIV/STI partner notification efforts online rather than an academic interest into the development and evaluation of innovative behavioral interventions on the Internet. The foray of health departments' partner notification efforts onto the Internet was prompted by the resurgence of syphilis and other STIs among MSM in the mid-1990s when risk behaviors increased as the perceived threats associated with HIV infection decreased—an unintended side effect of the HAART revolution. As described earlier, the syphilis resurgence was also linked to finding sex partners online and since these partners were mostly anonymous except for their chat room pseudonym (also known as "handler"), outreach into chat rooms was initiated to trace these "pseudonymous" partners [39]. Chat room outreach may go beyond simple partner notification and could include engaging visitors to chat rooms into one-on-one discussions of HIV risks and safer sex. However, as briefly alluded to above, chat room outreach is a delicate enterprise as workers engaged in such interventions must constantly be aware not to overstep their boundaries and jeopardize their presence on the site. To assist the online outreach worker in negotiating the many pitfalls of working in this environment, the National Coalition of STD Directors (NCSD) has issued a set of useful Internet STD/HIV prevention guidelines [40]. Nonetheless, a number of studies suggest that Internet outreach is effective for partner notification [41–44] and anecdotal information suggests there may be benefits for behavioral prevention as well. For example, a recently published study from New York demonstrated that Internet partner notification led to an 8% increase in the overall number of syphilis patients with at least one treated sex partner, 26% more sex partners being medically examined and treated if necessary, and 83% more sex partners notified of their STD exposure [39]. Furthermore, this type of "field work" may be particularly

efficient since a single worker can serve a number of Websites simultaneously without having to leave the office. Indeed, as suggested elsewhere, there are no technical limitations to centralizing these services and offering them across state lines, thus further enhancing the efficiency of this approach [45].

An innovative approach to online partner notification has been the stand-alone, fully user-driven inSPOT Website (www.inspot.org). Initially developed in response to the resurgence of syphilis among MSM, the site later expanded to include other STIs and risk populations beyond MSM. This program allows persons diagnosed with or suspected to have an STI to contact their partners by sending them an "e-card" (electronic post cards) specifying the STI they may have been exposed to, with or without the sender's identifying information. E-card recipients are then encouraged to attend STD clinics or other health-care providers for evaluation, diagnosis, and treatment. When promoted in the media, the Website has been shown to draw considerable attention and motivate the sending of e-cards [46]. However, recently published data from two STD clinics, one a randomized controlled trial [47], the other a survey-based study [48], have raised doubt about the program's effectiveness in these settings.

Short messaging service (SMS), a.k.a text messaging on mobile phones is increasingly used for the purposes of STI/HIV prevention. Examples include communication between providers and patients, partner notification, and sexual health promotion and education. While many programs appear to have used SMS/text messaging effectively, few of them have been rigorously evaluated [49, 50]. Still, some studies have shown the effectiveness of text messaging as a reminder system for anti-retroviral therapy [51, 52] and human papillomavirus immunization [53], but not for contraception adherence [52, 54]. SMS reminders were also shown to increase HIV/STI re-testing among HIV-negative MSM [55]. Finally, a recently published randomized study from Australia demonstrated efficacy of an SMS-based intervention to enhance STI knowledge and testing, but no effect was seen on condom use [56].

Care/Services

Online Testing

The introduction of nucleic acid amplification testing (NAAT) for chlamydia and gonorrhea infections in the mid-1990s heralded a revolution in STI control. Where, in the past, specialized clinics were needed to conduct invasive and unpleasant procedures to obtain specimens from the cervix or urethra for chlamydia and gonorrhea culture, NAAT allowed for the testing of urine and self-obtained vaginal or penile specimens that were much less invasive and could be conducted in a variety settings, including the privacy of one's own home. Over the past 15 years, the new testing technologies have allowed for the testing of many more people for chlamydia and gonorrhea and detect many more infections. Indeed, the continued increase in reported chlamydia infections in the US and Europe is probably still due to the increased use of NAAT in settings where chlamydia screening has only recently been introduced rather than a true increase in incidence [57].

The exponential use of the Internet for a virtually unlimited variety of services has led to the development of online STI testing programs. Researchers at Johns Hopkins University should be credited for pioneering in this area with the "I Want The Kit" program (www.iwantthekit.org). This program allows interested individuals to go online and order self-testing kits. After submitting the specimens via mail to the laboratory, they receive chlamydia, gonorrhea, and trichomonas test results within a week and are referred to local clinics for treatment, should any of the tests be positive [58]. A program similar to "I Want the Kit" is the "I Know" campaign targeting young women in the Los Angeles area (www.dontthinkknow.org) since 2007 [59]. A large-scale online chlamydia testing program was also recently conducted in the Netherlands, involving over 10,000 men and women [60].

These and other online testing programs have clearly demonstrated a proof of concept: people respond to these campaigns, they order kits, most receive results, and the majority of them

will get treated if they are found to be positive. Moreover, these people are not just the "worried well"—the chlamydia positivity rate found in these programs is actually quite high and comparable to the rates found among asymptomatic patients in STD clinics. For example, the "I Want the Kit" program reports 13% chlamydia positivity rates among men [61] and 10.3% among women [58]. A somewhat lower rate (8%) was found among women participating in the "I Know" campaign [59].

However, despite the innovative nature of these programs and considerable expenses incurred in program development and marketing, the overall yield in terms of absolute number of tests submitted and number of chlamydia cases diagnosed is still limited. For example, the "I Know" campaign reported 1,286 tests and 108 chlamydia cases diagnoses during 9 months of the campaign, or approximately 144 positive tests on an annual basis, which represents less than 1% of the 55,000 cases reported for the entire Los Angeles jurisdiction. These limited results occur against the backdrop of substantial expenses for campaign development and implementation and despite great enthusiasm of project staff. A cost-effectiveness analysis of the "I Know" campaign estimated a cost of over $600,000 per quality adjusted life year (QALY) saved, considerably more than the $50,000/QALY that is generally considered cost-effective [59].

To be fair, it could be argued that once the websites are built and the logistics of sending and receiving kits and test results are in place, the marginal cost of each additional test will be falling. However, we also know that the "build it and they will come" slogan does not necessarily hold for online testing; without ongoing and costly marketing and advertising, demand will quickly reduce to a trickle (Denver Public Health, unpublished observation). Yet, there are a number of potential advantages to the concept of online testing that may yet prove to assist with cost-effective scale-up of the intervention. First, since a single Web-based program can be accessed everywhere, there is, at least in theory, no reason why these programs need to be replicated in each STI prevention jurisdiction. A single national Website could function as well as, and probably better than, a large array of similar programs at the state level. Similarly, there is no need to involve a multitude of laboratories in an online testing program. Once a specimen is in the mail, for the purposes of sample integrity or programmatic logistics, it does not matter much whether the sample is shipped locally or across state boundaries. So, only involving one or few labs is theoretically possible and would substantially increase efficiency since a large volume of specimens would allow for economies of scale, and the training of only a few people dedicated to the program would enhance program quality as well. Finally, marketing and advertising could be centralized and easily included with existing national STI awareness campaigns, like the "Get Yourself Tested" campaign that is launched annually in the US as part of the April STD Awareness Month. In summary, there is proof of concept for online testing programs, but the tipping point for arriving at the status of a viable national STI prevention strategy may only be reached if inherent characteristics of the intervention are fully exploited [62].

Technological Advances in the Clinical Setting

While the real-world feasibility and effectiveness of many innovative online STI prevention programs have yet to be established, closer to home, the use of Internet technologies in the clinical environment, especially the development and implementation of browser-based and Internet-connected electronic medical records (EMR) is rapidly demonstrating its practical applicability. It is true that electronic medical record systems are not always very user-friendly and often involve a steep learning curve, especially for staff not used to working with computers or the Internet. Also, off-the-shelve EMR products are often built with billing in mind and may not meet the specific demands of a public health clinical environment. Yet, there are many advantages to a browser/Web-based system, a number of which will be reviewed below. Foremost, a real-time

electronic clinical management system through internal error checks and algorithm-based prompts can greatly enhance the quality of data collection and thus the quality of care delivered. This would include the basics of appropriate clinical examination, diagnosis and treatment, but systems can also be revised to accommodate the inclusion of new clinical protocols that traditionally take considerable time to be fully implemented due to slow clinician uptake. For example, at the Denver Metro Health Clinic (DMHC), prompts were included in the EMR recently to support the implementation of expedited partner therapy (EPT) resulting in a rapid increase in providers offering EPT to eligible partners [63].

Interfacing the EMR with the Internet allows for a number of additional benefits, including real-time connections to other online systems, such as laboratory services and automated transmission of reportable STIs from the clinic to the reporting jurisdiction, not only significantly shortening the reporting time lapse but also avoiding transcription errors and saving considerable clerical time. At DMHC an interface was built to provide STI test results online, currently used by approximately 50% of clients and saving additional clerical time [64]. Finally, a high-quality EMR facilitates program monitoring and evaluation and also allows for effectiveness research. For example, the Safe in the City study, involving over 38,000 patient records across the three participating study sites [65], could not have been conducted at the Denver site without the EMR. Similarly, the Denver STD clinic EMR, in place since 2005, was instrumental in establishing the effectiveness of EPT in reducing chlamydia and gonorrhea re-infections [66].

Closing Comments

The purpose of this book is to examine an integrated view of personal and public health aspects of, and approaches to, STI/HIV prevention in developed country settings, incorporating systems issues that include the use of technologies discussed in this chapter. One of the corollaries of this view is a shift in the STI/HIV prevention research paradigm from one that focuses on efficacy of interventions in a specialized environment, to one that emphasizes the applicability of interventions in the real world setting of compounding public health problems and public health needs. In the context of effectiveness, an intervention's feasibility, efficiency and reach (scale) are key characteristics. The Internet and the increasing use of mobile media offer great promises for all three and it is somewhat frustrating that we have not made greater strides in online prevention offerings beyond their proof of concept. In the closing paragraphs of this chapter, we therefore examine some of the underlying reasons for our seemingly slow progress and offer some suggestions for future interventions and research using the Internet and other electronic media.

First, STI/HIV prevention interventions, however nicely packaged, are not likely to attract much attention from those visitors on the Internet who are not concerned about their risk for STIs. Also, STI risk perception and subsequent behavior change is dependent on cues, for example the development of genital symptoms or having a partner with an STI. In this context it is important to consider that behavioral interventions that have been shown to be effective in reducing STI incidence, such as Project RESPECT [29] and Safe in the City [65], have been conducted in the STI clinical setting. Not only do persons recruited from STI clinics have higher STI risks (and thus an intervention effect may be easier to measure), but also they are acutely aware of their risk, thus creating a "teachable moment"; in terms of the Transtheoretical Model [67], they are "ready for action" to reduce risk behaviors. However, once the crisis subsides, so will the readiness to take action. Thus we cannot assume that once we build our online interventions that everybody will flock to our Websites and will engage in STI risk reduction activities. Rather, we should start to think to bring the interventions to places where at-risk individuals might go to find information. For example, to the extent that it is likely that they would land at information sites developed by CDC or the American Social Health Association, these sites could be expanded to

include online intervention programs. Videos form an attractive media that can be produced at relatively low cost (given their reach), have been shown to be effective in high-risk settings [65, 68, 69], and are very popular among teens and young adults. Moreover, in an online environment, they may be selected from a video repository based on automated interactive, risk-based algorithms [36].

As it has proven difficult to develop a large reach for primary STD/HIV prevention interventions online, it is appealing to use large-scale online programs that reach adolescents and young adults, especially on popular social networking sites like Facebook, Twitter, and YouTube. Parenthetically, as this is a rapidly changing field, new networking sites may gain in popularity where others are fading. Consequently, future characteristics and reach of these sites will undoubtedly dictate developments of future online public health interventions. Nonetheless, many STI/HIV prevention programs and organizations have a presence on the most popular sites, yet their effectiveness remains to be determined. Specific risk-reduction interventions have also been developed in these environments and are currently undergoing evaluation (SS Bull,—personal communication). We may also find partners who have an established presence in these environments. Consider for example, Kicesie's Sex Ed [70] a YouTube site posting "vlogs" (video logs) on a variety of sexual health topics. According to YouTube site statistics, these vlogs have been viewed an astounding 298 million times. Collaborations between such sites and STI prevention programs might provide the reach and scale the former has and the latter needs [71]. In this context, it is important to note that the popularity of this Website is in part due to the focus of its contents on sex-positive messages, rather than sexual diseases. Currently, in the STI and HIV prevention field, there is an ongoing discourse on shifting the emphasis from reduction of sexual risk (individual behavior focus) to the promotion of sexual health (population norm focus) [72, 73]. This important offline discourse may prove to have major implications for online STI prevention. In a broader sense, this discourse lives in the context of an ever-evolving and increasingly domineering electronic technological environment that redefines how people learn and think about STIs as well as how public health addresses them.

Acknowledgments The Internet and STD Center for Excellence is supported by the Association for Prevention Teaching and Research (APTR) and the Centers for Disease Control and Prevention (CDC)—APTR/CDC COOPERATIVE AGREEMENT Grant TS-1400.

References

1. Internet and American Life Project 2011 http://www.pewinternet.org/Static-Pages/Trend-Data/Whos-Online.aspx. Accessed 31 May, 2011.
2. Hispanics lead U.S. embrace of mobile technology 2011 http://www.pewinternet.org/Media-Mentions/2011/Hispanics-lead-US-embrace-of-mobile-technology.aspx. Accessed 31 May 2011.
3. Internet World Stats 2011 http://www.internetworldstats.com/stats.htm. Accessed 31 May 2011
4. Internet Pornography Statistics 2006 http://internet-filter-review.toptenreviews.com/internet-pornography-statistics.html. Accessed 30 May 2011
5. The tangled web of porn in the the office. In: Newsweek; 2008.
6. Klausner JD, Wolf W, Fischer-Ponce L, Zolt I, Katz MH. Tracing a syphilis outbreak through cyberspace. JAMA. 2000;284:447–9.
7. Bull SS, McFarlane M. Soliciting sex on the Internet: what are the risks for sexually transmitted diseases and HIV? Sex Transm Dis. 2000;27:545–50.
8. McFarlane M, Bull SS, Rietmeijer CA. The Internet as a newly emerging risk environment for sexually transmitted diseases. JAMA. 2000;284:443–6.
9. Liau A, Millett G, Marks G. Meta-analytic examination of online sex-seeking and sexual risk behavior among men who have sex with men. Sex Transm Dis. 2006;33:576–84.
10. McFarlane M, Bull SS, Rietmeijer CA. Young adults on the Internet: risk behaviors for sexually transmitted diseases and HIV(1). J Adolesc Health. 2002;31:11–6.
11. McFarlane M, Kachur R, Bull S, Rietmeijer C. Women, the Internet, and sexually transmitted infections. J Womens Health (Larchmt). 2004;13:689–94.
12. May R, Anderson R. Transmission dynamics of HIV infection. Nature. 1987;326:137–42.
13. Rietmeijer CA, Bull SS, McFarlane M. Sex and the internet. AIDS. 2001;15:1433–4.
14. Rietmeijer CA, Bull SS, McFarlane M, Patnaik JL, Douglas Jr JM. Risks and benefits of the internet for populations at risk for sexually transmitted infections (STIs): results of an STI clinic survey. Sex Transm Dis. 2003;30:15–9.
15. Bolding G, Davis M, Hart G, Sherr L, Elford J. Gay men who look for sex on the Internet: is there more HIV/STI risk with online partners? AIDS. 2005;19:961–8.

16. Jenness SM, Neaigus A, Hagan H, Wendel T, Gelpi-Acosta C, Murrill CS. Reconsidering the internet as an HIV/STD risk for men who have sex with men. AIDS Behav. 2010;14:1353–61.
17. Daneback K, Mansson SA, Ross MW. Using the Internet to find offline sex partners. Cyberpsychol Behav. 2007;10:100–7.
18. Elford J, Bolding G, Sherr L. Seeking sex on the Internet and sexual risk behaviour among gay men using London gyms. AIDS. 2001;15:1409–15.
19. Al-Tayyib AA, McFarlane M, Kachur R, Rietmeijer CA. Finding sex partners on the internet: what is the risk for sexually transmitted infections? Sex Transm Infect. 2009;85:216–20.
20. Rietmeijer CA, Lloyd LV, McLean C. Discussing HIV serostatus with prospective sex partners: a potential HIV prevention strategy among high-risk men who have sex with men. Sex Transm Dis. 2007;34:215–9.
21. Grov C, DeBusk JA, Bimbi DS, Golub SA, Nanin JE, Parsons JT. Barebacking, the Internet, and harm reduction: an intercept survey with gay and bisexual men in Los Angeles and New York City. AIDS Behav. 2007;11:527–36.
22. Berry M, Raymond HF, Kellogg T, McFarland W. The Internet, HIV serosorting and transmission risk among men who have sex with men, San Francisco. AIDS. 2008;22:787–9.
23. Snowden JM, Raymond HF, McFarland W. Seroadaptive behaviours among men who have sex with men in San Francisco: the situation in 2008. Sex Transm Infect. 2011;87:162–4.
24. Eaton LA, Kalichman SC, O'Connell DA, Karchner WD. A strategy for selecting sexual partners believed to pose little/no risks for HIV: serosorting and its implications for HIV transmission. AIDS Care. 2009;21:1279–88.
25. Meeting Summary: "Consultation on Serosorting Practices among Men who Have Sex with Men" 2009 http://www.cdc.gov/hiv/topics/research/resources/other/serosorting.htm. Accessed 30 May 2011
26. The New Centrality of Mobile Phones:How adolescents text & talk with friends and how that compares with other forms of interpersonal communication. 2011. http://www.pewinternet.org/Presentations/2011/Mar/~/media/Files/Presentations/2011/Mar/SRCD_Teens_Texting_talking_w_Friends_033111_pdfLenhart.pdf. Accessed 31 May 2011.
27. Illinois lawmakers send sexting bill to governor. 2010. http://articles.chicagotribune.com/2010-04-27/news/ct-met-sexting-bill-0428-20100427_1_sexting-lieutenant-governor-quinn-spokesman-bob-reed. Accessed 31 May 2011.
28. Ferguson CJ. Sexting Behaviors Among Young Hispanic Women: Incidence and Association with Other High-risk Sexual Behaviors. The Psychiatric quarterly 2010.
29. Kamb ML, Fishbein M, Douglas Jr JM. et al. Efficacy of risk-reduction counseling to prevent human immunodeficiency virus and sexually transmitted diseases: a randomized controlled trial. Project RESPECT Study Group. JAMA. 1998;280:1161–7.
30. Noar SM, Black HG, Pierce LB. Efficacy of computer technology-based HIV prevention interventions: a meta-analysis. AIDS. 2009;23:107–15.
31. Chiasson MA, Hirshfield S, Rietmeijer C. HIV prevention and care in the digital age. J Acquir Immune Defic Syndr. 2010;55 Suppl 2:S94–7.
32. Davidovich U, De Wit J, Stroebe W. Using the Internet to reduce risk of HIV infection in steady relationships. A randomized controlled trial of a tailored intervention for gay men. Amsterdam: Roel & Uitgeefprojecten; 2006.
33. Bull SS, Lloyd L, Rietmeijer C, McFarlane M. Recruitment and retention of an online sample for an HIV prevention intervention targeting men who have sex with men: the Smart Sex Quest Project. AIDS Care. 2004;16:931–43.
34. Rosser BR, Oakes JM, Konstan J, et al. Reducing HIV risk behavior of men who have sex with men through persuasive computing: results of the Men's INTernet Study-II. AIDS. 2010;24:2099–107.
35. Carpenter KM, Stoner SA, Mikko AN, Dhanak LP, Parsons JT. Efficacy of a web-based intervention to reduce sexual risk in men who have sex with men. AIDS Behav. 2010;14:549–57.
36. Bull S, Pratte K, Whitesell N, Rietmeijer C, McFarlane M. Effects of an Internet-based intervention for HIV prevention: the Youthnet trials. AIDS Behav. 2009;13:474–87.
37. Blas MM, Alva IE, Carcamo CP, et al. Effect of an online video-based intervention to increase HIV testing in men who have sex with men in Peru. PLoS One. 2010;5:e10448.
38. Lau JT, Lau M, Cheung A, Tsui HY. A randomized controlled study to evaluate the efficacy of an Internet-based intervention in reducing HIV risk behaviors among men who have sex with men in Hong Kong. AIDS Care. 2008;20:820–8.
39. Ehlman DC, Jackson M, Saenz G, et al. Evaluation of an innovative internet-based partner notification program for early syphilis case management, Washington, DC, January 2007-June 2008. Sex Transm Dis. 2010;37:478–85.
40. National Guidelines for Internet-based STD and HIV Prevention 2008. http://www.stdpreventiononline.org/index.php/resources/detail/277. Accessed 30 May 2011.
41. CDC. Internet use and early syphilis infection among men who have sex with men. MWR Morb Mortal Wkly Rep 2003;52:1229–32.
42. CDC. Using the Internet for partner notification of sexually transmitted diseases--Los Angeles County, California, 2003. MMWR Morb Mortal Wkly Rep 2004;53:129-31.
43. Mimiaga MJ, Fair AD, Tetu AM, et al. Acceptability of an internet-based partner notification system for sexually transmitted infection exposure among men who have sex with men. Am J Public Health. 2008;98:1009–11.

44. Hogben M, Kachur R. Internet partner notification: another arrow in the quiver. Sex Transm Dis. 2008;35:117–8.
45. Rietmeijer CA, McFarlane M. STI prevention services online: moving beyond the proof of concept. Sex Transm Dis. 2008;35:770–1.
46. Levine D, Woodruff AJ, Mocello AR, Lebrija J, Klausner JD. inSPOT: the first online STD partner notification system using electronic postcards. PLoS Med. 2008;5:e213.
47. Kerani RP, Fleming M, Deyoung B, Golden MR. A Randomized, Controlled Trial of inSPOT and Patient-Delivered Partner Therapy for Gonorrhea and Chlamydial Infection Among Men Who Have Sex With Men. Sex Transm Dis. 2011;38:941–6.
48. Rietmeijer CA, Westergaard B, Mickiewicz TA, et al. Evaluation of an Online Partner Notification Program. Sex Transm Dis. 2011;38(5):359–64.
49. Lim MS, Hocking JS, Hellard ME, Aitken CK. SMS STI: a review of the uses of mobile phone text messaging in sexual health. Int J STD AIDS. 2008;19:287–90.
50. Swendeman D, Rotheram-Borus MJ. Innovation in sexually transmitted disease and HIV prevention: internet and mobile phone delivery vehicles for global diffusion. Curr Opin Psychiatry. 2010;23:139–44.
51. Kelly JD, Giordano TP. Mobile phone technologies improve adherence to antiretroviral treatment in a resource-limited setting: a randomized controlled trial of text message reminders. AIDS. 2011;25:1137.
52. Pop-Eleches C, Thirumurthy H, Habyarimana J, et al. Mobile phone technologies improve adherence to antiretroviral treatment in a resource-limited setting: a randomized controlled trial of text message reminders. AIDS. 2011;25:825–34.
53. Kharbanda E, Stockwell M, Fox H, Andres R, Lara M, Rickert V. Text message reminders to promote human papillomavirus vaccination. Vaccine. 2011;29:2537–41.
54. Hou M, Hurwitz S, Kavanagh E, Fortin J, Goldberg A. Using daily text-message reminders to improve adherence with oral contraceptives: a randomized controlled trial. Obstet Gynecol. 2010;116(3):633–40.
55. Bourne C, Knight V, Guy R, Wand H, Lu H, McNulty A. Short message service reminder intervention doubles sexually transmitted infection/HIV re-testing rates among men who have sex with men. Sex Transm Infect. 2011;87:229–31.
56. Lim MS, Hocking JS, Aitken CK, et al. Impact of text and email messaging on the sexual health of young people: a randomised controlled trial. J Epidemiol Community Health. 2012;66(1):69–74.
57. Prevention CfDCa. Sexually Transmitted Disease Surveillance 2009. Atlanta: Department of Health and Hiuman Service; 2010.
58. Gaydos CA, Dwyer K, Barnes M, et al. Internet-based screening for Chlamydia trachomatis to reach non-clinic populations with mailed self-administered vaginal swabs. Sex Transm Dis. 2006;33:451–7.
59. Kerndt P, Rotblatt H, Papp J, Gift TL. "I Know:" Combining Home Testing Technology, Social Marketing, & Lessons From E-Commerce to Fight Chlamydia & Gonorrhea Disparities Among Young Women In: 2010 STD Prevention Conference. Atlanta; 2010.
60. Greenland KE, Op de Coul EL, van Bergen JE, et al. Acceptability of the Internet-Based Chlamydia Screening Implementation in the Netherlands and Insights Into Nonresponse. Sex Transm Dis. 2011;38(6):467–74.
61. Chai SJ, Aumakhan B, Barnes M, et al. Internet-based screening for sexually transmitted infections to reach nonclinic populations in the community: risk factors for infection in men. Sex Transm Dis. 2010;37:756–63.
62. Online STI Testing—Moving Beyond the Proof of Concept. 2011. http://www.stdpreventiononline.org/index.php/blog/edit/817.)
63. Mickiewicz TA, Al-Tayyib AA, Mettenbrink C, Rietmeijer CA. Implemetation of an Expedited Partner Therapy (EPT) Program in an Inner-City STD Clinic in Denver, CO. In: 19th Meeting of the Interational Society for STD Research. Quebec City, Canada; 2011.
64. Ling SB, Richardson DB, Mettenbrink CJ, et al. Evaluating a Web-Based Test Results System at an Urban STI Clinic. Sex Transm Dis. 2010;37(4):259–63.
65. Warner L, Klausner JD, Rietmeijer CA, et al. Effect of a brief video intervention on incident infection among patients attending sexually transmitted disease clinics. PLoS Med. 2008;5:e135.
66. Mickiewicz TA, Al-Tayyib AA, Mettenbrink C, Rietmeijer CA. Use and Effectiveness of Expedited Partner Therapy in an Inner-City STD Clinic In: 19th Meeting of the International Society for STD Research. Quebec City, Canada; 2011.
67. Norcross J, Krebs P, Prochaska J. Stages of change. J Clin Psychol. 2011;67:143–54.
68. O'Donnell LN, Doval AS, Duran R, O'Donnell C. Video-based sexually transmitted disease patient education: its impact on condom acquisition. Am J Public Health. 1995;85:817–22.
69. O'Donnell L, San Doval A, Duran R, O'Donnell CR. The effectiveness of video-based interventions in promoting condom acquisition among STD clinic patients. Sex Transm Dis. 1995;22:97–103.
70. Kicesie's Sex Ed. 2011. http://www.youtube.com/user/kicesie?blend=1&ob=5. Accessed 1 June 2011.
71. Blogging and You-Tube: Homegrown Internet Education 2010. http://cdc.confex.com/cdc/std2010/webprogram/Paper21656.html.
72. Swartzendruber A, Zenilman J. A national strategy to improve sexual health. JAMA. 2010;304:1006.
73. Sexual Health. 2011. http://www.cdc.gov/sexualhealth/. Accessed 20 October 2011