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Digital Sexually Transmitted Infection and HIV Services Across Prevention and Care Continuums: Evidence and Practical Resources

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Abstract

Increased demand for sexual health services (including prevention and treatment) have spurred the development of digital STI/HIV services. Earlier advances in testing technologies opened the door for self-testing and self-sampling approaches, in line with broader self-care strategies. Advances in HIV management mean that many people are living well with HIV and no longer need intensive in person monitoring, while those at-risk of HIV are recommended to have regular asymptomatic STI screening and pre-exposure prophylaxis. This narrative review examines the evidence and implications of digital STI/HIV services, focused on promoting testing, facilitating testing, clinical management and referrals, partner services, and prevention. We have used a prevention and care continuum to structure the review to increase utility to policy as well as practice. Digital STI/HIV services can be interwoven into existing clinical pathways to enhance face-to-face services or standalone digital STI/HIV services. A growing evidence base, including randomized controlled trials and observational studies, should help inform strategies for designing effective digital STI/HIV services. However, most studies to date have focused on high-income countries and people with smartphones, despite a substantial burden of STI/HIV in low and middle-income countries. There are also important differences between digital STI and HIV services that require careful consideration. We discuss digital STI/HIV service evidence and implications to inform research and programs in this exciting field.

Keywords: STI, HIV, digital, social media, e-health, m-health, clinical

Introduction

A person can visit a website, complete a brief survey instrument, and then be advised about self-testing or self-sampling for appropriate sexually transmitted infections. Then a mailed self-test kit allows the person to test themselves and interpret the result, all from the comfort of their home. This could then provide the basis for an online automated consultation, collection of antibiotics from a community pharmacy, and refer sex partners into the health system. Although this collection of digital health services may sound like fiction, pilot programs and a growing evidence base support digital STI services.(1, 2) For the purposes of this review, we define digital health as "the field of knowledge and practice associated with the development and use of digital technologies to improve health."(3) This includes mHealth, eHealth, artificial intelligence, and related big data approaches.(3) Online STI services can be standalone or they can operate as an extension of a physical clinic. Digital tools can also be used to make face-to-face services more effective and create new ways of engaging people with testing, wider prevention interventions and clinical care, including facilitating partner notification. In the context of sexual health, this includes STI clinics sending text messages to patients, software and hardware to spur healthy behaviors, remote photographic diagnosis, symptoms checkers, online treatment, and related online STI projects.

Several factors have catalyzed this shift. First, self-testing and self-sampling have decentralized diagnostics so that testing can be provided outside of health facilities.(4) Self-testing refers to a process in which a person collects their own samples (usually swab, urine, or blood) performs the diagnostic test and interprets their result in a place of their choice (e.g., home, clinic, work, or elsewhere). In self-sampling, the person collects their own

sample (usually swab, urine, or blood) and sends it to a laboratory for processing.(5) Second, increased usage of digital technologies in daily life combined with advances in the technologies themselves such as expanding digital algorithms (e.g., machine learning(6)), technologies (e.g., mobile phone applications(7)), and services (e.g., USSD, unstructured supplemental service data) have created possibilities for wholly online care. Alongside these technological trends are more supportive legislation and policies to facilitate digital services.(3) Third, digital approaches can reduce STI/HIV stigma,(8) highlighting the potential for greater population coverage. Fourth, the expansion of HIV pre-exposure prophylaxis (PrEP) has generated increased demand for associated STI testing.(9) Fifth, conventional STI clinics have been closed or limited in scope during the COVID-19 pandemic with patients encouraged to use available online services.(10) In many settings, people living with HIV have been encouraged to avoid in-person attendance. In some cases, this has accelerated existing research on digital approaches to optimizing STI services as alternatives to face-to-face care.(11)

Digital STI services have been introduced to meet different aims, including driving demand for essential STI services, reaching individuals who choose not to use in person facilities, and to increase service efficiency by decreasing uncomplicated visits to in-person services in an attempt to reduce costs. They may also be able to reach individuals who cannot reach in-person facilities, including people in remote rural areas, people with disabilities, and people who do not have access to transportation. At the same time, digital services could exacerbate existing inequities by creating barriers for people with low health literacy or others,(12) underlining the importance of considering these issues when planning and implementing new digital services.

Previous reviews of digital sexual health services have focused exclusively on HIV,(1) pre-dated the COVID-19 pandemic,(2, 13, 14) focused on specific populations,(15, 16) or focused on specific technologies.(17) Within a special issue of *Sexual Health*, this narrative review examines the evidence and implications of digital STI/HIV services, focused on promoting testing, facilitating testing, clinical management and referrals, partner services, and prevention. Where appropriate we reference national and professional body guidance and recommendations. We also make recommendations about priority areas for research and remaining challenges ahead in the digital STI service development process.

Methods

We used a narrative rather than a scoping or systematic review for the following reasons: there was substantial heterogeneity in the types of interventions and measured outcomes; there were marked differences in operational definitions across studies; and there was limited research for some key populations. We searched PubMed, Google Scholar, CINAHL using search terms “digital”, “social media”, “HIV” “STI”, “e-Health”, “mHealth”, and “STD.” We were substantively interested in reviewing the evidence for STI services, but have included information about HIV services where appropriate. We included low, middle, and high-income country settings but we only searched in the English language and limited our included articles to English language studies.

We have structured this review according to a prevention and care continuum because many public sector STI services use similar organizational categories,(18, 19) it aligns with WHO and UNAIDS metrics, and is relevant to many STI clinical contexts. Here we will focus on

engagement (including testing promotion), testing, clinical management and referrals, partner services, prevention, and surveillance. Each of these respective sections includes evidence from systematic and scoping reviews, best practice guidelines, and practical open access resources. We prioritized evidence from systematic reviews and randomized controlled trials over other types of evidence. At the same time, given the sparse literature in many fields, we included single studies where relevant.

Results

Engagement with STI services (including STI testing)

Can digital tools engage those at risk for STIs? Engagement refers to a set of bidirectional opportunities for health workers and local community members to communicate.(20) Engagement with STI services specifically focuses on education and awareness activities to generate demands for STI services, especially testing services. STI engagement activities could be entirely digital, entirely in-person, or a digital/in-person hybrid.(21) Engagement strategies use text messages, social networking mobile phone applications, user support groups, and websites to increase awareness of STI services (e.g., preventive and therapeutic services available).

One systematic review found that mobile phone applications increased sexual health knowledge and sexual health service use among adolescents, but found few studies and observed substantial heterogeneity.(22) Another systematic review found that crowdsourcing) facilitated HIV community engagement in online and in-person settings.(24) Crowdsourcing has a group of people solve all or part of a problem and then share solutions with the public (23). Crowdsourcing approaches include open calls, hackathons, and related

153 participatory events. In the context of HIV engagement, crowdsourcing can provide a formal
154 mechanism for stakeholder consultation, end-user involvement, public judging, and other
155 critical elements (23). A review of digital media interventions for sexual health promotion
156 among youth also found increases in knowledge related to HIV prevention.(15)

157

158 Several open access resources and guidance documents exist. The United States Centers for
159 Disease Control and Prevention have open access resources and best practice guidelines on
160 social marketing communications.(25) The UNAIDS/AVAC Good Participatory Practice
161 Guidelines provides suggestions for enhancing HIV community engagement that are relevant
162 to digital approaches.(26) The growing evidence base suggests that digital tools can enhance
163 STI and HIV engagement with STI services, increasing knowledge and promoting awareness
164 of STI testing options.

165

166 *Digital STI testing*

167 How can digital STI services be used to enhance access to STI/HIV testing and what is their
168 effectiveness? Digital technologies have been used to expand access to STI testing through
169 self-sampling (e.g., HIV, syphilis, gonorrhea, chlamydia, human papillomavirus),(27-29) and
170 self-testing (e.g., HIV,(30-32) syphilis,(33-35) and hepatitis C virus(36)). Digital tools cover
171 a range of functions of varying degrees of complexity and sophistication, including booking
172 appointments at STI clinics, ordering test kits , identifying people who would most benefit
173 from testing (triaging), conducting online sexual health consultations, verifying completion of
174 self-testing kits, referring people to access facility-based services, and provision of STI test
175 results.(2) In resource-limited settings, USSD (unstructured supplementary service data) has
176 been used to promote self-testing and confirm test uptake.(37)

There is growing evidence to support the use of digital approaches to increase the uptake of HIV testing. One systematic review found moderate certainty of evidence (two randomized controlled trials, two observational studies) to support digital crowdsourcing methods to develop interventions that increase HIV testing compared to conventional approaches.(38) A scoping review of qualitative studies(40) and scoping review of quantitative studies (31) demonstrates that crowdsourcing approaches can enhance HIV test uptake. A systematic review found moderate certainty of evidence that text messages increased sexual health testing compared to conventional messages (e.g., print messages, clinic education).(17) Two randomized controlled trials found that digital interventions to facilitate online self-testing increased HIV, syphilis, chlamydia, and gonorrhea test uptake.(32, 41) A systematic review found that digital interventions to support HIV self-testing were feasible, acceptable, and often preferred compared to conventional services.(42)

Several open access resources and best practice documents can help to inform digital STI testing services. The WHO/SESH/SIHI practical guide on crowdsourcing for health and health research provides practical advice on organizing crowdsourcing activities(23) and is accompanied by a TDR consensus statement(43) and systematic review.(38) Public Health England created a user guide for e-sexual health services which also provides practical advice on organizing self-sampling through the internet.(44) The British Association of Sexual Health and HIV released guidance on STI self-sampling packs and processes(45) and online sexual health provision more broadly.(46) The American Sexually Transmitted Diseases Association created a position statement on direct to consumer STI testing services.(47) One Welsh report examined the relationship between digital technology and health

inequalities.(12) There is strong evidence, policy support, and open access resources outlining how digital tools can facilitate HIV self-testing.(48) A growing evidence base suggests that syphilis self-testing,(49) HCV self-testing, and other STI self-sampling could be useful adjuncts to traditional care in some settings.(4)

Digital STI services for clinical management and referral

How have digital STI services been used in STI clinical management and referral pathways and what is their effectiveness? Digital approaches have been used to increase access and adherence to a range of commonly used drugs, ranging from preventive drugs (e.g., pre-exposure prophylaxis, PrEP, among people at risk for HIV infection) to therapeutics (e.g., anti-retroviral therapy among people living with HIV infection). One UK study provided a digital pathway for management of people with chlamydia which included an online automated consultation and electronic prescribing enabling people to collect antibiotics at a pharmacy without needing to present to conventional clinical facilities.(50) This research was based on a clinical decision-making algorithm. Mobile phone text message medication reminders can increase adherence to ART.(51) Digital PrEP systems could allow an individual to determine PrEP eligibility, initiate STI self-testing and self-sampling, and provide clinical consultation related to PrEP initiation. Several pilots have been developed that integrate PrEP initiation and digital technologies.(52)

Digital technologies have also been used to facilitate linkage to HIV services following diagnosis. One study from rural South Africa suggested that mobile phone–connected HIV testing and web-based clinical care and prevention pathways have the potential to support access to HIV prevention and care, particularly for young people and men.(53)

Several systematic reviews have examined digital interventions to enhance ART adherence among people living with HIV. One Cochrane systematic review(51) and a subsequent systematic review(54) found that scheduled short message service (SMS) text messages can increase ART adherence compared to conventional approaches. In contrast, there is much less evidence concerning use of digital interventions within STI treatment.

Digital approaches and partner services

How can digital interventions enhance partner services and what is the evidence of their effectiveness? Digital interventions can enhance partner services by assisting index patients to notify their partners (either personally or anonymously via text message or email) and facilitating sex partner management.(55) This could include providing test results notification or providing postal self-testing or self-sampling kits to partners.

Several studies have examined the effectiveness of digital partner service interventions. A narrative review from this special issue provides a summary of evidence on partner services, including digital approaches. One single study showed that prototype mobile phone applications may enhance partner notification and testing.(56) The US Centers for Disease Control and Prevention provide a toolkit for digital partner services(57) and National Coalition of STD Directors in the United States created guidelines for internet-based partner services.(58) A modest evidence base suggests that digital tools may enhance HIV partner services, but less research and programs exist for other STIs.(55) Further research and programs are needed in this area.

Digital approaches for STI prevention (vaccination)

How have digital approaches been used to increase uptake of vaccines for the prevention of STIs and what is their effectiveness? Digital methods have been used to increase human papilloma virus and HBV vaccinations. Some of the strategies identified below could be relevant to other STI vaccines which may be developed in the next decade (e.g., gonorrhea, chlamydia, syphilis). Vaccine promotion must negotiate the complex digital communication environment, especially misinformation and anti-vaccine sentiment from diverse groups.(59) There is an extensive literature on how social media has been used to amplify HPV vaccine hesitancy, sew confusion, and decrease HPV uptake.(60, 61) One single study found that artificial intelligence can be used to examine social media discussions about HPV vaccines, with this analysis of HPV vaccine-related Twitter discussions demonstrating that social media data can inform public health communication and education programs to improve HPV vaccination rates .(62)

There is less evidence about the use of digital tools to support HPV vaccination. One systematic review examined how social media interventions enhance HPV vaccination services using an implementation science framework.(63) Another systematic review assessed attitudes, beliefs, and knowledge from social media studies on HPV vaccination.(64) The World Health Organization created HPV vaccine communication considerations with a strong focus on digital media.(65) While some pilots have examined digital tools to increase HBV vaccination,(66) there is relatively less evidence. For example, a randomized controlled trial of a crowdsourced digital intervention included hepatitis B vaccination as a secondary outcome.(66)

Few studies and programs have used digital tools for STI prevention. The limited data available for HPV suggest that harms associated with social media are substantial and need to be consider in implementing digital HPV interventions.

Health economic evaluation of digital sexual health care

Is digital sexual health care good value for money? Although online services are often assumed to represent better value for money than more traditional modes of care delivery, there has been very little robust health economic evaluation. Individual components of care pathways may well be cheaper when delivered digitally as they tend to shift tasks from a clinician-led to a self-managed process with accompanying reduction in health care professional time and health system costs. However, it is important to evaluate health system costs in the context of whole care pathways; whilst it may be cheaper to diagnose asymptomatic infections using self-sampling in place of clinician obtained samples, if it takes more resource for the service to achieve adequate downstream outcomes such as index patient treatment or partner notification success, the net costs may be greater than traditional care. Further complexity arises as online services tend to generate new demand for testing and a shift of activity between services. One analysis found that online STI testing increased the number of STI tests, increased the overall cost of testing, and decreased the average cost per diagnosis.(67) The article by Gibbs et al. in this issue provides more in-depth perspectives on health economic evaluation of digital sexual health services.

Digital sexual health and health inequalities

How do digital sexual health care interventions affect health inequalities? Health inequalities are systematic differences in health outcomes for people occupying different positions in society.(68) STIs and HIV are socially patterned and disproportionately affect those already experiencing health inequalities, especially people marginalized based on race, gender, socio-economic disadvantage, and disability. In parallel, people from these groups may experience barriers accessing health care due to stigma and geographical inaccessibility of existing services.

Digital health interventions could be a useful tool in addressing some of these barriers and have potential to increase access to sexual health care. However, unless they are implemented in an inclusive way,(69) digital interventions could reinforce existing barriers and inadvertently widen the digital health divide.(12, 70) This is because the ability to engage effectively with digital services often requires access to an internet-enabled device, sufficient bandwidth, and digital literacy to navigate self-management pathways.(71)

Within sexual health, there is limited evidence on the impact of digital sexual health care interventions and health disparities. Some digital crowdsourcing interventions have been designed to increase participation from women, ethnic minorities, and other under-represented groups.(72-74) At the same time, several studies suggest that socio-economically disadvantaged groups have lower uptake of online STI testing,(75, 76) while other studies have not reported social gradients in online testing.(77) Work from the United Kingdom among people with mild learning difficulties highlighted considerable barriers to kit use and sample collection.(78) These inequalities highlight the need for legal, ethical, and human rights research to better understand the broader context of digital STI interventions.(79)

Research priorities

Although digital services show considerable promise, gaps in the evidence base make it challenging to determine what types of digital interventions will work for whom and in which circumstances. First, there is a need for usability research that explicitly involves the end-user in the research process. Co-creation and related engagement of end-users has been shown to be effective in the development of many digital health interventions(80) and advocated by a Lancet commission on Governing Health Futures.(81) Second, cost-effectiveness research and costing studies more broadly are needed to determine the circumstances in which digital interventions could be good value for money. Often digital interventions require substantial resources to develop and sometimes digital interventions assume ownership of a smartphone or other device. Research using low-cost platforms for analogue phones are needed to spur innovation focused on low-income users. Third, there is a need for legal and ethical research to consider how digital services impact health disparities. Finally, our data suggest that many digital tools have been developed for HIV and not applied to STI services. For example, although digital HIV self-testing has been widely used and is mentioned in World Health Organization guidelines, far fewer studies and programs have examined digital syphilis / other STI self-testing approaches.

Our review has several limitations. First, we only included guidelines that could be identified through a narrative review according to our specified criteria. A systematic review on the topic would likely identify more guidelines and best practice statements but would likely encounter difficulties with the volume of disparate literature. This is particularly important for the identification of guidelines created in low and middle-income country contexts.

Second, our review excluded non-English language studies. While there is support for this approach from empirical studies,(82) this also privileges high-income country research. Third, digital tools also contribute to a broader literature on telemedicine and telehealth, which demands a review of its own. Fourth, we acknowledge that there are substantial differences between HIV and other STI digital interventions. For example, digital interventions for PLHIV are often about long-term management (e.g., antiretroviral support) whereas STI interventions may be more focused on acute issues. However, abroader discussion of these differences is beyond the scope of this manuscript.

The evidence and open access resources identified have important implications for the public, providers, and health systems. For the public, some of the digital transitions we described present new methods for engagement prior to seeing a health care professional in a clinical setting. The public can and must have an important voice in shaping the development of digital STI care pathways and how they relate to in person services. For providers, digital tools may increase overall public demand and enhance linkage to clinical services. For health systems, digital systems could save resources and create more efficient clinics but evidence from robust health economic analyses needed. The studies we identified underline the need for integration of both digital and in-person services so that someone can move seamlessly between digital and in-person pathways based on preferences, medical needs, and resources. People may need assistance (e.g., peer navigators) in order to facilitate these transitions and reap the full potential of digital tools. Evaluation of whole systems are needed to adequately assess their effectiveness.

Conflicts of interest

Joseph D. Tucker, Jane Hocking, and Claudia Estcourt are Editors of *Sexual Health*, but they were blinded from the peer review process for this paper. The authors report no other conflicts of interest.

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Data availability statement

We relied on public open access databases to find relevant data. All data presented in this paper are available by contacting the corresponding author.

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