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Digital health for sexually transmitted infection and HIV services: A global scoping review

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Abstract

Purpose of review—This study aimed to review how digital health has been used for STI/HIV prevention, testing, and treatment.

Recent findings—A scoping review was conducted by searching five databases for peer-reviewed literature published between March 2018 to August 2019. 23 out of 258 studies met the inclusion criteria and were assessed. Six studies used digital platform to enhance STI/HIV prevention messaging; four studies found that digital health can provide vivid promotional information and has been instrumental in increasing the accessibility and acceptability of STI/HIV testing; three studies reported digital health provides a channel to understand and interpret the discourses on PrEP and increase PrEP uptake; three studies focused on refining big data algorithms for surveillance; four studies reported on how digital interventions could be used to optimize clinical interventions; and four studies found digital interventions can be used to assist mental health services.

Summary—Digital health is a powerful and versatile tool that can be utilized in the production of high-quality, innovative strategies on STIs and HIV services. Future studies should consider focusing on strategies and implementations that leverage digital platforms for network-based interventions, in addition to recognizing the norms of individual digital intervention platforms.

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Keywords

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Introduction

Innovative prevention tools are urgently needed to unload the high burden of sexually transmitted infections (STIs) and HIV in low- and middle- income countries[1]. Social media or digital health provide effective and expansive platforms that deliver STI/HIV services. Digital health services are, currently, Web 2.0 Internet-based applications, they facilitate and help blossom social networks online through profile connection between individuals and/or among groups [2]. Digital health is increasingly being utilized as a conduit for social interactions [3]. With the advancements in technology and increased availability and access to the internet, media platforms have become an integral part of our daily life. People now use digital platforms to seek health care, to explore entertainment options, and even seek sexual partners. Online media platforms also allow people to easily create and share messages without bounds or time restrictions [4]. The versatility of social media features has allowed public health authorities to adopt and apply these technologies to improve sexual health services. As a result, digital health is used in disease surveillance and public health interventions [5]. For example, the US CDC has started to use Facebook to educate the public about vaccinations, and the NIH has funded numerous digital health research studies that explore how digital platforms can be used to improve health care services.

More digital intervention approaches are being developed, piloted, implemented, and evaluated for STI/HIV prevention [6]. Recent applications include digital interventions for condom promotion, pre-exposure prophylaxis (PrEP) education and demand generation, STI/HIV testing access improvement, linkage to care, and treatment [7]. In this scoping review, we systematically reviewed how digital health has been used for STI/HIV prevention, testing, and treatment by putting together the latest evidence (studies published since 2018).

Methods

Search Strategy

A scoping review method was selected to identify peer-reviewed literature; this method provides a clear and thorough way to draw conclusions about rapidly developing research areas [8]. In order to accurately and clearly describe the fast-growing nature of digital health, we set the date criterion of the search for published articles between January 2018 and August 2019. In addition, search terms were selected based on their relevance to the search topic to expand the range of literature. Search terms included “social media”; “Facebook”; “Twitter”; “Instagram”; “Youtube”; “Wechat”; “e-health”, “digital health” and “artificial intelligence” in combination with the following terms: “sexually transmitted infections”; “sexual diseases”; “sexual health”; “HIV”; “Chlamydia”; “HPV”; “Gonorrhoea”; “Herpes”;

“Syphilis”. The database used were: Pubmed, Embase, MEDLINE (Ovid), and Web of Science, and Google Scholar.

Selection Criteria

Initial search retrieved 258 non-duplicate studies from the five databases between January 2018 and August 2019. After duplicates were removed, two authors (B.C. and H.B.) searched the title and abstract to determine if they met the inclusion criteria. All studies were reviewed separately and then jointly, to decide the final included studies. If it was not clear whether an article should be included, three authors (B.C., H.B., and W.T.) reviewed the full texts to discuss its eligibility and reached a consensus decision. Studies were only included if they evaluated the effectiveness of the digital intervention in preventing the transmission of STI/HIV or in improving access to care for people infected with STI/HIV. We excluded studies in which digital platforms were only used as a marketing platform for recruiting participants or for advertising. In addition, conference abstracts, non-English publications, and commentaries were also excluded.

Data Extraction

We used a standardized extraction form in Microsoft Excel, to extract the following information: first author, study design, publication date, target audience, the role of digital health, evaluation methods, intervention domains, and outcomes. The study intervention domains were further categorized into the following subcategories: (1) STI/HIV prevention messaging (promoting condom use, peer-led, theory-based, crowdsourcing digital interventions); (2) STI/HIV testing service (increasing the access to STI/HIV testing, online consultation with physicians); (3) PrEP (discourses on PrEP, PrEP monitoring, promote PrEP uptake); (4) Big data (monitoring and forecasting AIDS, epidemic surveillance, artificial intelligence for HIV prevention); (5) Care-related interventions to optimize clinical interventions; and (6) assist mental health services.

Results

The initial search retrieved 227 non-duplicate studies from January 2018 to August 2019. 196 articles were excluded after reviewing the title and abstract, leaving 31 articles; 8 were excluded after reading the full text. Thus, a total of 23 studies were included in the review (Figure 1).

Among the included studies, six focused on enhancing STI/HIV prevention messaging, four focused on developing testing services, three focused on PrEP, three focused on big data approach for prevention and surveillance, three focused on improving medication adherence, and four focused on assisting mental health services (Figure 2). A summary of the studies included in this review is presented in Appendix 1.

1 Enhance prevention messaging

Consistent condom use is one of the most effective ways to prevent STI/HIV transmission. Promoting condom use through disseminating health messages has been within the repertoire in traditional sexual health promotion. Digital intervention is endorsed as one of

the most effective ways to reach young adults [9]. Innovative health practitioners and researchers have developed digital interventions with different messaging approaches, such as peer-led, theory-based, and crowdsourcing digital interventions. In peer-led digital interventions, social media users with a large number of followers or networks are recruited as peer-leaders to advocate their peers about adopting healthy sexual behaviors. Theory-based digital interventions often leverage behavioral theories to guide their implementation. The crowdsourcing approach derives its intervention contents from collecting the wisdom of the crowds through challenge contests.

The digital peer-led intervention has been applied to prevent and reduce STI/HIV transmission and improve sexual health in secondary schools (STASH) [10]. Peer-led is a persuasive approach for health promotion, especially for young people. Forsyth et al.(2018) identified the most influential students and asked them to spread sexual health information in their friendship groups via digital platforms [10]. Moreover, given the risks of increased STI/HIV, the peer-led intervention has also been used to promote safe usage of dating apps, which is popular among young adults [11].

A variety of theories have been applied in digital interventions, such as health belief models, the theory of planned behavior [12], protection motivation theory [13], and unified theory of behavior (UTB) [14]. Although these conceptual frameworks are not born in the era of digital health, they provide systematic guidance to the development of new digital interventions for sexual health education. For instance, researchers have adopted UTB, which emphasizes the role of intention in the behavior adoption of sexual health programs, to compare the effectiveness of different technology delivery modalities (short messaging system, web-based desktop chatting, and mobile phone chatting) [14].

Crowdsourcing intervention is an innovative approach to use digital platforms for intervention. Digital platforms allow people to obtain wisdom from crowds and collect feedback from participants. Crowdsourcing digital interventions can scale up the target populations' engagement by asking participants to contribute to the intervention, which turns the passive status of participants into the active status of users. Diverse applications of crowdsourcing approaches have been found in soliciting images, videos, songs, stories, or policy suggestions from crowdsourcing contests [15,16]. In addition, Tang et al.'s review (2019) found that crowdsourcing is an effective, low-cost approach for improving condom use among key populations [17].

2, Developing STI/HIV testing services

Digital platforms have increased overall access to STI/HIV testing services. According to the 5A model (access, availability, appropriateness, acceptability, and applicability), digital health can contribute to all these aspects of care to provide better STI/HIV services [18]. Digital interventions can also provide vivid promotional information (e.g., images and videos); they have been instrumental (e.g., nearby testing sites) in increasing MSM's accessibility and acceptability of STI/HIV testing [16]. Practices that provide HIV self-testing kit requests or rapid STI testing services, through digital platforms, increase the availability, applicability, and affordability of STI/HIV testing [19]. Furthermore, digital

platforms allow patients to have online consultation/online communication services with physicians to increase the adequacy and appropriateness of STI/HIV testing access [20].

Additionally, in digital intervention, geolocation-based text messaging functionality is used to facilitate the effectiveness of reaching target populations. In China, the gay-dating app was utilized in combination with the push-notification platform and geolocation capabilities in digital intervention, to promote STI/HIV testing [21]. One-time mass message push, through the application's private message functionality was used. Users who accessed the links in the advertising message were redirected to a cellular phone number—which was based on an online appointment system, where they could schedule an onsite testing behavior. Another digital intervention, named WeCare, also used Facebook, texting, and GPS-based mobile social and sexual networking applications, to improve STI/HIV-related care engagement and health outcomes [22].

Research in STI/HIV testing promotion has entered the digital intervention arena to optimize its impact. Studies have compared different digital platforms to examine their effectiveness in increasing HIV testing. For instance, Jones et al. compared the dissemination of campaign messages, through Facebook, Twitter, Instagram, and Snapchat, among young black men. Their study found that Instagram, Twitter, and Snapchat worked well for spreading and promoting information. However, Facebook was not preferred because young people use Facebook less frequently, and Facebook is often viewed as a more family-oriented site; thus, sharing HIV-related messages could be stigmatizing [7]. In addition, studies have also combined digital interventions with other channels to maximize the effect of promoting STI/HIV testing[23].

Digital platforms can provide channels to facilitate communication between vulnerable populations like MSM and STI/HIV physicians, which can help facilitate offline visits. Studies have found that young people are interested and willing to use an MSM-friendly physician finder function embedded within a gay mobile app [20]. Consulting physicians online or using digital health can increase the adequacy of patients' access to STI/HIV information and encourage appropriate decisions associated with STI/HIV testing or treatment.

3, Increasing PrEP Uptake

The digital platform provides a channel for public health professionals to understand and interpret the discourses on PrEP. Many studies have examined digital conversations and discussions about PrEP. One research used a data mining strategy to analyze the Twitter discourse on PrEP awareness, including expressed opinions, perceived barriers, and key discussion points on its adoption [24–26]. Such studies could support public-health professionals and policymakers in PrEP monitoring, and inform decision making and strategy planning, for efficient HIV combination prevention [24].

The digital platform has also been used to implement interventions that promote PrEP uptake. Patel et al. (2018) used social media to provide education about PrEP, increase motivation to use PrEP, and facilitate access to PrEP [27]. Interventions on PrEP have good reaching effects in most of the studies done on it, including the PrEP4Love (P4L) campaign

in Chicago, which got 6,970,127 views on Facebook and 1,719,446 views through Instagram in three months [28].

4. Refining big data algorithms for surveillance

Digital platforms construct part of the big data of e-health. Mining digital messages and updates can help, in real-time data, to learn and understand the physical and emotional state of people who are at risk of STI/HIV infection. Nan and Gao (2018) used search engine data (Baidu) to monitor and forecast AIDS in China[29], and Young and Zhang (2018) performed a similar study using Google in the US. Through timed series data[30], both studies found that machine learning methods can lead to the estimation of AIDS incidences and death.

The potential of using the digital platform as a data source for epidemic and emotional surveillance has also been adopted [31]. Furthermore, using artificial intelligence (AI) for HIV prevention is also promising. A recent study examined the feasibility of using peer change agents (PCAs), selected via the AI algorithm, to deliver HIV prevention messages among youth experiencing homelessness [32]. AI-enhanced PCA intervention proved a feasible method for engaging youth.

5, Optimizing Clinical Interventions

STI/HIV clinical interventions refer to the care-related interventions that take place after diagnosis with STI/HIV, including linkage to care, adherence to medication, and retention. A mainstream approach is to use mHealth technologies (i.e., mobile health technologies that leverage mobile apps) to improve medication adherence among people living with STI/HIV. Studies have suggested the need for using digital platforms to monitor adherence to HIV antiretroviral therapy [33]. Guo et al. (2018) used digital platform to send weekly reminders to participants to remind them about medication uptake [34]. In a study conducted in Florida, among the 132 people living with HIV (PLWH), 70.2% (n=92) reported their interest in receiving daily medication adherence reminders via an app [35].

In addition, gamification is becoming a widely used method to improve adherence. Game-based interventions are often implemented in designing interactive technology-based adherence interventions. Such video games have been found to improve adolescents' and young adults' ART adherence. Gamification components have also been included in other interventions such as the Thrive with Me intervention, to improve antiretroviral therapy adherence among MSM [36]. Gaming design can evoke peer influence and draw on people's intrinsic motivation to engage with the intervention [36].

6, Assisting mental health services

Digital interventions are also being increasingly used as a tool in mental health improvement. Studies have been found that using digital platforms can significantly decrease perceived stress and depression among youth living with HIV [37]. digital interventions used to reduce anxiety and depression can enhance ARV adherence [34]. To improve PLWH's mental health, Guo et al. (2018) conducted a digital intervention to motivate PLWH to engage in physical activities. In this intervention, digital platforms were not only used to deliver a cognitive-behavioral stress management course and also track and monitor progress

with timely feedback and rewards [38]. The digital platform is the avenue for MSM or PLHIV to seek informational, instrumental and emotional social support, especially those who face challenges dealing with HIV [39]. One study found that social media friends provided more social support for PLHIV compared to offline friends [40].

Additionally, STI/HIV patients have reported favoring technology use for mental health, such as video conferencing with a counselor [41]. The ease of accessing mental health support is an important mechanism to achieve STI/HIV treatment engagement [41]. Digital health can overcome many of the barriers to care by increasing the accessibility of consultation and counseling. Wootton et al. (2019) proposed a protocol to develop telehealth counseling intervention that identified and problem-solved the challenges of barriers that prevent access to HIV care and adherence as well as mental health issues [42].

Suggestions and conclusions

First, digital intervention provides useful STI/HIV services that can be scaled up, especially in low-to-middle income countries. Numerous studies have examined the feasibility and acceptability of digital interventions, and a couple of RCTs have been conducted to investigate their effectiveness. Recent studies have also focused on the optimization and maximization of the effects of digital interventions. Further strategies that aim to scale-up digital intervention for STI/HIV prevention are needed.

Second, the role of digital health at the community level requires more examination. Studies have investigated how digital health was used to reduce STI/HIV infections at an individual level. However, studies that aim to explore and evaluate its role at the community level are still lacking. Studies should consider evaluating the effectiveness of digital interventions at the community level.

Third, digital health can be used as an efficient tool for STI/HIV surveillance. Since people often use digital platforms for communication across the globe, digital platforms may help enhance STI/HIV surveillance and provide real-time behavior monitoring of key populations and PLWHA [43].

Fourth, digital interventions should carefully take the features of the platforms into consideration. digital platforms are not created equal. Although social networks on these platforms are often perceived to exert peer influence on others to promote health behavior, studies have suggested that some platforms such as Facebook are not a preferred platform for sharing STI/HIV prevention content [44]. Future digital interventions are suggested not to ignore the norms of individual digital platforms.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Key points

- Digital health is a useful and powerful tool that can be used to improve STI/HIV prevention services
- Digital health has been used to enhance prevention messaging, develop testing service, increase PrEP uptake, refine big data algorithms for surveillance, optimize clinical intervention, and assist mental health services
- Future studies on scaling-up digital interventions and evaluating its role at the community level

Figure 1,
Flowchart of the review (Original)

Figure 2,
Type of digital STI/HIV interventions (Original)