Perspectives

Potential application of conversational agents in HIV testing uptake among high-risk populations

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ABSTRACT

Human Immunodeficiency Virus (HIV) continues to be a significant public health problem, with ∼1.2 million Americans living with HIV and ∼14% unaware of their infection. The Centers for Disease Control and Prevention recommends that patients 13 to 64 years of age get screened for HIV at least once, and those with higher risk profiles screen at least annually. Unfortunately, screening rates are below recommendations for high-risk populations, leading to problems of delayed diagnosis. Novel technologies have been applied in HIV research to increase prevention, testing and treatment. Conversational agents, with potential for integrating artificial intelligence and natural language processing, may offer an opportunity to improve outreach to these high-risk populations. The feasibility, accessibility and acceptance of using conversational agents for HIV testing outreach is important to evaluate, especially amidst a global coronavirus disease 2019 pandemic when clinical services have been drastically affected. This viewpoint explores the application of a conversational agent in increasing HIV testing among high-risk populations.

Keywords infectious disease

Background

Human Immunodeficiency Virus (HIV) continues to be a public health crisis. In the USA, ∼1.2 million people are living with HIV, with ∼14% unaware of their infection.[1] Individuals unaware of their infection account for 40% of ongoing community transmission.[2] Current Centers for Disease Control and Prevention recommendations suggest routine screening in health-care settings among patients 13 to 64 years of age, with those from high-risk populations (e.g. African American, men who have sex with men) to test at least annually.[3] Studies show that individuals who discover their recent seroconversion were more likely to change their sexual risk behaviors.[4,5] Aside from prevention of transmission, testing and early HIV diagnosis present opportunities for better health outcomes. The HIV Care Continuum aims to increase the number of those living with HIV who receive treatment and decrease viral load.[6] Initiation into the continuum begins with diagnosis followed by linkage to care. Studies show that early initiation to antiretroviral treatment has positive health benefits for those living with HIV and can reduce the risk of progressing serious illness or death.[7]

Despite the current recommendations, those at higher risk are not screened annually, leading to delayed diagnoses.[8,9] In 2017, 46% of adults 18 to 64 years old reported ever having tested, with 8% having tested in the past year.[10] Testing rates vary by age, ethnicity, region and other factors.[9,10] Similarly, barriers and facilitators to testing vary among high-risk populations.[11–15] This paper will discuss the role of a conversational agent, a recent technology, in increasing HIV testing among high-risk populations.

Digital tools and artificial intelligence

Digital tools have the potential to provide solutions to public health problems because they are flexible, more accessible and cost-effective than traditional methods. Applications of digital technology such as social media, electronic health record, mobile/smartphones and applications (apps) are evident in both public health research and clinical practice.[16–18]

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Artificial intelligence (AI) is a branch of computer science focused on building machines that mimic human intelligence to perceive, learn, reason and problem solve, and has a multitude of applications.[19] AI and machine learning have been utilized in various HIV prevention research studies[20–22]; from bench science[23] to clinical settings[24,25] and community interventions.[26] For example, investigators examined the impact of an AI-based mobile app to increase pre-exposure prophylaxis (PrEP) adherence among young men who have sex with men (MSM). The app was rated positively by participants, had high level of use throughout the study period, and resulted in PrEP adherence of 91%.[26] Machine learning algorithms may play an important role in research aimed to identify target populations. For example, investigators have used machine learning algorithms to predict HIV status among patients using electronic health records.[27] Models have performed well and had high level of accuracy in identifying patients at high risk of HIV diagnosis.[24,27] Similarly, in a study using peer models to deliver HIV prevention messages to youth experiencing homelessness, investigators compared a standard method of selecting peer models with a method using AI. Findings indicate that youth whose peer model was selected by AI had higher rates of HIV testing and condom use compared with youth whose peer model was selected via the standard method.[28]

Advancement and refinement in technology have led to the emergence of conversation agents (CA), which often use natural language processing (NLP) and AI. NLP allows computer systems to understand the natural speech of humans, the meaning and context of the message and interact with users through text or voice interface.[29,30] Applications of CA incorporating NLP include digital voice assistants such as Amazon's Alexa, Apple's Siri,[19] and well as traditional chatbots. In healthcare, AI-based conversational agents have been utilized for studies in mental health, sleep disorders, asthma, sexual health, substance use and language impairment through the use of telephones, apps (mobile device, Windows computer, Web browser) and short message service.[31]

In HIV, researchers have already explored the feasibility and acceptability of CA to promote testing. A text-based CA was developed to provide pre-test counseling for people inquiring about recent exposure, risk behaviors and symptoms, as well as tailored advice. Overall, CA were well received by users[32,33] and resulted in requests for an HIV self-test provider.[33] The United Nations Educational, Scientific and Cultural Organization Institute for Information Technologies in Education developed a text-based chatbot, Eli, geared toward youth to open a dialog about relationship, family, mental and physical health and sex. Among other things, Eli provides information about HIV prevention, testing and treatment, and offers guidance in overcoming fears and concerns. User reception has been positive with many praising developers.[34]

Although investigators have examined the early efficacy of text-based chatbots, no known studies have looked at how conversational agents using voice technology might be utilized for pre-test counseling to encourage HIV testing. The use of smart speakers with digital voice assistants continues on an upward trend with >110 million users in the USA.[35] Between 2019 and 2020, there was a 32% growth in new owners of smart speakers in US households alone.[36] Information seeking topped the list of queries from digital voice assistants followed by entertainment, accessing customer service, purchasing goods and services, payment and controlling smart home devices.[37] Data indicate a population whose daily lives are increasingly intertwined with AI. In response to this need, our team has been developing a conversational agent to address the opioid epidemic. Aimed for use by patients and caregivers, the conversational agent is being designed to assist in locating treatment facilities that are most appropriate for the patient and that are tailored to their needs.[38]

Conversational agents may provide some respite from barriers like stigma and limited access to test kits that some individuals at high risk experience.[38,39] Conversational agents may be programmed to provide factual information about different tests available that would allow the user to compare each test and determine which one best suit their needs. Additionally, CA may be a good source of science-based information that could potentially dispel any misinformation about HIV, testing and PrEP that is ubiquitous on the internet and social media.[40,41] The convenience of ordering a self-test kit and having it delivered at home or through a vending machine instead of picking it up at the pharmacy or at a clinic might also increase testing uptake.[42–44] This might be especially true for those living in rural areas where access may be limited.

As a result of the coronavirus disease 2019 pandemic, many people were unable to receive the health services they needed, including HIV services, due to changes in policy.[45] Safety protocols were implemented that necessitated accommodating fewer patients than normal which led to halting many home and community-based tests or postponing in-person clinic testing.[46] In regions with stricter measures, there was higher disruption of services, with some suspending rapid HIV testing altogether. This subsequently resulted in higher use of self-testing kits for some areas.[47] The accessibility of CA for information or to order home test kits may alleviate some of the burden experienced by clinics that are unable to provide service to patients or the community. Additionally, patients may find it more convenient and safer to interact with AI than to go in person to obtain testing.

There are a number of limitations in the use of CA to engage with patients and health consumers. Investigators have found that privacy risk, limited conversational responsiveness, user-perceived undesirable personality (rude, unsympathetic, patronizing, judgmental) and lack of trust in app creator were barriers for users to adopt CA for mental healthcare.[48] Concerns regarding HIV chatbots included misunderstanding the user, speech that was deemed too formal and the CA replied too quickly.[32] As NLP and machine learning continue to evolve, so will the ability of conversational agents to recognize and respond to users' inquiries and needs. Continuous evaluation and modification of the program may lead to improvements in the interface.

Conclusion

Advancement in technology proffers novel solutions to dealing with public health issues. The use of AI has the capacity to reach individuals at high risk for HIV infection; it is feasible, convenient and well accepted in the community. As current societal behavior trends toward the use of conversational agents in daily life, CA may play a role in providing accurate information about HIV tests to those who seek them. Despite limitations of using a new technology, the benefits of reaching out to those at high risk may have huge implications in mitigating this public health crisis.

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