

Potential Role of Conversational Agents in Encouraging PrEP Uptake



Maryam Hassani, MS
Sean D. Young, PhD, MS 

Abstract

Approximately 1.2 million people are living with HIV, with many of them unaware of their infection. Pre-exposure prophylaxis (PrEP) is available to minimize transmission among those at high risk for infection, including men who have sex with men, people who inject drugs, and female sex workers. Despite its availability, there is low usage of PrEP. To address this problem, various digital tools have been examined in HIV research. Among those, conversational agents are still underused and their capacity warrants examination to reach at-risk populations. In this paper, we discuss the potential of conversational agents in increasing uptake of PrEP by addressing barriers experienced among those at high risk for infection.

Background

HIV continues to be a public health crisis. Approximately 1.2 million people are living with HIV in the USA and 14% are unaware of their infection.¹ Approximately 40% of community transmission can be attributed to individuals who are unaware of their infection.² Currently, there is no known cure for HIV. However, it is possible to minimize transmission from a person living with HIV to their sexual partner through pre-exposure prophylaxis (PrEP). PrEP decreases the risk of transmission when taken as prescribed, with efficacy increasing as adherence increases.^{3,4} In 2016, the number of individuals taking PrEP was more than 77,000, with more males taking PrEP than females.⁵ However, despite its availability, prescriptions for PrEP remain low.⁶ Lack of awareness of availability by both at-risk individuals and people living with HIV, provider bias and distrust of the healthcare system,⁶ stigma,^{6,7} and low perception of HIV risk create barriers to uptake of PrEP.

Address correspondence to Sean D. Young, Department of Emergency Medicine, University of California, Irvine, Orange, CA, USA. Syoun5@hs.uci.edu.

Maryam Hassani, Department of Informatics, University of California, Irvine, Irvine, CA, USA.

Sean D. Young, Department of Informatics, University of California, Irvine, Irvine, CA, USA.

The Journal of Behavioral Health Services & Research, 2022. 1–7. © 2022, National Council for Mental Wellbeing. DOI 10.1007/s11414-022-09798-0

For persons who inject drugs, uptake is also hindered by limited access and negative experience with healthcare and criminal justice system.^{6,8,9} In addition to the previously mentioned barriers, cost is also a limiting factor to PrEP uptake among various low-income populations, including adolescents¹⁰ and female sex workers.¹¹⁻¹⁴

In light of low uptake of PrEP, this paper explores the use of conversational agents in providing information to those at high risk and encourages uptake of PrEP.

Digital Tools and Conversational Agents

Digital tools, such as mobile applications, electronic health records, and telemedicine often incorporating artificial intelligence and geolocation, have been used in promoting HIV prevention and PrEP uptake for at-risk populations.¹⁵⁻¹⁹

Conversational agents, a type of digital tool, can be in the form of chatbots or virtual assistants (e.g., Alexa, Siri), designed to mimic human-like textual or verbal communications. Simple chatbots and virtual assistants use keywords and pre-defined answers while smart chatbots benefit from natural language processing (NLP) approaches when communicating with the users.^{20,21} NLP, a branch of artificial intelligence, affords computer systems the ability to understand natural human speech patterns, as well as the meaning and context of the message. NLP can interact with human users through text or voice interface.^{22,23} Examples of NLP include Amazon's Alexa, Apple's Siri,²⁴ and smart chatbots.

More than 70% of consumers were satisfied with virtual assistants (i.e., Siri), using them for researching, making purchases, and other functions. Between 2018 and 2019, twice as many consumers stated in surveys that they would knowingly engage with chatbots.²⁵ Smart speakers with digital voice assistants such as Alexa and Siri continue on an upward trend.²⁶ Consumer uses for virtual assistants include requesting information, entertainment, customer service, retail purchase and payment, and controlling smart home devices.²⁷ To date, 1.4 billion people use chatbots on a regular basis, and as an example, there were over 300,000 chatbots on Facebook alone in 2018.²⁸

Conversational agents, often based on artificial intelligence, are already being explored for use in HIV prevention.²⁹ Examples of the use of conversational agents for HIV can be found in both research and health agencies. Conversational agents in the form of virtual assistants are suggested to have great potential for promoting HIV testing by offering pre-testing counseling, providing a directory of online home test kit vendors and nearby testing locations, and placing HIV test kits in a shopping cart or subscription service.³⁰ In one study, virtual assistants were evaluated on the accuracy of the derived information about PrEP for HIV prevention when targeting adolescents and young adults.³¹

In 2017, investigators used a chatbot on Facebook messenger to deliver information about HIV/AIDS.³² Other researchers used conversational agents to encourage uptake of HIV testing and were well received by users.^{33,34} A chatbot was developed by the United Nations Educational, Scientific and Cultural Organization Institute for Information Technologies in Education to provide youth with information about relationships, family, health, and sex and was positively received by the public in 2020. The chatbot was also an avenue to open a dialogue about HIV prevention, testing, and treatment.³⁵ With regard to PrEP, researchers examined the feasibility of a mobile application (app) to increase PrEP adherence among young men who have sex with men (MSM), between 2018 and 2020. The AI-based app was successful in reaching a 91% adherence rate among users and was rated positively by study participants.¹⁸

Although there has been a lot of research on using conversational agents in health domains, there has been no known study to investigate the use of conversational agents in addressing barriers to PrEP uptake. Conversational agents may hold great potential to be used in promoting PrEP uptake

and HIV prevention. Some of the benefits of using conversational agents in PrEP uptake are being able to have dynamic back and forth conversations, being able to provide verified correct information, ensuring scalability, and ability to have machines rapidly provide and distribute information to a large group of people.

PrEP, Barriers, and Conversational Agents

Stigma, provider bias, and distrust of healthcare system

Labeling, stereotyping, and rejection are among different forms of PrEP-related stigma³⁶ among those at high risk who may experience when seeking help in healthcare system, which works as a barrier to PrEP uptake. Using conversational agents such as chatbots or virtual assistants to gather information about PrEP may remove these limitations by those who would most benefit from PrEP. Users may be more comfortable communicating with conversational agents instead of providers who they feel might otherwise judge them for requesting PrEP. A similar approach has been used in a study to promote deep self-disclosure, in which participants stated feeling more comfortable sharing with the chatbot rather than the mental health professional when it comes to deeper levels of feelings and thoughts.³⁷

Knowledge and risk perception

Insufficient knowledge, questions, or concerns regarding PrEP can cause misconception in both healthcare providers and at-risk populations.³⁸ Lack of knowledge and misconceptions may be addressed by conversational agents through programmed information that is science-based. Information provided by conversational agents may be able to counter myths or misinformation that those at high risk may encounter online or on social media. To obtain accurate information about PrEP, using chatbots on social media messengers or mobile health applications might be more convenient compared to calling or emailing healthcare providers or waiting for the next clinic visit. Chatbots and virtual assistants can provide information in a more conversational manner that may be more appealing to some users compared to health or medical websites.

Also, some at-risk individuals might perceive their own true risk to be low, creating another barrier to PrEP uptake.⁶ In addition to basic information about PrEP, conversational agents may be programmed to address risk misperceptions through recognition of keywords and NLP algorithms to encourage those at high risk to seek the advice of a healthcare professional. This is among the reasons why conversational agents, using keywords and NLP approaches, might be preferred to text message informational campaigns that can only provide back and forth, fixed communications.

Advantages of using conversational agents

Conversational agents can be implemented/integrated in websites, social media, phone applications, and other messaging platforms and easily expanded to reach larger populations. This also makes them more accessible for a wide range of people. Conversational agents can provide users with a personalized response. They have the potential to be faster in comparison to emails and phone calls. Conversational agents also have potential to be programmed to use accurate information from credible sources and eliminate the distribution of misinformation.

Table 1 presents a comparison between conventional mediums and conversational agents regarding PrEP, based on the following factors:

- Multi-platform: covering different platforms such as mobile applications, social media, websites, and smart speakers or being accessible from various devices such as mobile and computer

Table 1

Conversational agents versus conventional mediums

	Conversational agents	Phone call	Email	In-person	Static informational website
Multi-platform	✓		✓		✓
Personalized response	✓	✓	✓	✓	
Fast response	✓				✓
Accurate information	✓	Prone to misconception			✓
Scalable	✓		✓		✓
Input/output modality	Written		Written		Written
	Verbal	Verbal		Verbal	
	Visual		Visual	Visual	Visual
Trust and privacy	This can vary based on technology and regulations				

- Personalized response: providing tailored responses according to the user's question
- Fast response: time spent to communicate with the medium and get a response (immediate response is preferred)
- Accurate information: providing the user with science-based and correct response
- Scalable: the extent medium can reach the target population at once and distribute information
- Input/output modality: methods of communication with the user
- Trust and privacy: available regulations to protect the user data

Although conversational agents are not a one-size-fits-all solution, and cannot overcome barriers such as PrEP cost, they may be able to address some of the limitations of features provided by the conventional mediums, for example, by responding with accurate, verified information in-time to the stigmatized population through text or voice and promote PrEP uptake.

Limitations to use of conversational agents

Novel use of existing digital tools is not without limitations. In one study, participants reported that the chatbot they engaged with replied too quickly, had speech patterns that were overtly formal, and occasionally misunderstood them.³³ In a mental health study using conversational agents, participants noted limited conversational responsiveness and that the conversational agent exhibited negative personality traits. Participants also suggested that lack of trust in the app programmer might be a barrier to using conversational agents.³⁹ Other users may have privacy concerns that would inhibit them from using conversational agents. As technologies continue to evolve, there is much that can be improved in conversational agents, including regulations to assure user privacy.

Conclusion

The increasing popularity and use of conversational agents in the community introduces a novel use of this technology in research and clinical practice. Chatbots and virtual assistants may offer an important service to help mitigate transmission of HIV by addressing barriers that those at high risk for infection experience. Conversational agents may be programmed to provide information about PrEP and address myths and misinformation that would otherwise inhibit uptake. As a

convenient and possibly cost-effective intervention, conversational agents warrant further study in HIV prevention.

Implications for Behavioral Health

It is important that chatbots focused on PrEP are delivered and implemented using proper social and behavioral science theory⁴⁰ to increase the likelihood of a successful implementation. Tailoring the PrEP-related chatbots for the target population, such as men who have sex with men, may have an impact on increasing the uptake of PrEP via chatbots.

Conversational agents are digital tools that have potential use in uptake of preventive medications for HIV infection. As the use of chatbots and virtual assistants increases, conversational agents may be useful in providing information to the public, most especially key populations who are at high risk for HIV infection and who may experience barriers to uptake of PrEP. The ability to obtain factual information, without judgment, may encourage behavioral changes to minimize risk of infection.

Chatbots are increasingly being used in general online life. For example, there are chatbots being used on popular sites such as Facebook that allow people to interact with a chatbot and get health information while browsing Facebook. The WHO has used Facebook as the platform for its Health Alert chatbot which provides instant and accurate information about Covid-19.⁴¹ We encourage HIV researchers to explore the potential of these types of approaches in the use of conversational agents and PrEP.

Funding This work was supported by the National Institute of Mental Health under Grant MH106415, National Institute on Drug Abuse (NIDA), National Center of Complementary and Integrative Health (NCCIH), and National Institute of Allergy and Infectious Diseases (NIAID).

Declarations

Conflict of Interest The authors declare no competing interests.

Disclaimer The views expressed in the submitted article are the authors' own and not an official position of the institution or funder.

References

1. *U.S. Statistics, Fast Facts*. HIV: The U.S. Department of Health & Human Services website, 2021. Available online at: <https://www.hiv.gov/hiv-basics/overview/data-and-trends/statistics>. Accessed on 22 February, 2022.
2. Gopalappa C, Farnham PG, Chen YH, et al. Progression and transmission of HIV/AIDS (PATH 2.0). *Med Decis Making*. 2017;37(2):224-233. <https://doi.org/10.1177/0272989X16668509>
3. Chou R, Evans C, Hoverman A, et al. Preexposure prophylaxis for the prevention of HIV infection: Evidence report and systematic review for the US preventive services task force. *Journal of the American Medical Association*. 2019;321(22):2214-2230. <https://doi.org/10.1001/jama.2019.2591>
4. Riddell J, Amico KR, Mayer KH. HIV preexposure prophylaxis: A review. *Journal of the American Medical Association*. 2018;319(12):1261-1268. <https://doi.org/10.1001/jama.2018.1917>
5. *PrEP Use Across the U.S. at the County-Level*. AIDSvu Emory University's Rollins School of Public Health website, 2020. Available online at: <https://aidsvu.org/prep-use-across-the-u-s-at-the-county-level/>. Accessed on 22 February, 2022.
6. Mayer KH, Agwu A, Malebranche D. Barriers to the wider use of pre-exposure prophylaxis in the United States: A narrative review. *Advances in Therapy*. 2020;37(5):1778-1811. <https://doi.org/10.1007/s12325-020-01295-0>
7. Rosengren AL, Lelutiu-Weinberger C, Woodhouse EW, et al. A scoping review of HIV pre-exposure prophylaxis stigma and implications for stigma-reduction interventions for men and transwomen who have sex with men. *AIDS and Behavior*. 2021;25(7):2054-2070. <https://doi.org/10.1007/s10461-020-03135-2>

8. Allen ST, O'Rourke A, White RH, et al. Barriers and facilitators to PrEP use among people who inject drugs in rural Appalachia: A qualitative study. *AIDS and Behavior*. 2020;24(6):1942-1950. <https://doi.org/10.1007/s10461-019-02767-3>
9. Biello KB, Bazzi AR, Mimiaga MJ, et al. Perspectives on HIV pre-exposure prophylaxis (PrEP) utilization and related intervention needs among people who inject drugs. *Harm Reduction Journal*. 2018;15(1):55. <https://doi.org/10.1186/s12954-018-0263-5>
10. Hosek S, Celum C, Wilson CM, et al. Preventing HIV among adolescents with oral PrEP: Observations and challenges in the United States and South Africa. *Journal of the International AIDS Society*. 2016;19(7Suppl 6):21107. <https://doi.org/10.7448/IAS.19.7.21107>
11. Auerbach JD, Kinsky S, Brown G, et al. Knowledge, attitudes, and likelihood of pre-exposure prophylaxis (PrEP) use among US women at risk of acquiring HIV. *AIDS Patient Care STDs*. 2015;29(2):102-110. <https://doi.org/10.1089/apc.2014.0142>
12. Footer KHA, Lim S, Rael CT, et al. Exploring new and existing PrEP modalities among female sex workers and women who inject drugs in a U.S. city. *AIDS Care*. 2019;31(10):1207-1213. <https://doi.org/10.1080/09540121.2019.1587352>
13. Peitzmeier SM, Tomko C, Wingo E, et al. Acceptability of microbicidal vaginal rings and oral pre-exposure prophylaxis for HIV prevention among female sex workers in a high-prevalence US city. *AIDS Care*. 2017;29(11):1453-1457. <https://doi.org/10.1080/09540121.2017.1300628>
14. Tomko C, Park JN, Allen ST, et al. Awareness and interest in HIV pre-exposure prophylaxis among street-based female sex workers: Results from a US context. *AIDS Patient Care STDs*. 2019;33(2):49-57. <https://doi.org/10.1089/apc.2018.0182>
15. Hoagland B, Torres TS, Bezerra DRB, et al. Telemedicine as a tool for PrEP delivery during the COVID-19 pandemic in a large HIV prevention service in Rio de Janeiro-Brazil. *The Brazilian Journal of Infectious Diseases*. 2020;24(4):360-364. <https://doi.org/10.1016/j.bjid.2020.05.004>
16. Garrett R, Young SD. Geolocation, ethics, and HIV research. *Health and Technology*. October 2021:1-5. <https://doi.org/10.1007/s12553-021-00611-0>
17. Ortblad KF, Baeten JM. Electronic health record tools to catalyze PrEP conversations. *The Lancet HIV*. 2019;6(10):e644-e645. [https://doi.org/10.1016/S2352-3018\(19\)30194-8](https://doi.org/10.1016/S2352-3018(19)30194-8)
18. Liu AY, Laborde ND, Coleman K, et al. DOT diary: Developing a novel mobile app using artificial intelligence and an electronic sexual diary to measure and support PrEP adherence among young men who have sex with men. *AIDS and Behavior*. 2021;25(4):1001-1012. <https://doi.org/10.1007/s10461-020-03054-2>
19. Garrett R, Young SD. Digital public health surveillance tools for alcohol use and HIV risk behaviors. *AIDS Behav*. 2021;25:333-338. <https://doi.org/10.1007/s10461-021-03221-z>
20. Maeng W, Lee J. Designing a Chatbot for Survivors of Sexual Violence: Exploratory Study for Hybrid Approach Combining Rule-based Chatbot and ML-based Chatbot. In: *Asian CHI Symposium 2021*, New York, NY, USA: Association for Computing Machinery; 2021:160-166. <https://doi.org/10.1145/3429360.3468203>
21. Car LT, Dhinagaran DA, Kyaw BM, et al. Conversational agents in health care: Scoping review and conceptual analysis. *Journal of Medical Internet Research*. 2020;22(8):e17158. <https://doi.org/10.2196/17158>
22. Nilsson NJ. *Principles of Artificial Intelligence*. San Francisco, CA, USA: Morgan Kaufmann Publishers Inc.; 1980.
23. Sarikaya R. The technology behind personal digital assistants: An overview of the system architecture and key components. *IEEE Signal Processing Magazine*. 2017;34(1):67-81. <https://doi.org/10.1109/MSP.2016.2617341>
24. *The Future Computed: Artificial Intelligence and Its Role in Society*. Microsoft Corporation. Redmond, Washington: Microsoft; 2018.
25. *AI Stats News: Chatbots Lead To 80% Sales Decline, Satisfied Customers And Fewer Employees*. Forbes website. Available online at: <https://www.forbes.com/sites/gilpress/2019/09/25/ai-stats-news-chatbots-lead-to-80-sales-decline-satisfied-customers-and-fewer-employees/>. Accessed on 22 February, 2022.
26. *Nearly 90 Million U.S. Adults Have Smart Speakers, Adoption Now Exceeds One-Third of Consumers*. Voicebot.ai website, 2020. Available online at: <https://voicebot.ai/2020/04/28/nearly-90-million-u-s-adults-have-smart-speakers-adoption-now-exceeds-one-third-of-consumers/>. Accessed on 22 February, 2022.
27. *Worldwide level of usage of voice assistants across various functions 2017*. Statista website. <https://www.statista.com/statistics/801963/worldwide-level-usage-voice-assistant-various-functions/>. Accessed on 22 February, 2022.
28. *The Future Is Now - 37 Fascinating Chatbot Statistics*. SmallBizGenius website, 2020. <https://www.smallbizgenius.net/by-the-numbers/chatbot-statistics/>. Accessed on 22 February, 2022.
29. Garrett R, Young SD. Potential application of conversational agents in HIV testing uptake among high-risk populations. *Journal of Public Health*. 2022;fdac020. <https://doi.org/10.1093/pubmed/fdac020> from this website <https://academic.oup.com/jpubhealth/advance-article/doi/10.1093/pubmed/fdac020/6535705>
30. Romero RA, Klausner JD, Marsch LA, et al. *Technology-delivered intervention strategies to bolster HIV testing*. Current HIV/AIDS Reports. 2021;18(4):391-405. <https://doi.org/10.1007/s11904-021-00565-y>
31. Darien K. Internet Derived Health Information About Pre-Exposure Prophylaxis (PrEP) for Human Immunodeficiency Virus (HIV) Prevention in Adolescents: A Qualitative Analysis of HIV Prevention Health Information Found Online, 2021. Available online at: <https://dataspace.princeton.edu/handle/88435/dsp01sx61dq41f>. Accessed on 24 February, 2022.
32. Brixey J, Hoegen R, Lan W, et al. SHIHbot: A Facebook chatbot for Sexual Health Information on HIV/AIDS. In: *Proceedings of the 18th Annual SIGdial Meeting on Discourse and Dialogue*. Saarbrücken, Germany: Association for Computational Linguistics; 2017:370-373. <https://doi.org/10.18653/v1/W17-5544>
33. Van Heerden A, Ntinga X, Vilakazi K. The potential of conversational agents to provide a rapid HIV counseling and testing services. In: *2017 International Conference on the Frontiers and Advances in Data Science (FADS)*; 2017:80-85. <https://doi.org/10.1109/FADS.2017.8253198>
34. Vermey K, Daas CD, Zweers W, et al. P046 Ensuring quality-assured and personalized online self-testing within a market-driven context. *Sexually Transmitted Infections*. 2019;95(Suppl 1):A99-A99. <https://doi.org/10.1136/sextrans-2019-sti.251>
35. *Chatbot answers young people's questions about HIV, health and relationships*. UNAIDS: The Joint United Nations Program on HIV and AIDS website. Available online at: https://www.unaids.org/en/resources/presscentre/featurestories/2020/october/20201015_chatbot. Accessed on 22 February, 2022.

36. Dubov A, Galbo P, Altice FL, et al. Stigma and shame experiences by MSM who take PrEP for HIV prevention: A qualitative study. *American Journal of Men's Health*. 2018;12(6):1843-1854. <https://doi.org/10.1177/1557988318797437>
37. Lee YC, Yamashita N, Huang Y. Designing a chatbot as a mediator for promoting deep self-disclosure to a real mental health professional. *Proceedings of the ACM Human-Computer Interaction*. 2020;4(CSCW1):031:1–031:27. <https://doi.org/10.1145/3392836>
38. Kambutse I, Igiraneza G, Ogbuagu O. Perceptions of HIV transmission and pre-exposure prophylaxis among health care workers and community members in Rwanda. *PLOS One*. 2018;13(11):e0207650. <https://doi.org/10.1371/journal.pone.0207650>
39. Prakash AV, Das S. Intelligent conversational agents in mental healthcare services: A thematic analysis of user perceptions. *Pacific Asia Journal of the Association for Information Systems*. 2020;12(2). <https://doi.org/10.17705/1pais.12201>
40. Coalition GAP. *AIDS in the World II: Global Dimensions, Social Roots, and Responses*. New York: Oxford University Press, 1996.
41. WHO launches a chatbot on Facebook Messenger to combat COVID-19 misinformation. World Health Organization website, 2020. Available online at: <https://www.who.int/news-room/feature-stories/detail/who-launches-a-chatbot-powered-facebook-messenger-to-combat-covid-19-misinformation>. Accessed on 22 February, 2022.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.