UNIVERSITY OF
FORWARD
THINKING
WESTMINSTER⌗

WestminsterResearch

http://www.westminster.ac.uk/westminsterresearch

Acceptability of artificial intelligence (AI)-enabled chatbots, video consultations and live webchats as online platforms for sexual health advice

Nadarzynski, T., Bayley, J., Llewellyn, C., Kidsley, S. and Graham, C.A.

This article has been accepted for publication in BMJ Sexual & Reproductive Health, 2020, following peer review, and the Version of Record can be accessed online at:

http://dx.doi.org/10.1136/bmjsrh-2018-200271

© Authors 2020.

The acceptability of Artificial Intelligence (AI)-enabled chatbots, video consultations and live webchat as online platforms for sexual health advice

Tom Nadarzynski[1,2], Jake Bayley[3], Carrie Llewellyn[4], Sally Kidsley[2] & Cynthia Graham[5]

1. University of Westminster, London

2. Solent NHS Trust, Southampton

3. Bart's NHS Trust, London

4. University of Sussex, Brighton

5. University of Southampton, Southampton

Corresponding author:

Dr Tom Nadarzynski

Room 6.101, University of Westminster

115 New Cavendish Street

London W1W 6UW, UK

Email: T.Nadarzynski@westmister.ac.uk

Abstract

Objectives: Sexual and reproductive health (SRH) services are undergoing a digital transformation. This study explored the acceptability of three digital services, (i) video consultations via Skype, (ii) live webchat with a health advisor and (iii) artificial intelligence (AI)-enabled chatbots, as potential platforms for SRH advice. Methods: A pencil-and-paper 33 item-long survey was distributed in three clinics in Hampshire, UK for patients attending SRH services. Logistic regressions were performed to identify the correlates of acceptability. Results: In total, 257 patients (57% women, 50% below the age of 25 years) completed the survey. As the first point of contact, 70% preferred face-to-face consultations, 17% telephone consultation, 10% webchat and 3% video consultation. Most would be willing to use video consultations (58%) and webchat facilities (73%) for ongoing care, but only 40% found AI chatbots acceptable. Younger age (<25) OR=2.43 [95%CI:1.35-4.38], White ethnicity OR=2.87 [95%CI:1.30-6.34], past sexually transmitted infection (STI) diagnosis OR=2.05 [95%CI:1.07-3.95], self-reported STI symptoms OR=0.58 [95%CI:0.34-0.97], smartphone ownership OR=16.0 [95%CI:3.64-70.5] and the preference for a SRH smartphone application OR=1.95 [95%CI:1.13-3.35] were associated with video consultations, webchat or chatbots acceptability. Conclusion: Although video consultations and webchat services appear acceptable, there is currently little support for SRH chatbots. The findings demonstrate a preference for human interaction in SRH services. Policy-makers and intervention developers need to ensure that digital transformation is not only cost-effective but also acceptable to users, easily accessible and equitable to all populations using SRH services.

Key messages
• The majority (70%) of sexual health service attendees prefer face-to-face contact over digital communication channels as the first point of contact.   • Most service users would be willing to use live webchat (73%) and video consultations (58%), but not an automated AI chatbot platform (40%).   • An AI platform for sexual health advice was not acceptable amongst patients attending sexual health services who perceived having STI symptoms.

Introduction

In England, the overall provision of sexual and reproductive health (SRH) services has been reduced by 14% between 2014 and 2018 due to austerity, with a 35% decrease in funding for education, advice and prevention [1]. There has been a 15% drop in access to contraceptive services, such as emergency contraceptives, amongst women and girls in the same period [2]. Rates of chlamydia, gonorrhoea and syphilis have been increasing since 2014 with the latest statistics indicating a 5% increase in sexually transmitted infections (STIs) between 2017 and 2018, suggesting that such severe cuts are a major public health concern [3]. Some SRH services have been considering digital and online methods of disseminating educational material in an affordable way by encouraging patients to utilise self-learning and self-care websites and mobile phone applications [4]. These digital interventions, such as web pages social networking sites and text-based platforms, aim to provide information about STIs and risk factors as well as promote screening for STIs (self-sampling or self-testing kits by mail) [5]. They engage with marginalised or isolated individuals at higher risk of STIs, especially young people, men who have sex with men, and black minority ethnic groups that face multiple barriers in accessing SRH services.

Around 90% of adults in the UK now have access to the Internet and nearly 95% of those aged between 16 and 24 own a smartphone [6]. Thus, providing health education through digital communication channels could increase access to care, allowing better management of demand for SRH services. SRH promotional material has already been distributed online and a number of studies have shown that social media could be a useful tool for the dissemination of information, increasing patient awareness and knowledge of STIs as well as the motivation to adopt preventative methods [7]. Digital communication channels, such as the Solent NHS Trust – Let's Talk About It service (www.letstalkaboutit.nhs.uk) allow individuals to understand their risk, recognise potential STI symptoms and the conditions that may require urgent medical attention. The objective of

remote advice platforms is to examine individual needs and signpost users to the most appropriate remote or in-clinic SRH services. While telephone consultations have been an established method of triage in primary care and genito-urinary medicine (GUM) [8], other digital communication channels are being considered to offer a variety of ways in which patients can access SRH services.

Video consultations, live web chat and chatbots have been proposed as supplementary digital platforms for patient-clinic communication. The advances in telemedicine, with parallel widespread access to essential technology such as smartphones with a high-quality camera, offer valuable opportunities for the provision of remote care via Skype or FaceTime for those patients who are not able to engage with clinicians due to distance or the lack of time. A qualitative study of primary care patients' views on video consultations showed positive attitudes, especially amongst those with mobility or mental health problems [9]. They were also seen as superior in improving communication, providing visual cues and building rapport when compared to telephone consultations. Live web chat or 'live texting' that allow communication between concerned Internet users and trained health advisors have also been proposed as an alternative method, especially for those who experience embarrassment or discomfort discussing sensitive issues face-to-face or via phone [10]. Usually, these platforms offer anonymity and professional SRH advice for those who experience high levels of anxiety and concern. Users might be advised to access SRH services when it is recognised that they require screening or treatment. This form of intervention could be particularly effective for discussing stigmatised high-risk behaviours such as same-sex intercourse, condomless sex or drug use (chemsex) where patients might not want to be identified [11]. Recent developments in artificial intelligence (AI) have offered the possibility of highly personalised and patient-centred care. Conversational agents or ontology-based chatbot systems enable verbal and textual communication imitating human interactions in an affordable way. The number of chatbots used in healthcare is rapidly

growing, with several already used in SRH [12, 13]. Chatbots may provide access to reliable information at times when contact with health professionals is not possible, especially amongst patients experiencing anxiety, embarrassment or who typically brows popular but less reliable search engines to look for SRH information.

Self-care can be limited by sexual health literacy, where individuals have difficulties in understanding and absorbing relevant information. Low health literacy has been associated with poorer health outcomes and reduced use of health services [14]. Due to difficulties in recognising and understanding symptoms, online self-diagnoses, typically conducted using Google search engines, can be incorrect and harmful if potential STIs are left untreated [15]. Thus, online services that enable easy and comprehensible access to SRH information, particularly for those with low levels of health literacy, are needed to enable better access to in-clinic SRH services. To date, the acceptability of these various digital platforms for SRH advice has not been comparatively examined in a clinical population. Thus, this study aimed to assess the acceptability of video consultations, live web chats and chatbots as potential advice platforms among patients attending SRH services.

Methods

Design and Participants

A cross-sectional, self-administered pencil-and-paper survey was distributed to service users of three SRH clinics in Hampshire (Southampton and Portsmouth), under Solent NHS Trust, between May 2017 and March 2018. They were asked about their views on novel digital platforms for online sexual health advice with the aim to help users to under their sexual health needs.

Hampshire is the largest county in the UK, with mostly rural populations outside the two big cities, and with 11% identifying as other than White British. The potential respondents were regular and new patients attending SRH services that at the time of the

study offered a range of specialist clinics such as contraception, psychosexual counselling, HIV care, STI screening and treatment. Potential participants were approached with a request to complete the survey during the registration for their appointment. The survey was anonymous and completed mostly in the waiting area before the consultation. A clinic population was chosen over Internet users to estimate baseline acceptability rates of digital interventions being developed as part of clinical services.

The survey was approved as a service evaluation and development project by Solent NHS Trust Clinical Governance (ref:SE-260).

Data Collection

The research questions and the survey content were developed in relation to the digital transformation of Solent NHS Trust sexual health services aiming to increase access, equality and cost-effectiveness. The survey was first piloted with a dozen service users where a think-aloud technique was used to assess its coherence and understanding.

The survey contained 33 items assessing: i) demographic factors (i.e. gender, age, ethnicity, employment, education, past diagnosis of STI/HIV, the distance from an SRH clinic and the perception of having an STI symptom at the time of the clinic visit); ii) the utilisation of technology (smartphone ownership, preferred media for health promotion and the use of online systems to book an appointment); iii) the willingness to use an app for SRH, to enter STI symptoms onto an online form, to consent for the digital consultation to be recorded; iv) confidence in the security of digital health records and v) the preferred method for a 'first point of contact' for SRH advice, with 4 options ('face-to-face', 'telephone', 'video consultations' and 'live webchat'). The acceptability of the three digital services (i.e., video consultations, live webchat, AI-enabled chatbots) used the 'willingness' binary "yes"/"no" responses e.g., "*Would you be willing to use an automated web-chat with a computer or a bot (not an actual human) to assist you with finding sexual health*

information?". The participants were given short descriptions of how they could engage with each digital service, for example, AI-chatbot was conceptualised as a discussion with a computer and not a human. The survey took 5-10 minutes on average to complete.

The participants were asked to return completed surveys to the reception and completion of the survey indicated consent for their data to be used, as stated on the study information sheet. It was not possible to estimate the response rate as the total number of patients approached was unknown. Nevertheless, around 600 blank surveys were printed and distributed across the three locations (Royal South Hants Hospital in Southampton, St Mary's Hospital in Portsmouth and Crown Heights Sexual Health in Basingstoke). The reasons for declined participation were not explored.

Patient and public involvement

Patients were not directly involved in the design, recruitment and the conduct of the survey. Posters will be disseminated in the waiting areas outlining the results of the study.

Data analysis

All surveys were collected by the lead author and data were inserted by hand into SPSS statistical software for the analysis. All responses were dichotomised into two categorical variables and the p-value was set at 0.05. Binary logistic regressions, using the enter method, were performed to identify factors associated with the acceptability of the three communication methods as candidates for an online advice system. The model was adjusted by selecting relevant variables.

Results

In total, 257 service users completed the survey (Table 1). The majority of the sample was White, women, holding an A/AS level education or higher and in full-time employment.

About a quarter of clinic attendees had been diagnosed with an STI in the past and 5% reported being HIV positive. Around 47% believed they had STI symptoms at the time of the survey and 28% attempted to self-treat these. About 37% searched the Internet for SRH information prior to their visit and 16% booked their clinical appointment online. Only 4% of the sample reported not having access to the Internet and about 1 in 10 not owning a smartphone device.

Acceptability of digital services

The majority of participants were willing to use a website (96%) or a smartphone application (57%) for SRH information. As a first point-of-contact to discuss SRH, most (70%) preferred face-to-face consultation at a clinic, 17% preferred telephone consultations, 10% live webchat, and 3% video consultation via Skype or Facetime. Most participants were willing to use video consultations (58%), and webchat (73%) in the future, but only 40% found an AI-enabled chatbot acceptable. The majority of participants (83%) found entering symptoms onto an online form acceptable and 66% would consent for the digital consultations to be recorded. Around 55% were willing to download software or app for video consultation and 66% would consent to be contacted by a health professional via Skype or Facetime. About half of the participants were concerned about the security for storing medical information and the privacy of digital communication channels. Only a small proportion (4%) reported the lack of confidence in the security of digital health records in the NHS.

The regression analysis revealed that the acceptability of video consultations was associated with younger age (under 25 years), being diagnosed with an STI in the past and STI symptom perception at the time of clinic attendance (Table 2). Those who owned a smartphone and had stronger preferences for using an app for SRH information were more willing to use video consultations. The acceptability of live webchat was associated with

younger age (under 25 years), identifying as White and owning a smartphone. The acceptability of using an SRH chatbot was positively associated with owning a smartphone and negatively associated with perceptions of STI symptoms while attending the clinic. The analysis also demonstrated that the acceptability of the three digital communication platforms showed significant correlations with one another. Those who were more willing to use an app for SRH, consent for the consultation to be recorded and to enter symptoms onto an online form were more likely to accept all three communication platforms. In general, owning a smartphone and consenting for the consultation to be recorded were the strongest predictors of acceptability.

Discussion

The vast majority of attendees preferred face-to-face contact, although they were receptive to remote forms of consultations. Our findings demonstrate high acceptability of webchat services and moderate acceptability of video consultations. This could be due to the familiarity of Solent NHS Trust service users with the webchat facility that was launched in April 2017, while the remaining two platforms were not available at the time of the study. Most participants were not in favour of SRH chatbots, especially patients that thought they had an STI symptom and thus, these platforms may not be suitable for high-risk populations. An automated chatbot platform might be less desirable for those already attending the clinic; however, it could enable clinicians to triage patients waiting and might improve the overall service delivery. Previous studies identified hesitancy towards AI-led chatbots due to concerns about confidentiality and cyber-security as well as the lack of empathy and trust in the autonomous decisions made by computers based on predefined algorithms [16]. Another explanation is a typical reluctance towards novel technologies, outlined in the Diffusion of Innovation theory [17], which indicates that the adaptation of new digital solutions is dependent on individual decision-making processes, their promotion, time since the introduction and social systems. Therefore, low or moderate acceptability could be expected

for innovative services that patients have little awareness of. Further studies should explore the level of engagement with these technologies amongst SRH patients as well as assess the acceptability rates in non-clinical and high-risk populations that face barriers to accessing SRH services.

The analysis offers insight into the potential digital divide, as 1 in 10 respondents reported not owning a smartphone, indicating that a substantial proportion of service users might have difficulties accessing digital services if they were only available through apps or smartphones. The current transformation of SRH services through increased digitalisation may lead to reduced service costs, but it may also limit access for those who are most in need of in-clinic services. Failing to develop services that reach people with no access or capacity to use technologies is likely to increase health inequalities [18]. In addition, our study demonstrates the importance of face-to-face interactions, as preferred by the majority of the patients and consistent with other recent studies [19]. Previous research demonstrated that individuals from lower socioeconomic backgrounds had lower e-health literacy, restricted access to technologies and were less likely to use digital health interventions [20]. Literacy-related disparities in technology access and use are widespread, with lower literacy patients being less likely to own smartphones or to use the Internet [21]. Therefore, digital SRH services should be considered as a supplement to clinical services rather than their substitute.

This is the first study exploring the acceptability of digital platforms for SRH advice, notably an AI chatbot, in a clinical population. The generalisability of these findings is limited to one NHS trust and patients in other local authorities may have different views on these platforms. Also, the reasons for low acceptability rates were not explored and this additional information would allow a better understanding of barriers to digital SRH services. Future studies should compare these acceptability rates with Internet users who face difficulties in accessing SRH services as well as patients in various geographical locations.

This study demonstrates low-to-moderate acceptability of AI chatbots and moderate-to-high acceptability of video consultations and webchats as platforms for SRH advice. Thus, there is a need to address patients' perspectives when developing online SRH services. Low acceptability is likely to translate into low uptake of these interventions. More research is required to evaluate potential reach, equality, engagement and cost-effectiveness of these interventions.

References

1. Iacobucci, G., & Torjesen, I. (2017). Cuts to sexual health services are putting patients at risk, says King's Fund. *BMJ: British Medical Journal (Online)*, *356*.

2. NHS Digital (2019) Sexual and Reproductive Health Services (Contraception), England, 2018/19. Accessed from: https://digital.nhs.uk/data-and-information/publications/statistical/sexual-and-reproductive-health-services/2018-19

3. Public Health England (2019) Sexually transmitted infections and chlamydia screening in England:2018. Health Protection Report (13)19. Accessed from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/806118/hpr1919_stis-ncsp_ann18.pdf

4. Bailey, J., Mann, S., Wayal, S., Hunter, R., Free, C., Abraham, C., & Murray, E. (2015). Sexual health promotion for young people delivered via digital media: a scoping review. *Public Health Research*, *3*(13), 1-119.

5. Wadham, E., Green, C., Debattista, J., Somerset, S., & Sav, A. (2019). New digital media interventions for sexual health promotion among young people: a systematic review. *Sexual Health*, *16*(2), 101-123.

6. Office for National Statistics (2019). Internet access – households and individuals, Great Britain:2019. Accessed from: https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/bulletins/internetaccesshouseholdsandindividuals/2019

7. Gabarron, E., & Wynn, R. (2016). Use of social media for sexual health promotion: a scoping review. *Global Health Action*, *9*(1), 32193.

8. Ewing, M., Read, P., Knight, V., Morgan, S., Hanlon, M., McDonald, A., ... & McNulty, A. (2013). Do callers to the NSW Sexual Health Infoline attend the services they are referred to?. *Sexual Health*, *10*(6), 530-532.

9. Donaghy, E., Atherton, H., Hammersley, V., McNeilly, H., Bikker, A., Robbins, L., ... & McKinstry, B. (2019). Acceptability, benefits, and challenges of video consulting: a qualitative study in primary care. *British Journal of General Practice*, bjgp19X704141.

10. Lelutiu-Weinberger, C., Pachankis, J. E., Gamarel, K. E., Surace, A., Golub, S. A., & Parsons, J. T. (2015). Feasibility, acceptability, and preliminary efficacy of a live-chat social media

intervention to reduce HIV risk among young men who have sex with men. *AIDS and Behavior*, *19*(7), 1214-1227.

11. Schnall, R., Travers, J., Rojas, M., & Carballo-Diéguez, A. (2014). eHealth interventions for HIV prevention in high-risk men who have sex with men: a systematic review. *Journal of Medical Internet Research*, *16*(5), e134.

12. Brixey, J., Hoegen, R., Lan, W., Rusow, J., Singla, K., Yin, X., ... & Leuski, A. (2017, August). Shihbot: A facebook chatbot for sexual health information on HIV/AIDS. In *Proceedings of the 18th annual SIGdial meeting on discourse and dialogue* (pp. 370-373).

13. Crutzen, R., Peters, G. J. Y., Portugal, S. D., Fisser, E. M., & Grolleman, J. J. (2011). An artificially intelligent chat agent that answers adolescents' questions related to sex, drugs, and alcohol: an exploratory study. *Journal of Adolescent Health*, *48*(5), 514-519.

14. Berkman, N. D., Sheridan, S. L., Donahue, K. E., Halpern, D. J., & Crotty, K. (2011). Low health literacy and health outcomes: an updated systematic review. *Annals of Internal Medicine*, *155*(2), 97-107.

15. Schembri, G., & Schober, P. (2009). The Internet as a diagnostic aid: the patients' perspective. *International Journal of STD & AIDS*, *20*(4), 231-233.

16. Nadarzynski, T., Miles, O., Cowie, A., & Ridge, D. (2019). Acceptability of artificial intelligence (AI)-led chatbot services in healthcare: A mixed-methods study. *Digital Health*, *5*, 2055207619871808.

17. Rogers, E. M., & Shoemaker, F. F. (1971). Communication of Innovations; A Cross-Cultural Approach. New York: Free Press.

18. Latulippe, K., Hamel, C., & Giroux, D. (2017). Social health inequalities and eHealth: a literature review with qualitative synthesis of theoretical and empirical studies. *Journal of Medical Internet Research*, *19*(4), e136.

19. Miners, A., Llewellyn, C., King, C., Pollard, A., Roy, A., Gilson, R., ... & Shahmanesh, M. (2018). Designing a brief behaviour change intervention to reduce sexually transmitted infections: a discrete choice experiment. *International Journal of STD & AIDS*, *29*(9), 851-860.

20. Kontos, E., Blake, K. D., Chou, W. Y. S., & Prestin, A. (2014). Predictors of eHealth usage: insights on the digital divide from the Health Information National Trends Survey 2012. *Journal of Medical Internet Research*, *16*(7), e172.

21. Bailey, S. C., O'conor, R., Bojarski, E. A., Mullen, R., Patzer, R. E., Vicencio, D., ... & Wolf, M. S. (2015). Literacy disparities in patient access and health-related use of Internet and mobile technologies. *Health Expectations*, *18*(6), 3079-3087.

Table 1 Sample characteristics and attitudinal variables on acceptability (N=257)

Variable	N (%)	Variable	N (%)
Gender		**Utilisation of technology**	
Man	111 (43)	Access to the Internet	
Women	146 (57)	Yes	246 (96)
Age		No	9 (4)
Under 18	7 (3)	Smartphone ownership	
18-24	119 (46)	Yes	232 (91)
25-34	70 (27)	No	23 (9)
35-44	25 (10)	Preference for first point-of-contact to discuss SRH issues	
45-54	26 (10)	Face-to-face consultation	171 (70)
55-64	5 (2)	Telephone	42 (17)
Over 64	4 (2)	Video consultation (Skype/FaceTime)	7 (3)
Ethnicity		Live web chat (texting service)	23 (10)
Asian	10 (3)	Device preference for online appointments	
Black (African/Caribbean)	13 (4)	Smartphone	178 (51)
Mixed	8 (3)	PC	26 (7)
White	227 (90)	Tablet	56 (16)
Employment status		Webcam	9 (3)
Full-time	136 (56)	Laptop	79 (23)
Part-time	30 (12)		
Student	65 (24)	**Acceptability/willingness variables**	
Unemployed	19 (8)	To use a website for SHR information	
Education		Yes	230 (94)
GNNQ/HNC/HND or lower	14 (4)	No	15 (6)
GCSE	59 (23)	To use an app for SHR information	
A/AS level/Highers	93 (37)	Yes	147 (57)
Degree or above	84 (36)	No	109 (43)
Registered with GP		To use live webchat with an advisor	
Yes	225 (98)	Yes	177 (73)
No	4 (2)	No	66 (27)
Previously diagnosed with an STI		To be contacted via Skype/FaceTime by a health professional	
Yes	58 (23)	Yes	167 (66)
No	197 (77)	No	87 (34)
HIV positive		To use video consultation (e.g. Skype)	
Yes	14 (5)	Yes	144 (58)
No	239 (95)	No	104 (42)
How did you get appointment?		To download software for video consultation	
Walk-in	47 (19)	Yes	136 (55)
Booked online	40 (16)	No	111 (45)
Booked by phone	152 (62)	To consent for consultation to be recorded	
Sent by GP/A&E	8 (3)	Yes	129 (52)
Perceived STI symptoms		No	120 (48)
Yes	120 (47)	To enter symptoms onto an online form	
No	132 (53)	Yes	200 (83)
Duration of STI symptom		No	41 (17)
Up to 7 days	30 (25)	To use AI-enabled chatbot for SRH advice	
1-12 weeks	49 (43)	Yes	100 (40)
Over 3 months	37 (32)	No	149 (60)
Attempted to self-treat STI symptoms			
Yes	37 (28)	**Cyber-security variables**	
No	93 (72)	Concerned about security for storing medical information	
Visited other service before SRH		Yes	137 (57)
Yes	85 (34)	No	104 (43)
No	161 (65)	Concerned about privacy of digital communication with health professionals	
Alternative resources for SRH advice			
GP	56 (50)	Yes	114 (47)
Pharmacy	2 (2)	No	127 (53)
Internet	33 (37)	Confidence in the security of digital health records in the NHS	
Other	10 (11)	Completely	94 (39)
Travel distance to SRH clinic		Mostly	137 (67)
Less than 15 minutes	106 (41)	Not at all	11 (4)
Less than 30 minutes	110 (44)		
Less than 1 hour	35 (14)		
Less than 2 hours	6 (2)		

SRH – sexual and reproductive health; HIV – human immunodeficiency virus; STI – sexually transmitted infection; AI – artificial intelligence; GNNQ/HNC/HND/GCSE – level of education; GP – general practitioner; A&E – accident and emergency department

Table 2. Factors associated with the acceptability of video consultations, webchat and chatbot

Variable	Video consultation OR [95% CI]	Webchat OR [95% CI]	AI chatbot OR [95% CI]
Demographic variables			
Gender			
Men	1.11 [0.71-1.98]	0.99 [0.93-1.21]	1.38 [0.91-2.01]
Women			1.00
Age			
Under 25 years	1.77 [1.06-2.93]*	2.43 [1.35-4.38]*	1.01 [0.61-1.68]
Over 25 years	1.00	1.00	1.00
Education			
A/AS Level or below	0.79 [0.45-1.36]	0.86 [0.46-1.62]	1.40 [0.83-2.44]
Degree or above	1:00	1.00	1.00
Ethnicity			
White	1.10 [0.49-2.47]	2.87 [1.30-6.34]*	1.33 [0.59-3.00]
Non-white	1.00	1.00	1.00
Employment			
Employed (full and part-time)	1.38 [0.89-2.32]	1.03 [0.57-1.85]	1.68 [0.98-2.90]
Unemployed or student	1.00	1.00	1.00
Diagnosed with an STI in the past			
Yes	2.05 [1.07-3.95]*	1.18 [0.58-2.39]	0.71 [0.38-1.33]
No	1.00	1.00	1.00
Diagnosed with HIV			
Yes	1.15 [0.35-3.63]	0.75 [0.22-2.56]	1.76 [0.55-5.23]
No	1.00	1.00	1.00
Perceived having STI symptoms			
Yes	1.68 [1.01-2.84]*	0.97 [0.54-1.75]	0.58 [0.34-0.97]*
No	1.00	1.00	1.00
Distance from GUM clinic			
Up to 30-minute drive	1.09 [0.54-2.17]	0.66 [0.28-1.53]	0.92 [0.46-1.82]
Over 1-hour drive	1.00	1.00	1.00
Utilisation of technology variables			
Smartphone ownsership			
Yes	16.0 [3.64-70.5]*	6.46 [2.47-16.8]*	4.58 [1.31-16.0]*
No	1.00	1.00	1.00
Preferred medium for health promotion			
Mobile phone application	1.95 [1.13-3.35]*	1.49 [0.82-2.69]	1.45 [0.86-2.45]
Website	1.00	1.00	1.00
Method of booking appointment			
Using online booking system	1.44 [0.71-2.91]	2.41 [0.96-6.04]	1.79 [0.90-3.56]
By phone or walk-in	1.00	1.00	1.00
Acceptability/willingness variables			
To use video-consultation (e.g. Skype)			
Yes	0.00	18.7 [8.52-41.0]*	3.86 [2.17-6.84]*
No	0.00	1.00	1.00
To use live webchat with an advisor			
Yes	18.7 [8.52-41.0]*	0.00	3.74 [1.90-7.37]*
No	1.00	0.00	1.00
To use AI-enabled chatbot			
Yes	3.86 [2.17-6.84]*	3.74 [1.90-7.37]*	0.00
No	1.00	1.00	0.00
To have an app for sexual health			
Yes	2.44 [1.45-4.11]*	3.73 [2.05-6.79]*	2.24 [1.30-3.79]*
No	1.00	1.00	1.00
To consent for consultation to be recorded			
Yes	26.6 [6.09-11.6]*	15.6 [7.83-31.1]*	4.13 [2.23-7.65]*
No	1.00	1.00	1.00
To enter symptoms onto an online form			
Yes	2.70 [1.35-5.40]*	3.75 [1.81-7,74]*	3.86 [1.63-9.17]*
No	1.00	1.00	1.00
Confidence in the security of digital health records in the NHS			
Yes	1.15 [0.68-1.94]	1.24 {0.69-2.24]	1.36 [0.80-2.29]
No	1.00	1.00	1.00

NHS – National Health Service; STI – sexually transmitted infection; AI – artificial intelligence; OR – odds ratio; GUM – genitourinary medicine; 1.00 – reference category for logistic regression; * p<0.05, CI – 95% confidence interval