Interactive Online Educational Modules Increase HIV and STI Prevention Competency Among Medical Students

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Abstract

Background: The rate of new HIV diagnoses in the United States continues to slowly decline, yet, men who have sex with men and transgender women remain disproportionately affected. Key to improving quality of prevention services are providers who are comfortable addressing concepts of HIV prevention and sexual health across the spectrum of gender identities and sexual orientations. It is important to begin HIV prevention and sexual health education before providers' practice habits are established. To address this need, we developed interactive educational modules and tested their impact on HIV prevention knowledge and awareness in future providers.

Methods: Sexual health providers at an academic hospital, research clinicians, community engagement professionals, and New York City community members were consulted to develop seven educational modules, which were piloted among medical students. Knowledge of HIV and sexually transmitted infection (STI) prevention and comfort assessing prevention needs of various patients were assessed via online questionnaires administered before and after our educational intervention.

Results: Pre- and post-module surveys were completed by 125 and 89 students, respectively, from all four years of training. Before the intervention, the majority of students had heard of HIV pre-exposure prophylaxis (PrEP) (99.2%) and post-exposure prophylaxis (PEP) (92.7%). About 31% (38/123) of students agreed that they could confidently identify a patient who is a candidate for PrEP or PEP – this increased to 91% (81/89) following intervention.

Conclusions: Our findings highlight a need for increased HIV and STI prevention training in medical school curricula to enable future providers to care for diverse, at-risk patient populations. Interactive modules offer an effective way to teach these concepts.

Introduction

Since 2017, the overall rate of new HIV diagnoses in the US has declined each year, due to HIV testing, treatment as prevention (TasP), and advances in biomedical prevention such as pre-exposure prophylaxis (PrEP) and post-exposure prophylaxis (PEP). However, transgender women and men who have sex with men (MSM) are disproportionately represented in new HIV diagnoses each year.^{1,2} Reasons for these disparities are multifactorial, but key to improving access to prevention and quality of prevention services are knowledgeable providers comfortable addressing topics of HIV prevention and sexual health concerns across gender, sexual orientation, and age. Providers frequently serve as key facilitators to accessing prevention services. Focus groups among lesbian, gay, bisexual, transgender, and queer (LGBTQ) individuals conducted previously by our group identified that an important factor in accessing prevention care and participating in HIV prevention research studies was receiving information from providers experienced in providing care to gender-diverse individuals.³ When LGBTQ individuals are stigmatized by health care providers this leads to distrust of providers, lack of sexual identity disclosure, delays in seeking needed medical care, and incomplete sharing of risk-taking behaviors related to HIV,

which are risk factors for HIV especially among Black MSM.⁴⁻¹⁰ In a survey of 120 U.S. internal medicine residents, only 2.3% had ever prescribed PrEP, with the top barrier being lack of familiarity, likely due to a lack of provider education and training.¹¹ Discomfort with sexual history taking and genital exams was identified as a barrier to STI testing^{12,13} and decreased the likelihood of prescribing PrEP.¹⁴⁻¹⁶

Education can change providers' intentions and practices.¹⁷ We propose that for lasting impact, it is important to start HIV prevention and sexual health education training before practice habits are firmly established. Therefore, medical students are an important group to target in order to shape future prevention practices and knowledge. Data about knowledge of and attitudes toward HIV prevention among medical students are fairly limited but reveal concerns about inadequate preparation for future practice.¹⁸⁻²⁰ A survey of medical students found that only 37.6% felt adequately trained to address sexual health concerns of patients and a recent online survey revealed that students did not feel fully prepared to care for LGBTQ patients.^{21,22} Focused education on HIV prevention, gender identity, and sexual orientation/behaviors issued early in medical education may remove barriers and stigmatization for LGBTQ patients. We proposed to address this need by creating interactive, educational modules adapted for medical students. Novel approaches such as web-based platforms that permit interactive learning, incorporate feedback, and utilize role-playing have proven extremely successful when used by Infectious Diseases faculty at an academic medical center to teach medical students general infectious diseases and virology.²³ This investigation built on the expertise of the research team to create interactive modules that focus on topics of HIV prevention, sexual health, risk reduction, and the biomedical prevention research pipeline. We tested the impact of these modules on knowledge of STI, HIV testing, and PEP/PrEP in a cohort of first through fourth year medical students.

We hypothesized that interactive, web-based modules would increase medical students' knowledge of PrEP and PEP, increase confidence in identifying candidates for HIV prevention services, and serve as acceptable learning tools for medical students.

Methods

Primary Outcome Measures

Our main outcome measures were: student-reported comfort and confidence engaging with LGBTQ patients (5-point scale), student-reported sexual history taking abilities and perception of medical education surrounding this topic (5-point scale), general knowledge of HIV/STI screening and prevention (10-point scale), and student-reported confidence in identifying patients who are candidates for PrEP and PEP (5-point scale).

Module Development

Educational modules were developed between September 2018 and January 2019 using *Articulate Storyline*. Sexual health providers, research clinicians, and community engagement volunteers at a large

urban tertiary care academic medical center located in a predominantly Latinx (72%) and immigrant (47%) community in New York city, were consulted for expertise and supplemental materials on risk reduction counseling, prescribing, and monitoring patients on PrEP and PEP, and biomedical prevention research studies.²⁴ These materials were used to develop unique clinical narratives and cases that were web-based and interactive. Finalized module content included seven, 5-10 minute modules: (1) a **PEP Module** on the indications and evidence behind PEP and how to monitor a patient on PEP. (2) **PEP Cases** where students engaged with four distinct clinical cases based on the foundational knowledge and skills learned in the PEP Module. (3) a **PrEP Module** on lab testing, prescribing, and clinical indications for PrEP. (4) **PrEP Cases** where students applied the knowledge learned in the PrEP Module by navigating four patient cases. (5) an **STI Testing Module** focused on special considerations when screening and treating diverse patient populations such as cisgender MSM, geriatric populations, patients living with HIV/AIDS, and transgender women. (6) a **Sexual Health Algorithm** about appropriate terminology when interacting with gender and sexually diverse patients, creating a welcoming environment for LGBTQ patients, and gendered pronoun usage. These concepts were supplemented by two clinical cases. (7) **Research Concepts** explored HIV prevention in the research setting such as preventive vaccine and antibody studies, topical microbicides, and long-acting injectable PrEP. Modules were hosted on an online secure server established by the research team. These modules can be viewed at Stick2PrEP.com.

Focus Group

Community members who were 18 years of age or older, living in the New York City metropolitan area, and had seen a provider more than once in the last 12 months for unspecified medical reasons were invited to provide contact information to participate in a community focus group about their HIV and STI testing experiences and provide feedback on initial versions of the educational modules. Gender and sexual minorities were strongly encouraged to participate. Community members were recruited via Craigslist, Facebook, and physical flyers posted on the medical center campus. Of 116 eligible community members who responded to advertisements, we contacted up to 16 for each focus group with gender, sexual orientation, risk factors for HIV/STI infection, and clinical experiences being relevant to the selection process. After obtaining informed consent from all participants, two focus groups were conducted in November 2018. All community members were reimbursed \$25 for their time and thoughtful contributions. These focus groups followed a prepared script and audio recordings for both focus groups were transcribed. Two research team members identified reoccurring themes from both transcripts, which were then used to further inform the content of the modules.

Medical Student Questionnaires

We developed an anonymous, web-based pre-module questionnaire which consisted of 20 items. Completion of the survey was not time restricted. The questionnaire was administered using Qualtrics Survey Software and was only open to medical students. Informed consent was obtained using the cover page of the survey. Electronic invitations to participate in the survey were distributed using class listserv accounts. Administrative permission was obtained prior to sending invitations to student listserv

accounts. Participant eligibility and inclusion criteria was defined as currently enrolled, first through fourth year medical students. Some fourth-year students were recruited for participation via a month-long residency preparedness course taken just prior to intern year. The questionnaire and participation were offered as voluntary, supplemental learning opportunities.

After completion of the pre-module survey, students were routed to another Qualtrics survey whereby they could provide an email address to receive a URL link to the learning modules. Students were given up to two weeks to complete seven learning modules. All participants received a link to complete an anonymous, post-module Qualtrics survey.

We used 20 items to assess student confidence, knowledge, and perception of sexual health concepts which were categorized into four discrete domains: 1) LGBTQ patient familiarity, 2) sexual history taking abilities and medical training perception, 3) HIV/STI screening and prevention knowledge, and 4) prevention confidence. To our knowledge, no validated survey instruments exist to measure these concepts, and thus the survey instrument was developed based on a review of published literature and clinical experience of the investigative team. These domains of assessment are shown in Table 1. For LGBTQ patient familiarity, sexual health abilities and training perception, and prevention services confidence, all items were weighted equally on a Likert scale from 1-5, with 1 being “strongly disagree” and 5 being “strongly agree.” Items assigned to the domains were used to create class-specific mean scores for the pre-module survey and a total mean score for both the pre- and post- module survey. HIV/STI screening and prevention knowledge was calculated on a scale of 0-10 and graded for correctness with each question weighted equally. Class-specific and total mean scores were calculated for the pre-module survey. Students were asked to provide demographic information to capture relevant educational and social variables (i.e., age, gender, race, sexual identity, familiarity with PrEP and PEP).

The post-module questionnaire was used to assess the same domains included in the pre-module questionnaire and utilized the same 20-item assessment. However, the post-module questionnaire did not include demographic information in an effort to protect student anonymity and avoid unintentional linkage of responses. Local institutional Review Board approval was obtained prior to starting the study and all methods were performed in accordance with the

Declarations of Helsinki. Students were reimbursed \$50 for completing the modules.

TABLE 1:

Medical student questionnaire domain categorization

<p>Domain 1:</p> <p>LGBTQ familiarity</p>	<ul style="list-style-type: none"> • I feel comfortable asking patients about their sexual orientation e.g. gay, bisexual • I feel comfortable discussing sexual health problems with patients of different gender identity than my own • I feel comfortable taking a sexual history from a patient who identifies as LGBTQ
<p>Domain 2:</p> <p>Sexual history abilities and medical training perception</p>	<ul style="list-style-type: none"> • I feel comfortable asking patients about their sexual practices e.g. "Are you sexually active?", "Do you practice vaginal sex?" • I find taking a sexual history easy • I have adequate skills to take a sexual history • I have enough exposure as a medical student to take a sexual history from a real patient • I have enough exposure as a medical student to take a sexual history from a simulated patient • I feel that there is not enough training in medical school on how to discuss sexual health problems with patients
<p>Domain 3:</p> <p>HIV/STI screening and prevention knowledge</p>	<ul style="list-style-type: none"> • How often should all sexually active gay, bisexual, and other men who have sex with men (MSM) be screened for HIV, syphilis, chlamydia, and gonorrhea? • According to the CDC, annual chlamydia screening is recommended for all sexually active women under the age of ___, as well as older women with risk factors such as ___. • 4th generation HIV tests detect ___ in blood specimens. • PrEP, when used daily and with condoms, has been shown to reduce the risk of HIV infection in those who are high risk by up to • Which of these individuals would benefit from PrEP use? • At time of initiation of a PrEP regimen, how many days of medication should you prescribe at the first patient visit? • How many days of medication should you prescribe at an initial PEP visit? • How many hours after HIV exposure should PEP be started? • Which of these individuals would be a candidate for PEP (assume within appropriate time window)? • True or False: HIV negative recipients of an HIV vaccine may test positive on some HIV antibody tests for the duration of a vaccine study and possibly thereafter
<p>Domain 4:</p> <p>Prevention confidence</p>	<ul style="list-style-type: none"> • I feel confident identifying a patient who is a candidate for PrEP, PEP, and other HIV/STI prevention services

For domain 3, students were presented with multiple choice options not presented in the figure. Students did not receive correct response feedback.

Statistical Analysis

T-test analyses were used to analyze demographic and educational variables for each year of medical education and total student sample. Domain-specific mean scores were calculated for each year of medical education and total student sample along with an interquartile range (IQR) to show the response value distribution. P-values for each domain were determined using an unpaired t-test. Given the paired nature of the responses, we intended to use a paired t-test; however, without means of linking the pre-module and post-module questionnaire responses, the individual level data could not be paired. The purpose of keeping the pre-module and post-module responses unlinked was to maintain the anonymity of the students in accordance with the IRB protocol. All data were analyzed using SAS Version 9.4 and Microsoft Excel.

Results

Responses were received from 125 individuals, a response rate of 20%. Response rate was calculated using number of responses received ($n = 125$) and the total number of potentially eligible students ($n = 620$) based on the number of students who received or had access to our invitation via email or the residency preparation course. Two responses were excluded from data analyses due to lack of data completeness. Of the 123 analyzed entries, student mean age was 26.5 (25.0-28.0) and M4 students were most represented among all student cohorts ($N=51$; 41.5%). The majority of students identified as white ($N=62$; 50.4%), heterosexual (96; 78.1%), and female ($N=71$; 57.5%). Twenty-two percent of students ($N=27$) identified as lesbian, gay, bisexual, other, or did not provide a response. This is above the estimated average for the U.S. adult population, which is 4.5%.²⁵ Most students had heard of PrEP and PEP before the educational modules ($N=122$; 99.2%) and ($N=114$; 92.7%) respectively. Complete participant characteristics are summarized in Table 2. Eighty-nine percent of students also completed a post-module survey. The overall completion rate was 71.2%. Figure 1 summarizes study participation and completion.

TABLE 2:

Baseline medical student characteristics, demographic information, and domain scores

Demographic Characteristic	M1 ¹ (n = 12) 9.8%	M2 (n = 37) 30.1%	M3 (n = 23) 18.7%	M4/M4+ (n= 51) 41.5%	Total (n =123) ²
Mean age (IQR)	24.9 (23.0- 25.5)	25.3 (24.0- 26.0)	27.1 (26.0- 28.0)	27.5 (26.0- 29.0)	26.5 (25.0- 28.0)
Gender Identity ³					
Male	6 (50.0%)	15 (40.5)	8 (34.8)	22 (43.1)	51 (41.5)
Female	6 (50.0)	21 (56.8)	15 (65.2)	29 (56.9)	71 (57.7)
Other	0 (0.0)	1 (2.7)	0 (0.0)	0 (0.0)	1 (0.8)
Race ⁴					
Black, non-Hispanic	0 (0.0)	4 (10.8)	2 (8.7)	4 (7.8)	10 (8.1)
White, non-Hispanic	7 (58.3)	16 (43.2)	12 (52.2)	27 (52.9)	62 (50.4)
Hispanic/Latinx	2 (16.7)	3 (8.1)	3 (13.0)	1 (2.0)	9 (7.3)
Asian/Pacific Islander	2 (16.7)	12 (32.4)	5 (21.7)	9 (17.7)	28 (22.8)
Mixed Race/Other	1 (8.3)	2 (5.4)	1 (4.4)	10 (19.6)	14 (11.4)
Sexual Identity					
Lesbian	0 (0.0)	1 (2.7)	0 (0.0)	1 (2.0)	2 (1.6)
Gay	2 (16.7)	2 (5.4)	2 (8.7)	7 (13.7)	13 (10.6)
Bisexual	1 (8.3)	3 (8.1)	0 (0.0)	4 (7.8)	8 (6.5)
Heterosexual	8 (66.7)	29 (78.4)	20 (87.0)	39 (76.9)	96 (78.1)
Other/No Response	1 (8.3)	2 (5.4)	1 (4.4)	0 (0.0)	4 (3.3)
Heard of PrEP					
	12 (100.0)	36 (97.3)	23 (100.0)	51 (100.0)	122 (99.2)
Heard of PEP					
	10 (83.3)	34 (91.9)	23 (100.0)	47 (92.2)	114 (92.7)

Mean score of LGBTQ familiarity level (IQR) ⁵	4.0 (3.3-4.5)	3.8 (3.3-4.3)	3.5 (3.0-4.0)	3.5 (3.0-4.0)	3.6 (3.0-4.0)
Mean score of sexual history abilities (IQR) ⁶	3.5 (3.3-3.7)	3.4 (2.8-3.7)	3.1 (2.7-3.5)	3.4 (3.0-3.8)	3.3 (3.0-3.7)
Mean HIV/STI screening and prevention score (IQR) ⁸	6.6 (6.0-7.0)	6.3 (5.0-7.0)	6.6 (6.0-8.0)	6.5 (5.0-8.0)	1. (6.0-7.0)

¹M1-M4 corresponds to year of medical education. M4+ refers to students who have completed more than four years of medical training (i.e., dual degree or research year). ²125 students responded to pre-module survey. Two respondents were excluded due to incompleteness. ³Students were given the option of selecting multiple gender identities. Transgender (FTM), transgender (MTF), and unlisted term with free text option were aggregated into “other.” ⁴Students who selected multiple racial categories were grouped into “mixed/other.” ^{5,6,7}LGBTQ familiarity, and sexual history abilities were on scale of 1-5. ⁸Mean HIV/STI screening and prevention score was assessed on scale of 0-10.

Total mean score of LGBTQ familiarity was 3.6 (IQR: 3.0-4.0) on a scale of 1-5. Mean LGBTQ familiarity score was highest among first-year medical students (4.0). Across all years, the mean score for sexual history abilities and perception of training on sexual history taking was 3.3 (3.0-3.7). Mean score for sexual history abilities and medical education training was also highest among first-year students (3.5). Total mean HIV/STI screening and prevention score was 6.4 (6.0-7.0) with the highest scores among first year and third year students (6.6).

All domains increased following the educational intervention. Total mean score of LGBTQ familiarity increased from 3.6 (3.0-4.0) to 4.2 (4.0-4.7) with p-value < 0.0001. Sexual history abilities increased from 3.3 (3.0-3.7) to 3.6 (3.3-4.2) with p-value = 0.002. This data is summarized in Figure 2. HIV/STI screening and prevention score also increased from baseline of 6.4 (6.0-7.0) to 8.1 (7.0-9.0) with p-value < 0.0001, shown in Figure 3. Total mean score of prevention confidence increased from 2.8 (2.6-3.0) to 4.2 (4.1-4.4) with p-value < 0.0001. Pre and post intervention mean domain scores are shown in Table 3.

Pre-module mean scores *n* = 123. Post-module mean scores *n* = 89. LGBTQ familiarity represents student confidence engaging concepts of LGBTQ patient care. Sexual history abilities represent student general sexual history taking comfort and confidence as well as perception of medical training preparedness. Prevention confidence reflects student confidence identifying indications for PrEP, PEP, and other sexual health prevention measures.

Pre-module mean scores $n = 123$. Post-module mean scores $n = 89$. HIV/STI screening and prevention scores are on scale of 0-10 and represents general sexual health screening and prevention questions scored for correctness.

TABLE 3:

Pre and post educational intervention mean domain scores

	Pre-Survey (n=123)	Post-Survey (n=89)	p-value
LGBTQ familiarity (IQR) ¹	3.6 (3.0-4.0)	4.2 (4.0-4.7)	<0.0001
Sexual history abilities (IQR) ²	3.3 (3.0-3.7)	3.6 (3.3-4.2)	0.002
Prevention confidence (IQR) ³	2.8 (2.6-3.0)	4.2 (4.1-4.4)	<0.0001
HIV/STI screening and prevention (IQR) ⁴	6.4 (6.0-7.0)	8.1 (7.0-9.0)	<0.0001

^{1,2,3}LGBTQ familiarity, sexual history abilities, and prevention confidence scores are on scale of 1-5. LGBTQ familiarity represents student confidence engaging concepts of LGBTQ patient care. Sexual history abilities represents students' sexual history taking comfort and confidence as well as perception of medical training and preparedness. Prevention confidence reflects student confidence identifying indications for PrEP, PEP, and other sexual health prevention measures within specific patient populations and clinical scenarios. ⁴HIV/STI screening and prevention score is on scale of 0-10. HIV/STI screening and prevention domain is general sexual health screening and prevention questions scored for correctness.

To further assess changes in prevention confidence before and after the educational intervention, we evaluated specific Likert scale responses to questions assessing confidence identifying patients who are candidates for PrEP, PEP, and other prevention services. These findings are summarized in Figures 4 and 5.

Pre-educational PrEP and PEP confidence $n = 123$. Participants were asked to rate their agreement with the statement "I feel confident identifying candidates for PrEP and PEP." Strongly disagree and disagree were grouped into one category (54/123; 43.9%). Neutral confidence was an independent category (31/123; 25.2%). Strongly agree and agree were grouped into one category (38/123; 30.8). While one participant completed the pre-educational prevention confidence assessment, they did not provide demographic information and their responses were invalidated. This exclusion resulted in total number of "strongly agree/agree" responses being decreased from 39 to 38.

Post-educational PrEP and PEP confidence $n = 89$. Participants were asked to rate their agreement with the statement "I feel confident identifying candidates for PrEP and PEP." Strongly disagree and disagree

were grouped into one category (2/89; 2%). Neutral confidence was an independent category (6/89; 6.7%). Strongly agree and agree were grouped into one category (81/89; 91%).

We performed an additional analysis of the HIV/STI screening and prevention knowledge domain to assess change in knowledge of specific HIV and STI screening and prevention concepts before and after intervention, summarized in Table 4. While there was an increase in percentage of correct responses for all questions within the domain following the educational intervention, four of the ten questions met our criteria for statistical significance

($p < 0.05$). All statistically significant changes in correct responsiveness involved prescribing, monitoring, and evidence behind PrEP and PEP. This perhaps reflects a collective gap in knowledge within this clinical domain as well as a significant increase in this domain following the intervention.

TABLE 4:

HIV/STI screening and prevention knowledge percent correct by question

	Pre-Survey (% correct) n=123	Post-Survey (% correct) n=89	p-value
Q1	87.8	92.1	0.31
Q2	95.1	95.5	0.90
Q3	68.3	77.5	0.14
Q4	30.1	59.6	<0.0001
Q5	65.9	68.5	0.68
Q6	39.0	73.0	<0.0001
Q7	25.2	66.3	<0.0001
Q8	59.4	94.4	<0.0001
Q9	82.1	87.6	0.28
Q10	91.9	92.1	0.94

Question guide:

Q1. How often should all sexually active gay, bisexual, and other men who have sex with men (MSM) be screened for HIV, syphilis, chlamydia, and gonorrhea?

Q2. According to the CDC, annual chlamydia screening is recommended for all sexually active women under the age of ____, as well as older women with risk factors such as ____.

Q3. 4th generation HIV tests detect ____ in blood specimens.

Q4. PrEP, when used daily and with condoms, has been shown to reduce the risk of HIV infection in those who are high risk by up to

Q5. Which of these individuals would benefit from PrEP use?

Q6. At time of initiation of a PrEP regimen, how many days of medication should you prescribe at the first patient visit?

Q7. How many days of medication should you prescribe at an initial PEP visit?

Q8. How many hours after HIV exposure should PEP be started?

Q9. Which of these individuals would be a candidate for PEP (assume within appropriate time window)?

Q10. True or False: HIV negative recipients of an HIV vaccine may test positive on some HIV antibody tests for the duration of a vaccine study and possibly thereafter.

For the focus groups, two community members attended the first focus group and four community members attended the second ($n = 6$). The first and second focus groups lasted 90 and 120 minutes, respectively. Demographic characteristics of focus group participants are summarized in Table 5. Three key themes were identified from the focus groups, which were used inform module content and are summarized in Table 6, with supporting quotes.

TABLE 5:

Focus group participant demographic information

Focus Group	Age	Race	Gender identity	Sexual orientation	Heard of PEP	Ever taken PEP	Heard of PrEP	Ever taken PrEP
1	31	Mixed race (did not specify)	Female	Heterosexual	Y	N	Y	N
1	24	Black/Non-Hispanic	Male	Heterosexual	N	N	Y	N
2	37	Black/Non-Hispanic	Male	Gay	Y	N	Y	Y
2	56	Black/Non-Hispanic	Male	Bisexual	Y	Y	Y	Y
2		White/Non-Hispanic	Female	Heterosexual	Y	N	Y	N
2	40	Black/Non-Hispanic	Male	Heterosexual	Y	Y	N	N

Focus group participants were required to choose a fictitious name during recording. For data presentation purposes, participants are grouped according to which of the two focus groups in which they participated and not by the pseudonym selected during recording.

Female refers to cisgender female and male refers to cisgender male. We did not have any trans-identifying participants for either focus group.

Y = yes; N = no.

Unfilled box indicates that participant did not provide response within free text response box. This demographic information reflects factors which were important to our selection process but does not represent all demographic information participants provided prior to the focus group.

TABLE 6:

Focus group themes with supporting quotations from participants

Community focus group themes and quotations ¹	
Theme	Illustrative Quotes
Bias and stereotype in patient-provider interactions	“But maybe to not use – I don’t necessarily feel like you have to speak to minorities, gay men, or people who live in maybe impoverished neighborhoods like we are high risk just because of those factors.”
Diversifying standard clinical practices	“I think they should have like a checklist of things, you know. I’ve never been to a primary care doctor that – maybe I filled it out on paper – that asked me if I’m bisexual, if I’m heterosexual, whatever. I’ve never really experienced that before.”
Openly promoting access to innovative prevention services	“You know, you don’t see signs in the office that says PrEP or anything like that. You go to these community based places and you see PrEP everywhere, you know? But you don’t see it in no primary care doc, you know, about that.”

Focus group quotations were selected, verbatim, from audio recorded transcripts. Language was not abridged or manipulated. Transcription was performed by Transcripts for North America.

Discussion

This study evaluated medical students’ knowledge and confidence of HIV and STI prevention concepts across the spectrum of gender identity and sexual orientation. Our findings suggest that there is a need for increased HIV and STI prevention training in standard medical school curriculums, particularly given the recent Centers for Disease Control (CDC) recommendation that all sexually active adolescents and adults be informed by their providers about PrEP.²⁶ This conclusion is supported by our findings that while most students had heard of pre-exposure prophylaxis (99.2%) and post-exposure prophylaxis

(92.7%), only 30.8% of students felt confident identifying patients who were candidates for these prevention therapies. Before the intervention, relatively few students could identify the number of days of medication that should be prescribed at an initial visit for PrEP (39%) and PEP (25%). Baseline HIV and STI prevention knowledge was similar across years of medical education. Fourth year medical students preparing to begin residency did not feel more confident compared to their classmates at identifying candidates for prevention services nor did they report the highest confidence in their sexual history taking abilities or confidence interacting with LGBTQ patients. This highlights a lack of effective curricula for medical students related to sexual health.

Our findings also suggest that educational modules are an effective and easy-to-implement way of increasing medical student knowledge. While 30.8% of students felt confident identifying a candidate for prevention services before the educational intervention, this increased to 91% following completion of the educational modules. In addition, LGBTQ familiarity, sexual history abilities, and HIV/STI screening and prevention domains increased following the intervention. These trends in increased comfort and confidence support the utilization of innovative educational modules as practical and accessible learning tools to increase medical student knowledge.

The student feedback on the modules was overwhelmingly positive. Feedback from one anonymous student states, "Great modules, this is the first time in my medical school program to learn about PEP, as well as my first formal education module on PrEP, keep it up and make it more available to future healthcare providers." Another anonymous student provided the following feedback: "Really useful modules, especially the PEP module as I received no education on post-exposure prophylaxis, as well as how to prescribe it to my patients throughout the entirety of medical school. These modules should become an integral part of our clinical training."

This study has several strengths. The educational modules were designed in part by sexual health providers who provided the clinical expertise and nuance of screening and treating HIV and other STIs. Another strength was the assessment of medical knowledge along the gradient of medical education. This allowed us to assess student knowledge at different stages of learning which prevented an assumption of learning being a linear process and directly correlated with the amount of medical education one has received.

Our study is not without limitations. Pre- and post-module questionnaires were completed anonymously and we did not provide students with an anonymous identification number or traceable identifier which limits our ability to make precise inference about the pre and post characteristics of those who completed the study. In addition, this limited the statistical power of our analyses as our study data are intrinsically paired, but unpaired statistical analyses were used due to an inability to pair or link specific pre and post intervention responses. We were also limited in our ability to make observations about post-intervention changes on a class- or demographic-specific level as we did not collect demographic information or medical education level in the post-module questionnaire. The study may have limited generalizability since the baseline characteristics of students who completed the study do not necessarily reflect the

characteristics of all medical students or providers. Also, given that the data was gathered by self-report, it is possible that students over or under estimated their own abilities during survey completion. If our recruitment attracted students with specific social or educational variables, this may have been a confounding element. Furthermore, students training in New York City, where there have been robust public campaigns dedicated to HIV prevention in groups such as women of color and MSM, may have greater baseline exposure to the concepts we assessed than the students who are training in other areas of the United States.

Since their inception, these modules have become a part of the curriculum for first- and fourth-year medical students. In the future, we aim to pilot these modules among other medical institutions to expand sample size and allow a broader analysis across institutions. We also believe it would be useful to pilot among residents and synthesize modules into brief and focused cases to accommodate resident schedules. Directly assessing the educational intervention in residents would also allow us to assess real-world changes in clinical practice in addition to hypothetical comfort and confidence in students.

Conclusion

We demonstrated that online educational modules surrounding HIV prevention are easy to design and implement, viewed favorably by learners, and effectively increase medical students' knowledge of STI testing, HIV prevention strategies, and confidence in taking a sexual history. Broader implementation of such modules in medical school curricula could enhance HIV prevention services offered by the next generation of medical providers.

Abbreviations

AIDS = acquired immunodeficiency syndrome

FTM = female-to-male

HIV = human immunodeficiency virus

IQR = interquartile range

IRB = internal review board

LGBTQ = lesbian, gay, bisexual, transgender, queer/questioning

MSM = men who have sex with men

MTF = male-to-female

PrEP = pre-exposure prophylaxis

PEP = post-exposure prophylaxis

STI = sexually transmitted infection

TasP = treatment as prevention

US = United States

Declarations

Ethics Approval and Consent to Participate

This investigation was conducted in accordance with the Declarations of Helsinki and was approved by the Internal Review Board (IRB) at Columbia University Irving Medical Center (CUIMC) (protocol AAAR8304). Informed consent was obtained from all medical student participants via the pre-module online questionnaire and from all community members who participated in the focus groups.

Consent for Publication

Not applicable.

Availability of Data and Materials

The datasets generated and analyzed during the current study are not publicly available as they are protected by the Columbia University Irving Medical Center IRB but are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

WG, MAA, JB, CC, JZ, and MES participated in study conceptualization. WG and MAA were the primary creators of the educational modules. RJG provided instruction on the software used to create the modules. CC, JZ, BG, RJG, and MES reviewed the module content and offered feedback. WG and CS completed the data analysis. MAA, JB, and WG conducted the focus groups and identified key themes from interview transcripts. WG and MAA drafted the manuscript, with feedback from CS, JZ, and MES. All authors read and approved the final manuscript.

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References

1. Volume 32 | HIV Surveillance | Reports | Resource Library | HIV/AIDS | CDC.
<https://www.cdc.gov/hiv/library/reports/hiv-surveillance/vol-32/index.html>. Accessed December 17, 2021.
2. U.S. Statistics | HIV.gov. <https://www.hiv.gov/hiv-basics/overview/data-and-trends/statistics>. Accessed January 20, 2022.
3. Taylor NK, Taylor NK, Young MR, et al. Assessing Knowledge of HIV Vaccines and Biomedical Prevention Methods Among Transgender Women in the New York City Tri-State Area. *Transgender Heal*. 2020;5(2):116–121. doi:10.1089/TRGH.2019.0049
4. Bayer CR, Eckstrand KL, Knudson G, et al. Sexual Health Competencies for Undergraduate Medical Education in North America. *J Sex Med*. 2017;14(4):535–540. doi:10.1016/J.JSXM.2017.01.017
5. Fish JN, Turpin RE, Williams ND, Boekeloo BO. Sexual Identity Differences in Access to and Satisfaction With Health Care: Findings From Nationally Representative Data. *Am J Epidemiol*. 2021;190(7):1281–1293. doi:10.1093/aje/kwab012
6. Dean MA, Victor E, Guidry-Grimes L. Inhospitable Healthcare Spaces: Why Diversity Training on LGBTQIA Issues Is Not Enough. *J Bioeth Inq*. 2016;13(4):557–570. doi:10.1007/S11673-016-9738-9
7. Institute of Medicine (US) Committee on Lesbian GB and THI and RG and O. The Health of Lesbian, Gay, Bisexual, and Transgender People. *Heal Lesbian, Gay, Bisexual, Transgender People Build a Found Better Underst*. June 2011:1-347. doi:10.17226/13128
8. Schnall R, Clark S, Olender S, Sperling JD. Providers' perceptions of the factors influencing the implementation of the New York State mandatory HIV testing law in two Urban academic emergency departments. *Acad Emerg Med*. 2013;20(3):279–286. doi:10.1111/ACEM.12084
9. Zucker J, Patterson B, Ellman T, Morrison E SM. HIV Testing and Linkage to Prevention Services in Northern Manhattan: The First Step to Ending the Epidemic. *HIV Res Prev*. 2016.
10. Dorell CG, Sutton MY, Oster AM, et al. Missed opportunities for HIV testing in health care settings among young African American men who have sex with men: implications for the HIV epidemic. *AIDS Patient Care STDS*. 2011;25(11):657–664. doi:10.1089/APC.2011.0203
11. Martin J, Burke K, Boettcher J, Bhalerao N, Huhn G. Reluctance to Prescribe Pre-Exposure Prophylaxis (PrEP) Among Internal Medicine Residents (IMRs) Training at a U.S. Hospital with a Large HIV-infected Population. *Open Forum Infect Dis*. 2017;4(suppl_1):S449-S450. doi:10.1093/OFID/OFX163.1143

12. Barbee LA, Dhanireddy S, Tat SA, Marrazzo JM. Barriers to Bacterial Sexually Transmitted Infection Testing of HIV-Infected Men Who Have Sex With Men Engaged in HIV Primary Care. *Sex Transm Dis.* 2015;42(10):590–594. doi:10.1097/OLQ.0000000000000320
13. Carter JW, Hart-Cooper GD, Butler MO, Workowski KA, Hoover KW. Provider barriers prevent recommended sexually transmitted disease screening of HIV-infected men who have sex with men. *Sex Transm Dis.* 2014;41(2):137–142. doi:10.1097/OLQ.0000000000000067
14. Krakower D, Ware N, Mitty JA, Maloney K, Mayer KH. HIV providers' perceived barriers and facilitators to implementing pre-exposure prophylaxis in care settings: a qualitative study. *AIDS Behav.* 2014;18(9):1712–1721. doi:10.1007/S10461-014-0839-3
15. Edelman EJ, Moore BA, Calabrese SK, et al. Primary Care Physicians' Willingness to Prescribe HIV Pre-exposure Prophylaxis for People who Inject Drugs. *AIDS Behav.* 2017;21(4):1025–1033. doi:10.1007/S10461-016-1612-6
16. Criniti S, Crane B, Woodland MB, Montgomery OC, Urdaneta Hartmann S. Perceptions of U.S. Medical Residents Regarding Amount and Usefulness of Sexual Health Instruction in Preparation for Clinical Practice. <http://dx.doi.org/101080/1554612820161198734>. 2016;11(3):161–175. doi:10.1080/15546128.2016.1198734
17. Smith DK, Mendoza MCB, Stryker JE, Rose CE. PrEP Awareness and Attitudes in a National Survey of Primary Care Clinicians in the United States, 2009–2015. *PLoS One.* 2016;11(6). doi:10.1371/JOURNAL.PONE.0156592
18. Shindel AW, Baazeem A, Eardley I, Coleman E. Sexual Health in Undergraduate Medical Education: Existing and Future Needs and Platforms. *J Sex Med.* 2016;13(7):1013–1026. doi:10.1016/J.JSXM.2016.04.069
19. Coverdale JH, Balon R, Roberts LW. Teaching sexual history-taking: a systematic review of educational programs. *Acad Med.* 2011;86(12):1590–1595. doi:10.1097/ACM.0B013E318234EA41
20. Malhotra S, Khurshid A, Hendricks KA, Mann JR. Medical school sexual health curriculum and training in the United States. *J Natl Med Assoc.* 2008;100(9):1097–1106. doi:10.1016/S0027-9684(15)31452-8
21. Wittenberg A, Gerber J. Recommendations for improving sexual health curricula in medical schools: results from a two-arm study collecting data from patients and medical students. *J Sex Med.* 2009;6(2):362–368. doi:10.1111/J.1743-6109.2008.01046.X
22. White W, Brenman S, Paradis E, et al. Lesbian, Gay, Bisexual, and Transgender Patient Care: Medical Students' Preparedness and Comfort. *Teach Learn Med.* 2015;27(3):254–263. doi:10.1080/10401334.2015.1044656
23. Van Nieuwenhuizen P, Khangoora K, Gordon R. Virology Online: a free, web-based, adaptive-learning course. *Open Forum Infect Dis.* 2017;4(suppl_1):S445-S445. doi:10.1093/OFID/OFX163.1132
24. *COMMUNITY HEALTH PROFILES 2018 Washington Heights and Inwood 12.*
25. LGBT Data & Demographics – The Williams Institute. <https://williamsinstitute.law.ucla.edu/visualization/lgbt-stats/?topic=LGBT#density>. Accessed

December 17, 2021.

26. Dawn. PREEXPOSURE PROPHYLAXIS FOR THE PREVENTION OF HIV INFECTION IN THE UNITED STATES-2021 UPDATE A CLINICAL PRACTICE GUIDELINE.

Figures

Figure 1

Study participation and completion

620 students were recruited via email and residency preparation course. One hundred twenty-five (125) students responded and completed the pre-module questionnaire. Two submissions were excluded due to incomplete demographic information and incomplete self-assessment; thus, 123 students were included in pre-module analyses. Of the 125 students who responded, 89 also completed the post-module questionnaire.

Figure 2

Pre and post educational intervention LGBTQ familiarity, sexual history abilities, and prevention confidence

Pre-module mean scores $n = 123$. Post-module mean scores $n = 89$. LGBTQ familiarity represents student confidence engaging concepts of LGBTQ patient care. Sexual history abilities represent student general sexual history taking comfort and confidence as well as perception of medical training preparedness. Prevention confidence reflects student confidence identifying indications for PrEP, PEP, and other sexual health prevention measures.

Figure 3

Pre and post educational intervention HIV/STI screening and prevention knowledge

Pre-module mean scores $n = 123$. Post-module mean scores $n = 89$. HIV/STI screening and prevention scores are on scale of 0-10 and represents general sexual health screening and prevention questions scored for correctness.

Figure 4

Pre-educational intervention PrEP and PEP confidence

Pre-educational PrEP and PEP confidence $n = 123$. Participants were asked to rate their agreement with the statement “I feel confident identifying candidates for PrEP and PEP.” Strongly disagree and disagree were grouped into one category (54/123; 43.9%). Neutral confidence was an independent category (31/123; 25.2%). Strongly agree and agree were grouped into one category (38/123; 30.8). While one participant completed the pre-educational prevention confidence assessment, they did not provide demographic information and their responses were invalidated. This exclusion resulted in total number of “strongly agree/agree” responses being decreased from

39 to 38.

Figure 5

Post-educational intervention PrEP and PEP confidence

Post-educational PrEP and PEP confidence $n = 89$. Participants were asked to rate their agreement with the statement “I feel confident identifying candidates for PrEP and PEP.” Strongly disagree and disagree were grouped into one category (2/89; 2%). Neutral confidence was an independent category (6/89; 6.7%). Strongly agree and agree were grouped into one category (81/89; 91%).