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RESEARCH ARTICLE

Mpox and Vaccine Knowledge, Beliefs, and Sources of Trusted Information Among Gay, Bisexual, and Other Men Who Have Sex With Men in the U.S.

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Introduction: This research aims to characterize disparities in mpox- and vaccine-related knowledge in gay, bisexual, and other men who have sex with men in the U.S.

Methods: The authors conducted a study using the American Men's Internet Survey, which includes 823 cisgender (defined as their gender identity matching their sex assigned at birth) males aged ≥15 years from August 5 to 15, 2022. The authors evaluated sociodemographic and behavioral factors associated with mpox knowledge, including race/ethnicity, region, age group, and HIV pre-exposure prophylaxis use using chi-square tests.

Results: The authors identified knowledge gaps, with many participants unsure about whether individuals need 2 doses of the vaccine (34.4%) and whether the vaccine confers immediate protection (27.2%). The authors observed racial and regional disparities ($p<0.01$), with 24.4% of non-Hispanic Black men and 18.1% of men living in the South reporting little to no mpox awareness. Among the 707 self-reported HIV-negative participants, people who used pre-exposure prophylaxis within the past year were more likely to exhibit high awareness about mpox than people who did not use pre-exposure prophylaxis.

Conclusions: Findings suggest the potential to leverage existing networks (i.e., sexually transmitted infection or general health care services with pre-exposure prophylaxis use) for future targeted health service programming or education campaigns for mpox vaccination among gay, bisexual, and other men who have sex with men.

INTRODUCTION

Human mpox virus is an orthopoxvirus that was first identified in humans in the 1970s during smallpox eradication campaigns in Africa.[1] Yet, rapid epidemiologic changes beginning in the spring of 2022 resulted in the WHO declaring the multicountry mpox outbreak a public health emergency of international concern in July 2022. The public health emergency of international

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concern ended in May 2023 after sustained decline in the number of cases.[2]

Mpox was previously primarily zoonotic in transmission,[3] and zoonotic transmission still occurs within endemic countries, but zoonotic transmission is not currently the main driver of transmission during the global outbreak of Clade IIb MPXV, the strain that caused the 2022 mpox pandemic.[4] Over recent years, the authors have observed an increased incidence of mpox in endemic countries, driven by increased human−animal interfaces, waning immunity since the cessation of smallpox vaccinations, and increased travel.[5]

The first case of mpox in the 2022−2023 U.S. outbreak was reported on May 17, 2022.[6] As of January 10, 2024, there were >92,500 confirmed mpox cases globally,[6] with 31,689 cases in the U.S. Additional preliminary research of the outbreak presented a wide range of physical manifestations of mpox infection[7] and identified viral DNA in lesions and semen of infected individuals.

Gay, bisexual, and other men who have sex with men (GBMSM) were disproportionately affected in the 2022 mpox pandemic.[5] This phenomenon is hypothesized to have emerged and been sustained by a variety of community or ecologic factors such as environmental or pathogenic changes; highly connected sexual networks within GBMSM and overlap of outbreaks with large-scale community events such as pride festivals; a long incubation period of the virus; few vaccinated individuals at the onset of the epidemic; lack of community awareness; and structural barriers, including sexual identity and behavior stigma, which may have limited engagement with mpox prevention or treatment.[5,8−10]

The U.S. federal government launched a comprehensive response and research plan to the outbreak,[11] including distributing the mpox vaccine; encouraging testing; making treatments available for free; and educating health care providers and the public[12] on steps to reduce risk of infection, symptoms, and behaviors that can lead to the spread of mpox. Specifically, U.S. Centers for Disease Control and Prevention (CDC) worked with public health partners to craft messages to reach populations most affected by mpox,[13] focusing on methods that would directly reach gay and bisexual men of different racial, ethnic, socioeconomic, and geographic backgrounds[14] such as specific websites, dating apps, or media programs. However, news media reported gaps in these efforts early in the outbreak, including limited vaccine rollout[15] and concerns of stigma producing reluctance to provide specific messaging for GBMSM despite the disproportionate burden.[16]

The U.S. Monkeypox Research Priorities were released in July 2022 and identified outstanding research questions, objectives, and investigations that, if addressed, would provide critical, real-time data to inform U.S. outbreak response operations, communications, and implementation.[11] Research priorities for public health communication strategies included collection of "qualitative and quantitative data and perspectives from affected populations to guide implementation of response interventions.[11]"

In the 2022−2023 mpox outbreak, people most affected by mpox may not have had complete information about the disease or may have been exposed to misinformation.[17,18] In response, this study sought to assess the level of awareness about mpox early in the outbreak, where people are receiving their information, beliefs and knowledge related to vaccination and transmission, and disparities. To understand motivators of behavior change, identify education or awareness gaps for programmatic purposes, and address U.S. Monkeypox Research Priorities, the authors evaluated awareness, levels of knowledge or beliefs about mpox vaccination, and sources of trusted information among a nationwide sample of GBMSM in the U.S.

METHODS

The American Men's Internet Survey (AMIS) mpox substudy was a 1-time, self-administered online survey conducted from August 5 to 15, 2022 to assess the knowledge, behaviors, and experiences related to mpox and vaccination perceptions and behaviors among GBMSM in the U.S. and was developed because of the global mpox outbreak. This survey was developed by Emory University in collaboration with the CDC and Johns Hopkins University as an associated substudy of the AMIS-2021 survey. The mpox substudy included men aged ≥15 years living in the U.S. who had previously participated in the AMIS-2021 survey.

Study Sample

The AMIS mpox substudy sampling frame included all individuals who completed AMIS-2021, had anal or oral sex with a man in the past 12 months, and consented to be recontacted about future research studies (N=2,999). Survey eligibility criteria were verified for all respondents to the AMIS mpox substudy. Methods for the annual AMIS survey have been previously described.[19] Briefly, the original AMIS-2021 survey participants were recruited through social media advertising and included cisgender men, aged ≥15 years, who reported ever having had sex with a man and lived in the U.S. or its territories.

All potential individuals for the substudy received an email invitation to complete the survey on August 4,

2022 and, if they did not complete the survey, were sent a reminder on August 11, 2022. All participants provided electronic informed consent after eligibility screening and could stop their participation in the survey at any time. Participants were not compensated.

Participants could complete the mpox substudy using a secured uniform resource locator on any device. The survey was available in English, and the median completion time for the survey was 17.3 minutes. The survey contained several modules, including demographics, mpox vaccine history, sexual behavior, substance use, HIV testing, sexually transmitted infection (STI) testing and diagnoses, HIV pre-exposure prophylaxis (PrEP), recent symptoms, mpox testing, mpox diagnosis, and experiences of stigma. All mpox-related questions were developed owing to the mpox pandemic and were not included in prior AMIS surveys.

Measures

To measure awareness of mpox, the authors used a single item 4-point Likert scale that asked how much participants had seen, read, or heard about mpox. The authors then used 9 items to measure mpox-related beliefs or knowledge. Each item contained a statement about mpox, with Likert-like responses (*strongly disagree*, *mostly disagree, mostly agree*, or *strongly agree*). Examples of these statements included *the Monkeypox vaccine provides immediate protection against Monkeypox* and *You need one dose of the Monkeypox vaccine to be protected*. Owing to the timing of the survey, monkeypox was still being used commonly rather than mpox.

The authors also included a single question to assess trusted sources of information about mpox: What sources would you trust for accurate information about monkeypox? Response options included health care providers, state or local public health officials, health information websites, the CDC, WHO, social media, dating apps, news media, or none of these. Participants could select multiple responses.

Statistical Analysis

The data reported in this subsurvey were analyzed using Stata, Version 16.1.[20] The authors first summarized and tabulated levels of awareness in the overall sample. The authors then used chi-square tests to evaluate differences in awareness about mpox by sociodemographic and behavioral factors, including race/ethnicity (non-Hispanic Black, Hispanic, non-Hispanic White, other), U.S. region (Northeast, Midwest, South, West, U.S. Dependent Areas), age group (15−24, 25−29, 30−39, or ≥40 years), HIV status, and PrEP use.

The authors summarized unstratified measures of the mpox-related vaccine and transmission beliefs and knowledge items. The authors then summarized the distribution of trusted sources of health information and evaluated the most common responses by racial/ethnic groups.

This study was reviewed and approved by the Emory University IRB. This activity was also reviewed by CDC and was conducted consistent with applicable federal law and CDC policy. AMIS data are shared with the CDC and Johns Hopkins University through contractual data sharing agreements. The data in this substudy are not publicly available to protect individual confidentiality.

RESULTS

The response rate among AMIS-2021 cycle participants who provided email addresses for future study contacts was 27.5% (824 of 2,999). After enrollment for the survey was completed, data were reviewed and assessed to ensure data reliability. The authors further removed 1 individual from analysis who reported never hearing about mpox to result in a total analytical sample of 823 individuals.

Overall, 44.0% (362 of 823) of participants reported high awareness (they had seen, heard, or read a lot) about mpox, and 16.1% (*n*=140) reported little to no awareness (Table 1). However, non-Hispanic Black participants reported the lowest levels of awareness, with 24.4% (*n*=21) reporting little to no awareness of mpox. Levels of awareness of mpox varied significantly by region, with the greatest unawareness in the West (21.6%). There was a positive association between HIV PrEP use and mpox awareness. People who used HIV PrEP had greater mpox awareness, with 49.7% (*n*=157) of individuals who used PrEP (*n*=316) indicating high mpox awareness compared with 37.3% (*n*=146) of individuals who did not use PrEP (*n*=391).

More than 25% of individuals indicated that they did not know or were unsure about many of the statements related to mpox (Table 2). The greatest knowledge gaps were related to knowledge of the number of mpox vaccine doses needed, with 31.3% (*n*=248) indicating that 1 dose is sufficient. Some individuals also indicated that the mpox vaccine confers immediate protection against mpox (27.2%, *n*=215) and that transmission of mpox could occur through semen (34.9%, *n*=278) or saliva (27.0%, *n*=794).

The most endorsed sources of trusted information included individual's doctors or health care providers (89.8%, *n*=739), the CDC (80.7%, *n*=664), and state or local public health officials (77.6%, *n*=639) (Table 3). The least endorsed sources of information were dating apps (15.0%, *n*=123) and social media (6.7%, *n*=55).

Table 1. Level of Mpox Awareness Among U.S. Men Who Have Sex With Men, August 2022

Characteristic	All participants, *n* (column %)	Level of mpox awareness			χ^2 *p*-value
		Little or none, *n* (row %)	Some, *n* (row %)	A lot, *n* (row %)	
Total	823 (100.0)	140 (16.1)	321 (39.0)	362 (44.0)	—
Race/ethnicity					0.148
Non-Hispanic Black	86 (10.5)	21 (24.4)	30 (34.9)	35 (40.7)	—
Hispanic or Latino	88 (10.7)	9 (10.2)	36 (40.9)	43 (48.9)	—
Non-Hispanic White	581 (70.6)	103 (17.7)	223 (38.4)	255 (43.9)	—
Other	68 (8.3)	7 (10.3)	32 (47.1)	29 (42.7)	—
Age, years					0.795
15–24	46 (5.6)	7 (15.2)	22 (47.8)	17 (37.0)	—
25–29	86 (10.5)	16 (18.6)	35 (40.7)	35 (40.7)	—
30–39	213 (25.9)	40 (18.8)	82 (38.5)	91 (42.7)	—
≥40	478 (58.1)	77 (16.1)	182 (38.1)	219 (45.8)	—
Region					**0.004**
Northeast	174 (21.1)	16 (9.2)	72 (41.4)	86 (49.4)	—
Midwest	141 (17.1)	25 (17.7)	68 (48.2)	48 (34.0)	—
South	304 (36.9)	55 (18.1)	114 (37.5)	135 (44.4)	—
West	204 (24.8)	44 (21.6)	67 (32.8)	93 (45.6)	—
STI diagnosis in past 12 months					0.245
No	755 (91.7)	132 (17.5)	297 (39.3)	326 (43.2)	—
Yes	68 (8.3)	8 (11.8)	24 (35.3)	36 (52.9)	—
HIV status					0.255
HIV negative or unknown	720 (87.5)	124 (17.2)	287 (39.9)	309 (42.9)	—
HIV positive	103 (12.5)	16 (15.5)	34 (33.0)	53 (51.5)	—
HIV PrEP use in the past 12 months					**0.004**
No	391 (55.3)	74 (18.9)	171 (43.7)	146 (37.3)	—
Yes	316 (44.7)	48 (15.2)	111 (35.1)	157 (49.7)	—

Note: PrEP use was evaluated only among those who did not report being HIV positive. Bold text in this table indicates a *p*-value <0.05.
PrEP, pre-exposure prophylaxis; STI, sexually transmitted infection.

Most participants selected at least 1 source of trusted information, with 13 participants (1.6%) saying that they trusted none of the listed sources. Of the 13 men who did not trust any sources of health information, 92.3% (*n*=12) did not receive any mpox vaccine. Although there were absolute differences in trusted source of health information by race/ethnicity, these findings were not statistically significant.

DISCUSSION

The key objective in these analyses was to identify awareness or knowledge gaps about mpox vaccination among a nationwide sample of U.S. GBMSM to inform ongoing programmatic efforts and research priorities at that time. Prior research suggested that the lowest rates of mpox vaccination were in rural areas, particularly in the South and Midwest, particularly among Black GBMSM than among other race groups.[18] This study aligned with this and reinforced the need for additional outreach services to overcome disparities and led to focused efforts to reach Hispanic/Latino and Black GBMSM.

The authors' finding of greater mpox awareness among GBMSM who reported HIV PrEP use could be attributed to mpox testing and vaccine clinics also providing other sexual health services. This may speak to the utility of this approach and builds on previous studies showing that men who use HIV PrEP may be more likely to have testing and treatment for STIs.[21,22] However, it could also mean that disparities that already exist with HIV PrEP access may be repeated for mpox. The protective effect of HIV PrEP use on mpox awareness in this study could indicate higher health literacy or self-efficacy among individuals using HIV PrEP, more interactions with the health care system and educational opportunities through interactions with health providers,[23] or differing social or sexual networks of individuals who are more informed about mpox than individuals not using HIV PrEP.

Table 2. Knowledge About Mpox and Vaccination by Percentage Agreement Among U.S. Men Who Have Sex With Men, August 2022

Characteristic	Respondent *n*	Strongly agree, *n* (row %)	Mostly agree, *n* (row %)	Mostly disagree, *n* (row %)	Strongly disagree, *n* (row %)	Do not know/ unsure, *n* (row %)
Statement						
There is a vaccine that can prevent mpox	794	522 (65.7)	183 (23.1)	13 (1.6)	15 (1.9)	56 (7.1)
The monkeypox vaccine provides immediate protection against mpox	792	32 (4.0)	125 (15.8)	207 (26.1)	211 (26.6)	215 (27.2)
You need 1 dose of the mpox vaccine to be protected.	793	39 (4.9)	106 (13.4)	177 (22.3)	221 (22.9)	248 (31.3)
You need 2 doses of the mpox vaccine to be protected.	796	350 (44.0)	114 (14.3)	40 (5.0)	16 (2.0)	274 (34.4)
Mpox can be transmitted by semen	796	165 (20.7)	121 (15.2)	83 (10.4)	148 (18.6)	278 (34.9)
Mpox can be transmitted by saliva	794	249 (31.4)	170 (21.4)	73 (9.2)	87 (11.0)	214 (27.0)
Mpox can only be transmitted to others while people are experiencing the rash	794	169 (21.3)	154 (19.4)	153 (19.3)	122 (15.4)	195 (24.6)
Condoms can prevent you from getting mpox during sex	795	18 (2.3)	63 (7.9)	208 (26.2)	372 (46.8)	132 (16.6)
Wearing clothing can prevent you from getting mpox during close contact	795	87 (10.9)	275 (34.6)	176 (22.1)	100 (12.6)	155 (19.5)

Note: Because some individuals did not answer every question, the authors had between 792 and 796 responses for each of these items.

Gaps in awareness and knowledge about mpox and vaccination are likely to make future epidemic control more challenging. Given the disparities in uptake of mpox-related interventions, it is also critical for public health programs to adapt and translate emerging science into actionable messaging, interventions, and programs.

An earlier report from authors' study noted changes in behavior after identification of mpox, with approximately 50% of GBMSM reporting reductions in their number of sexual partners and/or hookups owing to community mpox infections.[24] Although these community behavioral changes are an important contributor to reducing transmission,[25] the previously described gaps in mpox vaccine services uptake[24] may be related to awareness or certain beliefs or knowledge about the virus and disease.

The authors found knowledge gaps regarding transmission risk such as use of condoms or clothes to prevent transmission or risk of transmission through saliva or semen. In addition, the authors found knowledge gaps about effectiveness of vaccination, such as when protection is conferred or the number of doses necessary

Table 3. Sources of Trusted Health Information About Mpox Among U.S. Men Who Have Sex With Men by Race/Ethnicity, August 2022

		Race/ethnicity				
Characteristic	All participants, *n* (column %)	Non-Hispanic Black, *n* (row %)	Hispanic, *n* (row %)	Non-Hispanic White, *n* (row %)	Other, *n* (row %)	χ^2 *p*-value
Total	823 (100.0)	86 (10.5)	88 (10.7)	581 (70.6)	68 (8.3)	
Sources of trusted health information[a]						
Doctor or health care provider	739 (89.8)	73 (84.9)	75 (85.2)	530 (91.2)	61 (89.7)	0.135
Social media	55 (6.7)	9 (10.5)	5 (5.7)	36 (6.2)	5 (7.4)	0.497
Dating apps	123 (15.0)	11 (12.8)	17 (19.3)	88 (15.2)	7 (10.3)	0.421
News media	275 (33.4)	28 (32.6)	31 (35.2)	190 (32.7)	26 (38.2)	0.801
State or local public health officials	639 (77.6)	62 (72.1)	64 (72.7)	457 (78.7)	56 (82.4)	0.265
Health info sites (e.g., WebMD)	372 (45.2)	39 (45.4)	35 (39.8)	268 (46.1)	30 (44.1)	0.734
U.S. Centers for Disease Control and Prevention	664 (80.7)	64 (74.4)	70 (79.6)	470 (80.9)	60 (88.2)	0.192
WHO	538 (65.4)	50 (58.1)	50 (56.8)	389 (67.0)	49 (72.1)	0.078
I do not trust any of these	13 (1.6)	1 (1.2)	2 (2.3)	9 (1.6)	1 (1.5)	0.945

[a]Participant may select multiple sources or that they did not trust any of them.

for protection. These findings suggest a critical need to focus further research and community education efforts, particularly among populations with the lowest levels of awareness or knowledge related to mpox early in the public health response in future outbreak settings. Ultimately, beliefs and perceived knowledge about transmission may inform individual's decisions to engage in behaviors. Specifically, incorrectly thinking that prevention strategies could work (when they do not), such as using condoms to prevent transmission, produces a different challenge compared with believing that vaccines do not work (when they can). This information, coupled with the Advisory Committee on Immunization Practices review of mpox vaccine efficacy and recommendation to add the JYNNEOS vaccine schedule for individuals susceptible to mpox acquisition,[26] can inform future information campaigns in outbreak settings.

Regarding trusted information sources, there were few participants who indicated no sources of trusted information. Given widespread trust in providers and public health officials/agencies, collaboration is critical, especially with local health departments and providers serving GBMSM (and other) individuals. Community engagement and partnerships can enhance the messages and channels for distribution.[23] Previous studies have illustrated that technology can be utilized to promote health education or interventions,[27] particularly for HIV-related matters, and there is a general lack of trust in social media and dating apps in this study population. These platforms of communication may be valued in some networks or settings to promote equity,[27] but they cannot be the sole source of information.

In summary, the federal mpox research and response plan explicitly worked to avoid stigmatizing language and take a harm-reduction approach to prevention strategies in vaccination,[11,12] providing a range of clear and frank options that are supported by data and science. Still, this work has identified gaps in mpox awareness and vaccine knowledge by factors such as region and HIV PrEP use. Findings suggest the potential to leverage existing networks (i.e., STI or general health care services with PrEP use) for targeted health service programming related to mpox or other emerging infections disproportionately affecting GBMSM. These same platforms have successfully been leveraged for education campaigns and mpox vaccine delivery among particularly affected populations in the U.S., including GBMSM,[28] and to expand services to other communities that can be disproportionately affected.

In addition to the promotion of nonstigmatizing sex-positive language regarding behavioral interventions, programs can address inequities across racial/ethnic groups and regionally in access to messaging, testing, prevention services, and treatment. Importantly, working toward equity in vaccine coverage is central to the mitigation of mpox-related health effects. Because there are global decreases in mpox incidence yet continued transmission[29] in the U.S., this body of research can be built upon to work toward disparities in the health impacts of current and future mpox outbreaks.

Limitations

This study sample is a convenience sample and is subject to self-selection bias, which has resulted in an GBMSM sample that skews older and more non-Hispanic White than the general U.S. male population, which limits overall generalizability to the entire GBMSM population in the U.S. The authors recognize that the response rate for the survey was 27.5%, which is relatively low. The nonresponse could bias the results because individuals who responded to the substudy may have been more connected or aware of mpox than the general population. Given this sample, participants may have been more likely to be more aware of mpox and more likely to trust traditional sources of health information such as care providers, public health officials, and government/multilateral agencies. In addition, because the data were self-reported, there could have been misinterpretation of some of the questions or more positive responses owing to social desirability. The timing of data collection from early to mid-August 2022 reflects a particular point in time, and results may not be applicable to current ongoing mpox prevention efforts.

CONCLUSIONS

Mpox quickly became a public health concern in 2022 among many individuals throughout the US, particularly GBMSM. After developing a rapid-response survey to study mpox through AMIS from August 5 to 15, 2022, the authors identified several knowledge gaps in GBMSM, ranging from the number of necessary doses of the mpox vaccine and how quickly it confers resistance to infection. The authors observed racial and regional disparities, with a greater proportion of non-Hispanic Black men and men living in the South reporting little to no mpox awareness than other groups. In addition, the authors found that among HIV-negative participants, people who used PrEP within the past year were more likely to exhibit high awareness about mpox than people who did not use PrEP. In addition, the authors found that individuals who did not trust the listed sources of health information were unlikely to become vaccinated for mpox, posing potential barriers to reach full community vaccine coverage. Regardless,

the authors conclude that integrating mpox services into existing social services and health delivery networks (i.e., STI care or general health care services) is essential for future mpox health education, combatting misinformation, and improving service delivery and vaccine efforts.

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