# Impact of MPOX on Behavior Changes and Vaccine Uptake Among MSM

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**Abstract**

The emergence of the monkeypox virus into a global community still reeling from the ravages of the COVID-19 pandemic represented the latest challenge to public health response. The rapid spread of the disease into non-endemic countries beginning in the spring of 2022 necessitated a swift understanding of how to diagnose, treat, and prevent this novel infection most effectively. Ultimately, changes in sexual behavior and the widespread implementation of vaccination were attributed as the primary reasons for the worldwide decline in cases. The purpose of this study was to assess the knowledge of MPOX disease, transmission methods, and recommended prevention strategies (including sexual behavior changes and vaccination) in patients who identify as men who have sex with men (MSM) and seek care from the HIV clinics operated by Arnot Health in Chemung County, NY. A secondary goal was to assess any changes in MSM behavior due to the 2022 MPOX outbreak.

An invitation containing a QR code linked to an online survey was mailed to 150 HIV clinic patients in September 2023. Although only 15 surveys were completed, several intriguing trends were identified. The respondents were predominantly White, male, and homosexual individuals spanning three distinct generations of age. A considerable variation in the extent of sexual behavior practices was reported, with respondents scoring an average of 0.69 (out of a possible 3.0), indicating an overall lack of knowledge of MPOX transmission and the importance of preventative measures. In addition, an average score of 0.85 (out of a possible 2.0) suggested that respondents had not changed their sexual behavior practices in direct response to the MPOX epidemic that began in 2022. Interestingly, the degree of MPOX vaccine uptake among respondents (66.7%) was higher than expected in a rural setting, although lower than what has been reported in urban jurisdictions.

The results of this study demonstrate a need to focus preventative health interventions on MSM and other LGBTQ individuals living in rural communities. Public health agencies must collaborate with primary care providers to engage these vulnerable groups and provide the required education and resources. Specifically, the risk of MPOX infection needs to be incorporated into a more extensive discussion on sexual health and the critical importance of behavior modification and vaccination to minimize the health risks.

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## List of Abbreviations

ACIP .....Advisory Committee on Immunization Practices

AMIS.....Emory American Men's Internet Survey

CDC .....Centers for Disease Control and Prevention

FDA.....Food and Drug Administration

HIV .....Human Immunodeficiency Virus

MPOX.....Revised term for monkeypox virus (Effective November 2022)

MSM .....Men Who Have Sex with Men

NYSDOH.....New York State Department of Health

PCR.....Polymerase Chain Reaction

SEM .....Social-Ecological Model

STI.....Sexually-Transmitted Infection

WHO.....World Health Organization

# Chapter 1

## Introduction

The emergence of the monkeypox virus into a global community still reeling from the ravages of the COVID-19 pandemic represented the latest challenge to public health response. Organizations such as the Centers for Disease Control and Prevention (CDC), still battling coronavirus variants, were forced to juggle the demands of a pathogen foreign to many countries. The World Health Organization (WHO) renamed the monkeypox virus MPOX in November 2022 to reduce the stigmatization of the disease (WHO, 2022). Although the virus responsible for MPOX infection is not new—the organism was first identified in Denmark from a colony of monkeys being used for research in 1958 (Magnus et al., 2009)— its introduction into nations where cases are not typically endemic has prompted health officials to learn the unique characteristics of MPOX quickly. In turn, the need arose to devise new strategies to identify cases and implement control measures for this infection. After more than 30,000 cases and 32 deaths since the first patients were identified in May 2022 (Owens et al., 2023), the tactics employed appeared to have paid off in the United States (U.S.). As of December 2022, fewer than 10 MPOX cases per day prompted the Biden administration to announce that it did not expect to extend its declaration of a public health emergency for the outbreak of MPOX past its scheduled expiration at the end of January 2023 (Weiland, 2022).

Changes in sexual behavior have been attributed as one of the reasons for the decline in cases. In an online survey of gay, bisexual, and other men who have sex with men (MSM) conducted during August 5-15, 2022, respondents reported the outbreak prompted a behavior change: 48% reported reducing their number of sex partners, 50% reported reducing one-time sexual encounters, and 50% reported reducing sex with partners met on dating apps or at sex

venues (Delaney et al., 2022). The global implementation of the MPOX vaccination in non-endemic countries, particularly the JYNNEOS vaccine, has also been cited as a critical tool for helping to curb transmission in developed countries (Adams, 2022). The incidence of MPOX in the United States between May 10 to December 31, 2022, was estimated to be 71% in persons residing in large central urban areas. Comparatively, the incidence of MPOX cases in rural areas was approximately 4% of that of the larger urban locations (Zelaya et al., 2023). However, little is known about the impact of MPOX infections in rural locations of the United States, nor is much understood about the breadth or success of interventions implemented in these regions to combat this disease. The challenges faced by rural health officials in responding to a public health crisis like MPOX are exacerbated by limited resources and frequent social stigma (Rodriguez, 2022). Further light needs to be shed on the extent of these struggles and the effect of the MPOX outbreak on gays, bisexuals, and other MSM living in rural areas.

This capstone project was a non-experimental, quantitative study to assess the knowledge of MSM living in upstate New York regarding MPOX and its impact on sexual behavior. The study utilized survey methodology to investigate MSM knowledge of MPOX and to determine variability in risk perception between HIV and sexually transmitted infections (STIs), including MPOX. The survey instrument used a modified version of the Emory American Men's Internet Survey (AMIS) and included an assessment of MSM demographic data, knowledge of MPOX, and perceived ability and desire to modify sexual practices in response to the threat of MPOX infection (Emory AMIS, 2022). The study provided an opportunity to evaluate using the modified survey instrument to measure risk perception and determine if the instrument could be utilized in replicated studies with MSM populations living in other rural areas of the United States.

No known quantitative study has attempted to investigate the knowledge of rural MSM individuals regarding MPOX infection and its impact on changing attitudes and sexual behaviors. Thus, several theories and models are frequently discussed in the literature that could be a solid basis for this study. The theory of planned behavior, proposed initially by Ajzen (1985), suggests behavioral achievement depends on motivation and intention. However, a limitation of the theory is the assumption that an individual has acquired the opportunities and resources to perform the desired behavior successfully, nor does the theory account for fear, threat, mood, experience, or other variables that could factor into intention and motivation (LaMorte, 2022). Both limitations could apply to MSM individuals, particularly those in rural communities. The social-ecological model (SEM) theory examines the individual and their affiliations to people, organizations, and the community to determine the effectiveness of interventions (Brown, 2023). The relationships between these entities are incorporated in the five stages of the SEM: individual, interpersonal, organizational, community, and public policy (Brown, 2023). The SEM has been utilized in the literature when studying MSM groups. For example, Hergenrather et al. (2021) examined the influence of masculinity on HIV risk behavior in the model context, while Baral et al. (2013) relied on a modified SEM to assess the risks and risk contexts of HIV epidemics. The SEM, therefore, served as the theoretical framework for this study.

**Statement of the Problem**

Abundant research illustrates the association between MSM awareness of sexual practices and willingness to engage in preventative measures to mitigate infections linked to these practices (Delaney et al., 2022; Hubach & Owens, 2022; Singer et al., 2022). Although not definitively labeled as a sexually transmitted infection, the risk of MPOX infection due to sexual

practices and other close, skin-to-skin contact has also resulted in educational outreach initiatives that follow similar prevention goals. A missing component in research conducted to date has been analyses of MSM living in rural areas and how their behaviors changed following the events of the MPOX epidemic that began in 2022. In addition, there have been few attempts to contrast the sexual practices of MSM living in rural areas with the same behaviors of their urban counterparts.

**Significance**

Many rural locations in the United States often lack the resources to conduct health assessments and improvement initiatives of a significant scale. As a result, programs directed at preventing STIs may not receive the funding required to implement an effective intervention. MSM individuals living in rural communities also face the additional burden of social stigma that may prohibit seeking needed physical and mental health care. Data from this study could be used to craft educational messaging and prevention initiatives tailored to MSM groups living in rural areas, which would be beneficial given the limited scope and reach of a region's respective public health departments.

**Purpose of the Research**

This project assessed the knowledge of MPOX disease, transmission methods, and recommended prevention strategies (including sexual behavior changes and vaccination) in MSM patients of the Elmira, NY, or Ithaca, NY, HIV clinics operated by Arnot Health. A secondary goal was to assess any changes in MSM behavior due to the 2022 MPOX outbreak. An anticipated outcome of this project was the identification of gaps in the knowledge base of MSM about MPOX, the perception that this virus poses little threat (more likely now that the disease has largely faded from the public eye), and low acceptance for vaccination as a primary

prevention strategy. The outbreak of a cluster of MPOX cases in the Chicago, Illinois area in the spring of 2023 should serve as a reminder of the legitimacy of this infection, considering the preliminary estimation that more than 50% of these new MPOX cases occurred in previously vaccinated individuals (National Center for Emerging and Zoonotic Infectious Diseases [NCEZID], 2023a).

**Research Questions and Hypotheses**

**RQ1**: Compared to sexually transmitted infections (STIs) and HIV, do MSM perceive MPOX as a risk to their health?

H1.1$_O$: There is no difference in MSM perception of MPOX as a risk to health compared to HIV or other STIs.

H1.1$_A$: MSM perceive MPOX as a more significant risk to health than HIV or other STIs.

H1.2$_A$: MSM perceive HIV as a more significant risk to health than MPOX or other STIs.

H1.3 $_A$: MSM perceive STIs as a more significant risk to health than MPOX or HIV.

**RQ2**: Are MSM sexual behaviors related to the level of MPOX knowledge?

H1.1$_O$: There is no relation to sexual behavior in MSM in response to the level of knowledge of MPOX.

H1.1$_A$: Sexual behavior in MSM is related to the level of knowledge of MPOX.

**RQ3**: Is there a difference in the MPOX vaccination uptake between MSM individuals living in rural areas and MSM living in urban locations?

H1.1$_O$: There is no difference in the MPOX vaccination uptake among MSM individuals living in rural areas and MSM living in urban locations.

$H1.1_A$: MSM living in rural areas have a lower MPOX vaccination uptake when compared to MSM living in urban areas.

$H1.2_A$: MSM living in rural areas have a higher MPOX vaccination uptake when compared to MSM living in urban areas.

**Summary**

This study aimed to determine potential relationships between MPOX knowledge, perceived risk of MPOX infection compared to other STIs, changes to sexual behavior practices, and MPOX vaccine uptake in MSM individuals living in rural and urban areas. The factors underlying MSM disease awareness, the risk to their health, and subsequent willingness to seek preventive services could have broader implications for public health innovations aimed at MSM and other underserved populations. Understanding the factors behind disease management is exponentially more critical in rural settings, given the lack of resources that burdens many public health agencies in those locations.

Chapter 1 has laid the groundwork for the study, including the problem, purpose, significance, and research questions with hypotheses. Chapter 2 will delve into the literature related to MPOX, which was utilized to focus the research and devise the most effective methodological approach. Chapter 3 will further discuss this approach and explain the study's non-experimental design, the population and sample, procedures for participant recruitment and data collection, the process for data analysis, and limitations and delimitations. Chapter 4 will discuss the study's findings related to its research questions and hypotheses. A summarization and interpretation of the findings will comprise Chapter 5. Discussion of study findings will be presented in reference to literature and theory. The chapter will conclude with recommendations for future research and an overall conclusion of the study.

# Chapter 2: Literature Review

## Introduction

This chapter presents a review of the current literature related to MPOX and changes in sexual behavior, with an emphasis on MSM and their reaction to the MPOX epidemic that began in 2022. Chapter 2 begins with an overview of MPOX history, virus biology, symptoms, transmission, testing, and current recommendations for prevention and treatment. Recent epidemiological data for MPOX from 2022 to the present will also be detailed. Because MPOX is of particular concern to HIV-positive, immunocompromised individuals and members of racial and ethnic minorities, a discussion of the literature about the health impact on this at-risk group is also presented in this chapter. Many factors must be considered with outreach efforts related to MPOX prevention and treatment. Thus, the published literature was reviewed for information on MPOX knowledge, attitudes, and dimensions of the SEM, which are also included in this chapter. The chapter concludes with the gaps found in the literature and a review of the methodology. Various strategies were used from February 2023 through March 2023 to obtain the literature for this review. The published literature reviewed in this chapter primarily spans the past 5 years; however, some older literature was included for foundation and trend purposes. Several online databases, such as EBSCO, OVID, ScienceDirect, and MedlinePlus, accessed from Radford University, were searched for relevant literature on MPOX biology, vaccination, and treatment, MSM groups, immunocompromised individuals (primarily due to HIV/AIDS infection), perceived risk, 2022 MPOX clades, the social impact of MPOX, MPOX knowledge and attitudes and the social-ecological model. In addition, websites for the CDC, WHO, National Institutes of Health, Department of Health and Human Services, New York State Department of Health (NYSDOH), and the U.S. Food and Drug Administration (FDA) were searched for

current literature on MPOX. The initial literature searches used the term “monkeypox” because much of the research was published before the WHO name changed to MPOX in November 2022 (WHO, 2022). Inclusion criteria relied on a combination of “monkeypox” and “epidemiology,” “at-risk populations,” “education,” “vaccination,” and “knowledge,” which yielded more than 1,200 articles when filtered by full-text, peer-reviewed, English-language articles. Further preference was given to research focused on MSM populations in the United States.

## MPOX History

MPOX is one of 17 known species of the Orthopoxvirus, including human smallpox (variola). Orthopoxviruses are a group of zoonotic, double-stranded DNA viruses with significant reservoirs in vertebrate animals, including wild and domestic mammals, food animals, and rodents (Diaz, 2021). Although MPOX and variola virus share many genetic sequences (the central region of their genomes is 96.3% identical), there are notable differences between the respective sections of MPOX and variola virus that encode for virulence and host range (breadth of organisms capable of being infected by a pathogen), with MPOX falling short in both factors compared to variola. The scope of the genetic differences indicates that MPOX is unlikely to evolve into a pathogen as virulent or quickly transmissible as variola (Shchelkunov et al., 2001).

## Transmission

The primary method of transmission is through close, personal, and often skin-to-skin contact, including direct contact with MPOX rash, scabs, and bodily fluids, or via indirect routes such as touching objects, fabrics (clothing, bedding, towels), and surfaces used by a person with MPOX, or by contact with respiratory secretions (CDC, 2022a). MPOX can also travel in large respiratory droplets deposited in the mouth, nose, or eyes. However, the larger particle size

means prolonged contact is required for efficient human-to-human spread (Barron & Rohde, 2022). Viral loads of MPOX are higher in the anus and lesions of the skin and considerably lower in sites such as the respiratory tract, urine, blood, or semen. The variation in viral loads suggests that close, intimate contact, particularly activities such as oral or anal sex, is more responsible for MPOX transmission than casual contact or indirect contact with shared belongings of the infected individual (Palich et al., 2022).

Although rare, the transmission of MPOX in the healthcare setting has also been documented. An emergency department nurse in Florida was exposed to MPOX in July 2022 after sustaining a needlestick injury after using a needle to create an opening in the vesicular lesion of a suspected MPOX patient (Mendoza et al., 2022). A physician in California who worked at two clinics primarily serving lesbian, gay, bisexual, transgender, and queer (LGBTQ) and HIV-positive patients contracted MPOX in August 2022 after providing care to two patients that tested positive for MPOX. The patients had not undergone triage per clinic protocols for suspected infection with MPOX but had symptoms concerning for MPOX infection (Alarcón et al., 2022). The incidents underscore the importance of following all recommended protocols for personal protective equipment and specimen collection when interacting with patients suspected of MPOX infection.

**Signs and Symptoms**

The incubation period of MPOX can range from 5 to 21 days, with an average of 6 to 13 days (WHO, 2022a). There are two distinct periods of infection. The invasion period (between 0 and 5 days) is marked by the onset of fever, headache, swelling of the lymph nodes, back pain, muscle aches, and a lack of energy (WHO, 2022a). The second period is noted by the appearance of a rash beginning within 1 to 3 days of the fever. The concentration of the rash is primarily on

the face and extremities, although the oral mucous membranes, genitalia, conjunctivae, and cornea have all been observed (WHO, 2022a). The rash can initially resemble pimples or blisters and may be painful or itchy. In some infected patients, the rash may precede other symptoms. An individual generally becomes infectious from when symptoms first appear until the rash has healed, scabbed over, and a new layer of skin has formed, with the illness resolving in approximately 2 to 4 weeks (CDC, 2022b).

**Testing**

The most widely used methods for testing for MPOX involve the collection of skin lesion material, which can include swabs of the lesion surfaces, exudate, or lesion crusts, depending on the phase of the rash (CDC, 2022e). MPOX testing should also be considered for individuals with rashes who present to evaluate more common infections (such as varicella zoster or sexually transmitted infections), especially if other epidemiologic risk factors are present (NYSDOH, 2022). The sensitivity and accuracy of polymerase chain reaction (PCR) testing amplifying pathogen-specific primers is considered the preferred laboratory test for skin lesion material collected for MPOX diagnosis (American Society for Microbiology, 2022). Although PCR testing is currently limited to commercial and public health laboratories, more accessible methods may soon be available. For example, in October 2022, the FDA issued an Emergency Use Authorization to Abbott Molecular for the Alinity mMPOX. This real-time PCR test could be used by qualified and trained clinical laboratory personnel (FDA, 2022).

Serology and antigen detection methods are generally not recommended due to the cross-reactivity of the MPOX with other Orthopoxviruses does not provide an MPOX-specific confirmation or the possibility of a false positive result for an individual who has received a vaccinia-based vaccine (WHO, 2022b).

**Vaccination**

The humoral and cellular responses generated by orthopoxvirus infections that are cross-protective with other viruses in the genus point toward vaccination, particularly vaccinia-based (smallpox), as perhaps the most efficacious means of controlling MPOX outbreaks (Schnierle, 2022). Two vaccines have been approved for use in the United States. The ACAM2000, approved by the FDA, uses a live, replication-competent vaccinia virus and is percutaneously administered in a single dose; re-vaccination is recommended every 3 years (Hung et al., 2022). However, the notable downside of the ACAM2000 is the potential for a vaccinated individual to inadvertently transmit the virus to an unvaccinated via close contact with the inoculation lesion or exudate (Hung et al., 2022).

The predominant MPOX vaccine used in the United States, JYNNEOS, relies on a live, replication-incompetent virus subcutaneously administered in a two-dose regimen of 0.5 ml each (Hung et al., 2022). The CDC recommends that the vaccine be given within 4 days after exposure to prevent the onset of the disease and between 4 and 14 days after exposure to, at minimum, reduce the disease symptoms (CDC, 2022c). An alternative regimen involving intradermal injection with a dose of 0.1 ml was given Emergency Use Authorization by the FDA in August 2022 in an attempt to increase the limited supply of the vaccine at the time (CDC, 2022c). An evaluation of MPOX infection rates by vaccination status provides insight into the effectiveness of this prevention strategy. In September 2022, 32 U.S. jurisdictions reported using the JYNNEOS vaccine, enabling one of the first comparisons of MPOX incidence in vaccinated and unvaccinated populations. Specifically, in the population of individuals aged 18 to 49 considered most at risk of MPOX infection (including MSM), those who remained unvaccinated had 14 times the risk of infection compared to those who had received a first dose of the

JYNNEOS vaccine at least 2 weeks earlier (Payne et al., 2022). A follow-up study of 43 U.S. jurisdictions from July 31, 2022, to October 1, 2022, also evaluated men 18 to 49 eligible for the JYNNEOS vaccine (Payne et al., 2022a). MPOX incidence among unvaccinated persons was estimated to be 9.6 times as high as that among individuals who received two vaccine doses and 7.4 times as high as those who received only the first dose (Payne et al., 2022a). The initial data also suggested no difference in protection between subcutaneous and intradermal administration routes (Payne et al., 2022a).

The Advisory Committee on Immunization Practices has approved both ACAM2000 and JYNNEOS for pre-exposure prophylaxis against orthopoxvirus (including MPOX) in individuals at risk of exposure and infection (Rao et al., 2022). From May 22, 2022, to January 31, 2023, 57 jurisdictions administered 1,189,651 doses of JYNNEOS vaccine, 61.7% of which were first doses, 38.1% of which were second doses, and 0.2% of which were reported as dose three or higher (Owens et al., 2023). The majority who received one or more vaccine doses were male (91.4%) and aged 25 to 49 (64.2%) (Owens et al., 2023). Race and ethnicity analysis (available for 91% of vaccines administered) determined that 51.2% were non-Hispanic White, 22.7% were Hispanic or Latino, 12.4% were non-Hispanic Black or African American (Black), 7.4% were non-Hispanic Asian, 5.6% were non-Hispanic multiracial, and less than 1% were Hispanic American Indian or Alaska Native and non-Hispanic Native Hawaiian or other Pacific Islander (Owens et al., 2023),

**Antivirals**

The FDA has not formally approved any treatments for MPOX infections. A drug approved by the FDA in 2018 for smallpox infection known as tecovirimat (TPOXX) has rapidly become the preferred medication for treating severe MPOX infections despite a lack of data

establishing its safety or effectiveness (FDA, 2022a). However, the CDC holds expanded access to Investigational New Drug (IND) protocols that allow for the use of TPOXX to treat MPOX infections, although currently, the medication is only available for distribution through the Strategic National Stockpile (CDC, 2022g). Other medical countermeasures initially developed to treat smallpox infections have also been used to treat MPOX in severe cases. These medications include antivirals (i.e., tecovirimat, brincidofovir, cidofovir, and trifluridine ophthalmic solution) and vaccinia immune globulin intravenous (VIGIV). As of February 2023, tecovirimat and VIGIV remain available through CDC-sponsored expanded access IND protocols; brincidofovir through an FDA–authorized single-patient emergency use IND; and cidofovir and trifluridine, commercially (CDC, 2022f).

**Epidemiological Data – 2022 Epidemic**

Following its initial identification in 1970, MPOX is now considered endemic to approximately 10 countries in West and Central Africa, including the Democratic Republic of Congo, which has reported more than 1,284 cases in 2022 alone (Cohen, 2022). Two distinct clades of MPOX have been identified—the West African clade and its Central African counterpart, each with varying degrees of severity based on an analysis of their respective genomes (McCollum & Damon, 2013). The West African clade is estimated to have a case-fatality rate of 3.6%, while the Central African clade has a substantially higher rate of 10.6% (Bunge et al., 2022). Cases of MPOX infection identified as part of the 2022 outbreak in non-endemic countries have all been identified as infected with the West African clade (WHO, 2022a).

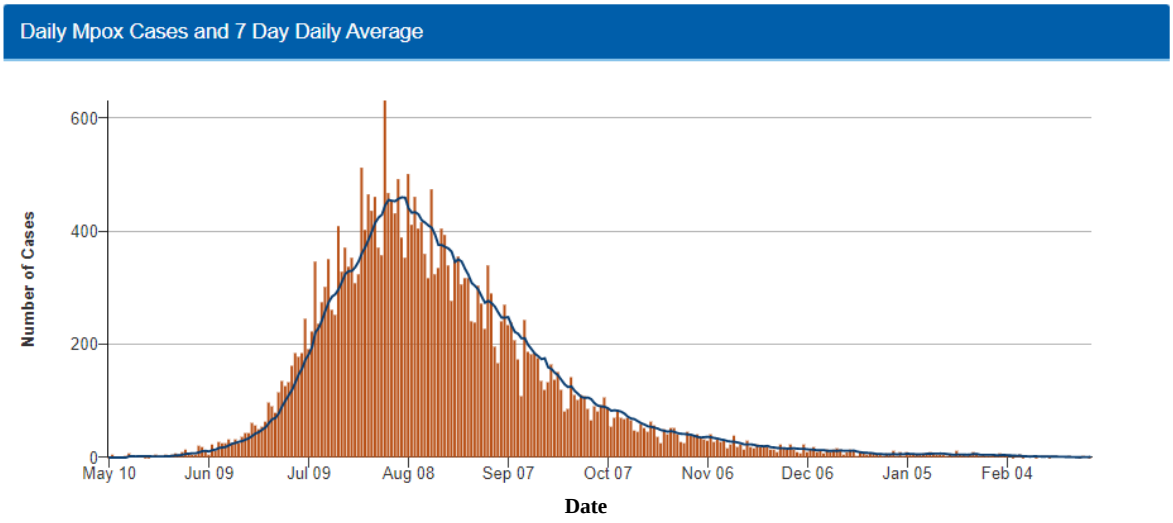
## Incidence and Prevalence

As of May 2023, 30,401 cases of MPOX infection have been identified in the United States (CDC, 2022c). Given that the overall population of the United States, as of January 1, 2023, is projected to be approximately 334,233,854 (U.S. Census Bureau, 2022), the current prevalence of MPOX can be estimated to be 9.10 per 100,000 population.

As of February 1, 2023, the CDC reports the incidence of MPOX cases in the United States every 2 weeks. As shown in Figure 1, the peak number of cases was identified during July and August 2022, followed by a downward trend in the subsequent weeks that continued through December 2022.

**Figure 1**

*U.S. Daily MPOX Cases and 7-Day Daily Average*




Source: Centers for Disease Control and Prevention. (2022, August 17). *U.S. MPOX Case Trends reported to CDC*. U.S. Mpox Case Trends Reported to CDC. Retrieved March 1, 2023, from https://www.cdc.gov/poxvirus/mpox/response/2022/mpx-trends.html

The decline in the incidence of cases has been attributed to changes in behavior among high-risk individuals (especially those with a high number of partners limiting sexual activity) and the fast uptake of vaccines (Doucleff & Huang, 2022), primarily the live, non-replicating

smallpox and MPOX vaccine JYNNEOS (Center for Biologics Evaluation and Research, 2022). A better understanding of the potential routes of MPOX transmission has also been attributed to identifying fewer cases. Research from Palich et al. (2022) has suggested that viral loads of MPOX are higher in the anus and lesions of the skin and considerably lower in sites such as the respiratory tract, urine, blood, or semen. The variation in viral loads between the analyzed specimens suggests that close, intimate contact, particularly activities such as oral or anal sex, is more responsible for MPOX transmission than casual contact or indirect contact with shared belongings of the infected individual (Palich et al., 2022). Determining the most efficient transmission methods is critical since this will enable public health officials to tailor messaging on which behaviors or activities should be modified or avoided to prevent the spread of MPOX infection and the target populations for this information.

**Geographic Distribution in the United States**

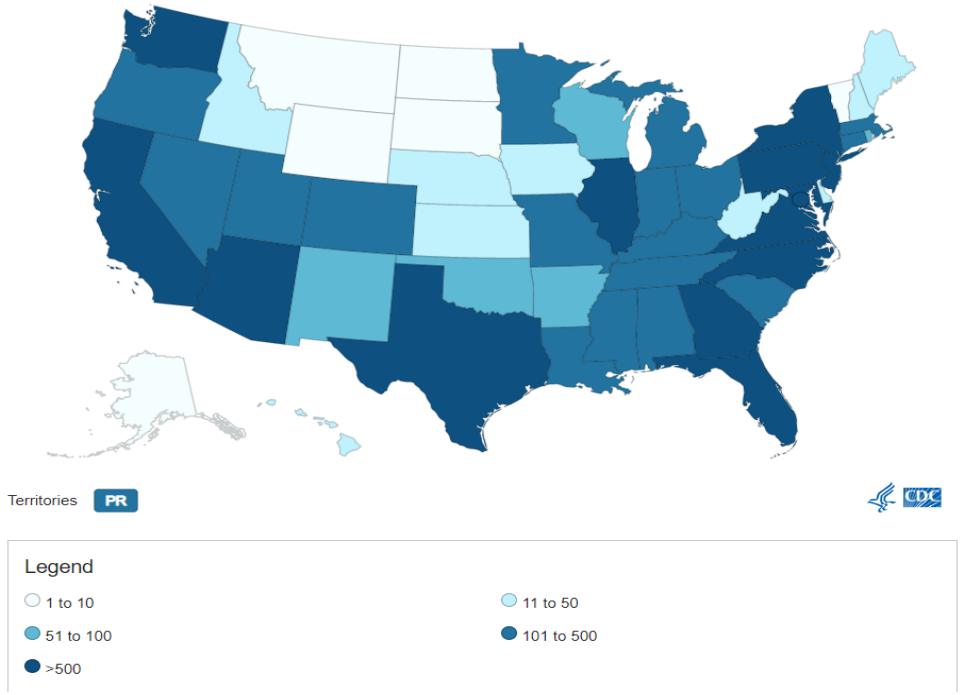
The number of MPOX cases identified in the United States was not limited to a specific geographical region. The incidence of MPOX in the United States between May 10 to December 31, 2022, was estimated to be 71% in persons residing in large central urban areas. Comparatively, the incidence of MPOX cases in rural areas was approximately 4% that of the larger urban locations (Zelaya et al., 2023). However, the challenges faced by rural health departments in responding to a public health crisis like MPOX are exacerbated by limited resources and frequent social stigma (Rodriguez, 2022). Even a few cases could become much more significant health issues if sufficient resources are not provided for mitigation.

Figure 2 shows widespread cases throughout the United States, with California, New York, Texas, and Florida recording the top four highest cases in 2022. Alaska, Wyoming, South Dakota, and Vermont reported the fewest cases in 2022 (CDC, 2022c). Although the data

reported by the CDC is not further stratified according to county or city levels, the presence of several major metropolitan cities in the regions with the highest cases would suggest that many of the MPOX infections would be centered in these urban locations.

**Figure 2**

*U.S. Map of MPOX Cases*




Source: Centers for Disease Control and Prevention. (2022, November 23). *2022 U.S. Map & Case Count*. Centers for Disease Control and Prevention. Retrieved March 1, 2023, from https://www.cdc.gov/poxvirus/mpox/response/2022/us-map.html

## International Outbreaks in Non-Endemic Countries

The appearance of MPOX in countries where the disease is not ordinarily endemic has resulted in varying responses by the governments and healthcare institutions in those locations. In February 2023, Mexico reported 72 cases, the highest weekly increase among the top 10 countries with identified MPOX outbreaks (Paun, 2023). A considerable factor driving the increase in cases has been the refusal of the Mexican government to participate in vaccination distribution, citing concerns that the vaccines have not been proven safe and effective (Paun,

2023). Likewise, only 12 Latin American countries participated in a joint MPOX vaccine purchasing initiative, with other nations citing liability and financial concerns as reasons for not importing vaccines (Paon, 2023). The identification of four MPOX cases within 24 hours in Toronto, Canada, in January 2023 raised concerns that the virus was still circulating in an area where only 15% of eligible individuals completed the entire two-dose vaccination series (Pelley, 2023). A fully vaccinated individual in Maricopa County, Arizona was diagnosed with MPOX in May 2023 (KNXV, 2023). The Chicago Department of Public Health documented 29 MPOX cases between April 22, 2023, and May 23, 2023, after recording only five cases between January 1, 2023, and April 15, 2023 (Cherone, 2023). The global spread of MPOX continues to be an issue of concern—a February 2023 report by the WHO noted a 70% increase in cases from the week prior (WHO, 2023), which prompted the WHO to maintain MPOX as a public health emergency of international concern (WHO, 2023a).

An assessment conducted by NCEZID of the potential for a resurgence of MPOX in the United States due to viral reintroduction concluded that the risk is greater than 35% in most regions of the country (NCEZID, 2023). The increased risk was attributed to relatively low immunity in high-risk populations (notably MSM individuals), with modeling suggesting outbreaks could be as large or larger than observed in 2022, assuming there are no additional vaccinations or adaptions to sexual behavior. The degree of waning immunity in individuals vaccinated in 2022 is also of concern—the loss of protection or inability to prevent MPOX transmission would increase the probability of a resurgent outbreak (NCEZID, 2023).

**At-Risk Groups and Behaviors**

The global outbreak of MPOX that began in 2022 has predominantly been observed in the populations encompassed by the category of MSM, which can include gay, bisexual, and

other behaviors, identities, and healthcare needs (Mayer et al., 2012). Sexual networks among MSM have been described as more densely connected than non-MSM communities, with frequent changing of partners and a higher likelihood of having several partners simultaneously (Kupferschmidt, 2022). A United Kingdom (U.K.) study found that among survey respondents diagnosed with MPOX infection, more than 60% had been diagnosed with a sexually transmitted infection in the past year, 44% reported more than 10 sexual partners in the previous 3 months, and 44% reported group sex during the incubation period of the disease (U.K. Health Security Agency, 2022). Individuals employed as sex workers could also be considered an at-risk group. Specifically, the high frequency of long-lasting and extensive face-to-face, skin-to-skin, and mucosa-to-mucosa (e.g., oral, genital, or anal) contact with multiple people would leave sex workers especially vulnerable to MPOX infection (Strathdee et al., 2023).

**Travel History and Illicit Narcotic Use in MSM Groups**

In addition to the close physical contact among MSM individuals described previously, one hypothesis underlying the initial spread of MPOX to nonendemic countries has involved travel history (Bhattacharya et al., 2022). Several index cases reported travel to countries and territories (i.e., Belgium, Canary Islands) hosting large-scale festivals where individuals had close, prolonged contact with others that may have put them at risk for MPOX infection (Abed Alah et al., 2022). Party settings with sexual contacts are reflected in the overall data for the epidemic, with 43.4% of likely MPOX exposures categorized according to this type of social setting (WHO, 2022c). Other events combined sexual activity with illicit narcotics such as mephedrone and crystal methamphetamine (Thornhill et al., 2022). The frequency use of methamphetamine has been linked to avoidance of COVID-19 preventive behaviors in urban MSM, suggesting that determining how methamphetamine use intersects with psychosocial,

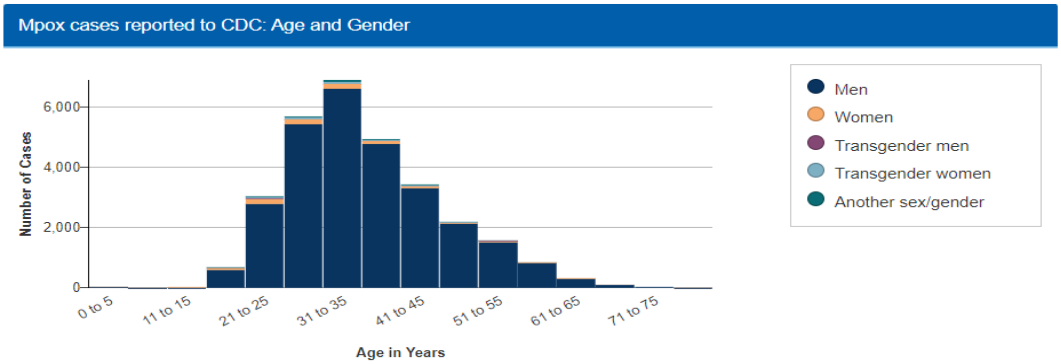
behavioral, and biological factors could be used to improve MPOX prevention efforts (Cohen et al., 2022). A study involving the U.K. Biobank, a prospective cohort for the investigation, prevention, diagnosis, and treatment of chronic diseases, determined that cannabis use and alcohol consumption were correlated with a high number of sexual partners and at-risk sexual behaviors in both gay and heterosexual populations (Vallée, 2023). Mass gathering events, including music festivals, dance and pool parties, and bathhouses, have been identified in multiple locations throughout the United States, where individuals congregated together and engaged in activities with close skin-to-skin contact (Howard, 2022). The combination of these factors could enable MPOX to continue circulating within a community or propel the start of yet another outbreak.

**Demographics of At-Risk Groups**

As shown in Figure 3, the prevalence of MPOX cases in the United States has been observed in men between the ages of 21 and 45 (CDC, 2022d). In particular, the top three categories include men 31 to 35 years of age (6,207 individuals), men 26 to 30 (5,040 individuals), and men 36 to 40 (4,468 individuals) (CDC, 2022d). An examination of cases identified between May and July 2022 indicated a disproportionate breakdown by race, with 41% occurring in White individuals, 28% among Hispanics, and 26% among Blacks (Philpott et al., 2022). A combined 54% of cases in the Hispanic and Black populations is notable, considering these groups comprise one-third of the general population (U.S. Census Bureau, 2021). As of March 2023, 33.1% of MPOX cases have been noted in Black individuals, 31.2% in Hispanic or Latino, and 29.4% in White individuals (CDC, 2022d).

**Figure 3**

*U.S. MPOX Cases by Age and Gender*




Source: Centers for Disease Control and Prevention. (2022, August 22). *MPOX cases by age and gender, race/ethnicity, and symptoms*. Centers for Disease Control and Prevention. Retrieved March 1, 2023, from https://www.cdc.gov/poxvirus/mpox/response/2022/demographics.html

The impact of MPOX infection on the Hispanic population in the larger urban areas has been particularly noteworthy—New York City has reported 34% of MPOX infections in its Hispanic residents (NYC Health, 2022), while Los Angeles recorded 45% of cases in its Hispanic population (LA County Department of Public Health, 2022). The reasons behind the disproportionate infection rate are multifactorial—lack of access to healthcare and health insurance, language barriers (paperwork on antiviral treatment was not available from the CDC until August 2022), and social stigma (individuals in many Hispanic communities were uncomfortable with potentially "outing" themselves in order to seek care) have all been cited as contributory to the spread of MPOX infection (Kekatos, 2022).

Infections with MPOX in the pediatric population have also been reported. Between May 17 and September 24, 2022, a total of 83 individuals less than 18 years of age were diagnosed with the infection, accounting for 0.3% of reported cases (Hennessee et al., 2022). The children (64% male) in the 0 to 12 age group reportedly had skin-to-skin contact through routine childcare activities as the predominant means of exposure (although transmission via fomite was

suspected in one case). In comparison, the adolescents (89% male) in the 13 to 17 age group had male-to-male sexual contact in 64% of the exposures (Hennessee et al., 2022). Echoing several disparities in MPOX noted in adults, adolescents with MPOX were non-Hispanic Black or African American (47%) or Hispanic or Latino (35%). However, none of the children or adolescents studied required ICU hospitalization or died due to MPOX infection (Hennessee et al., 2022).

The characteristics of patients with MPOX infection requiring hospitalization also reveal several notable trends. From August 10 to October 10, 2022, data on 57 patients admitted to hospitals with severe MPOX symptoms revealed that 82% also had AIDS, 68% were Black, and 23% were experiencing homelessness at admission (Miller et al., 2022). Of the 57 patients, a total of 13 required transfer to an intensive care unit, and 12 expired with MPOX listed as a contributory cause of death in at least five of the patients (an official cause in an additional six patients was still under investigation at the time of publication). The findings from this group of patients prompted the CDC to recommend HIV testing for all sexually active patients (unless already known to be HIV-positive) at the time of MPOX testing (Miller et al., 2022).

Individuals experiencing homelessness or accessing homeless services are considered challenging to reach when attempting to provide screening and treatment services for MPOX. A survey of 207 individuals in San Francisco between October 25–November 3, 2022, participated in an orally administered survey and provided a serum specimen to understand MPOX prevalence and transmission pathways (Waddell et al., 2023). Two individuals had detectable anti-orthopoxvirus IgG, and one had detectable antibodies, indicating possible undetected MPOX infections (Waddell et al., 2023). Interestingly, none of the three had sexual contact within the past month, identified as an MSM, or had a rash during the interview. Two did admit to sharing

unwashed utensils, spending time around and touching someone with a rash, and sharing smoking devices (Waddell et al., 2023).

**Mortality – 2022 Epidemic**

The 2022 MPOX epidemic has been associated with low mortality—five deaths had been reported globally out of the more than 16,000 cases recorded leading up to July 2022 (equaling a rate of 0.03%), with no deaths occurring outside of the Central and West African regions where the disease is endemic (Vogel, 2022). The discrepancy between previously reported mortality rates for MPOX and the current data is thought to be attributed to several factors. Areas where MPOX is endemic usually have limited access to medical services (care is not sought until the illness becomes severe, often due to bacterial superinfections), the strain driving the global outbreak is derived from the less severe West African clade, and the populations being affected are predominantly young and healthy adult males (all deaths from MPOX between the 1970s and 1990s were in children under the age of 10) (Vogel, 2022). However, health officials in some U.S. localities have associated deaths in immunocompromised residents with MPOX infection. Texas was the first in August 2022 to attribute a fatality to MPOX, followed by six deaths in Illinois, Maryland, New York, and Nevada (Carbajal, 2022). A May 2023 update by CDC noted 42 fatal cases of MPOX had been reported in the United States, with 87% occurring in Black individuals (McQuiston et al., 2023).

**Impact of MPOX Infection on At-Risk Groups**

While the impact of MPOX infection has predominantly been measured in the MSM population, there are two subgroups where the effects have been especially noteworthy—HIV-positive individuals (particularly those considered immunocompromised) or those with recent sexually transmitted infection (STI) (Curran et al., 2022) and racial and ethnic minority groups

(Rodríguez-Díaz et al., 2022). The focus in the literature extends beyond the documented clinical effects of MPOX to include social and behavioral aspects of this infection. Many of the challenges and disparities often discussed in these groups have been amplified due to MPOX.

**Impact of MPOX on HIV-Positive Individuals**

The connection between MPOX and HIV infection is not unique to the 2022 global epidemic—previous outbreaks in Nigeria also documented concurrent HIV infection and its association with poor MPOX clinical outcomes (Ogoina et al., 2020), with fatalities attributed to MPOX in a 2017 outbreak associated with HIV-positive patients who had either stopped antiretroviral therapy more than 3 months prior to MPOX infection or had never started the regimen (Yinka-Ogunleye et al., 2019). An analysis of 1,979 individuals with MPOX infection in eight U.S. jurisdictions on May 17–July 22, 2022, including California (including Los Angeles County and San Francisco), the District of Columbia, Georgia, Illinois (including Chicago), and New York (excluding New York City), determined that 38% were also infected with HIV, 41% had an STI in the prior year, and 18% were both HIV-positive and diagnosed with an STI within the preceding year (Curran et al., 2022). Of note, among the individuals identified with MPOX and HIV infection, 94% had received HIV care in the preceding year, 82% were virally suppressed, and 78% had a CD4 count greater than or equal to 350 cells/$mm^3$ (Curran et al., 2022). Studies involving other diseases suggest that individuals with HIV who receive and maintain antiretroviral therapy and have adequate CD4 counts may not be at increased risk for opportunistic infections, including MPOX infection, after exposure (O'Shea et al., 2022). An outbreak of 546 MPOX infections in MSM with either HIV-positive or negative status in Germany also demonstrated few severe cases, low hospitalization rates, no fatalities, and similar clinical pictures between the two groups. Notably, most individuals observed were considered in

good health, with only four subjects having a viral load greater than 200 copies per ml (Hoffmann et al., 2022).

However, individuals with advanced immunosuppression may be at increased risk of complications due to MPOX infection. Between August 10–October 10, 2022, the CDC provided consultative services to 57 individuals hospitalized with severe manifestations of MPOX infection (Miller et al., 2022). Most (82%) of the individuals were HIV-positive, with 72% having a CD4 count of fewer than 50 cells/$mm^3$ (Miller et al., 2022). All had severe dermatologic manifestations, and 68% also had severe mucosal lesions. Of note, 68% of the individuals were Black, and 23% were experiencing homelessness (Miller et al., 2022). An analysis of 382 confirmed MPOX infections diagnosed between May 11, 2022, and January 18, 2023, in HIV-positive individuals living with HIV with a CD4 cell count of fewer than 350 cells per $mm^3$ from sites in 19 countries noted an increased risk of a fulminant form of MPOX. The severity of this infection stage is characterized by necrotizing skin and genital and non-genital cutaneous and mucosal lesions. The risk of respiratory complications, neurological involvement (e.g., altered mental status, encephalitis), and secondary bacterial infections have also been linked to MPOX infection. All complications were more common in people with a CD4 cell count of fewer than 100 cells per $mm^3$ compared with individuals with more than 300 cells per $mm^3$, with the rate of hospitalization and intensive care unit admission increasing as CD4 cell levels declined. The study also reported the deaths of 27 hospitalized patients, and of that population, the median CD4 level was 35 cells per $mm^3$, and the median HIV viral load was log5 RNA copies per ml (Mitjà et al., 2023).

Discussions in the literature related to risk factors and behaviors contributing to HIV infection also bear relevance to the current MPOX outbreak. In the early days of the HIV

epidemic, new HIV diagnoses were highest in large cities and coastal areas (Curran et al., 1988). However, by 2018, more than half of HIV diagnoses were detected in Washington, DC, Puerto Rico, and 48 U.S. counties, the latter being disproportionately located in the South (Fauci et al., 2019). The MPOX epidemic that began in 2022 was also notable for the highest number of cases in U.S. locations with large urban populations, including California, New York, Texas, and Florida (CDC, 2022c). Whether MPOX has the potential to follow a similar distribution of cases has yet to be determined. The geographical disparities in HIV infections are thought to be driven by significant racial or ethnic factors. The combination of a higher burden of HIV infection among Black people (compared to other races or ethnicities), unequal access to HIV prevention and treatment services, and a more significant proportion of the overall population in Southern states (e.g., 31% in Georgia, 32% in Louisiana, and 38% in Mississippi, compared to 13% nationally as of 2018) equal an overwhelming burden on Black individuals living with HIV (Sullivan et al., 2021). The restricted expansion of Medicaid in many Southern states, widespread healthcare provider shortages, low health literacy, and HIV stigma have also been cited as factors continuing to drive HIV disparities in the South (Sullivan et al., 2021).

The differences observed between HIV risk behaviors in urban and rural MSM individuals should also be considered about MPOX. Compared to urban MSM, rural MSM individuals in one study were noted to be less likely to have been tested for HIV and STIs or utilize HIV prevention services within the previous year (or to have been tested for HIV at all) and reported living in communities less tolerant towards gay and bisexual people (McKenney et al., 2017). The lack of available resources likely plays a role in underutilizing services. Ahrens et al. (2021) relied on geocoded data from the National Prevention Information Network to examine organizations that provide prevention, testing, and treatment services related to HIV.

The analyses determined that compared with urban counties, a smaller proportion of rural counties had organizations capable of providing HIV prevention, testing, and treatment services (Ahrens et al., 2021).

**Sexually Transmitted Infections and MPOX**

Concomitant STIs with individuals diagnosed with MPOX infection strongly correlate in the literature. Analysis of an MPOX outbreak spanning 16 countries between April and May 2022 noted that in 29% of individuals diagnosed with MPOX, gonorrhea, chlamydia, and syphilis were found in 8%, 5%, and 9%, respectively, of those who underwent MPOX testing (Thornhill et al., 2022). A cohort of 54 MSM individuals seeking services from sexual health clinics in London, U.K., between May 14 and May 25, 2022, were confirmed positive for MPOX and offered sexual health screening (Girometti et al., 2022). Of the 51 who accepted screening, 25% tested positive for gonococcal or chlamydial infections, with six testing positive for pharyngeal gonorrhea, two for urethral gonorrhea, one for rectal gonorrhea, four for rectal chlamydia, two for urethral chlamydia, and two had dual gonorrhea and chlamydia infection (Girometti et al., 2022). Of note, STIs were detected with a higher prevalence in HIV-positive individuals (Girometti et al., 2022). A 32-year-old immunocompromised patient in South Florida presented with respiratory symptoms suggestive of pneumothorax and skin lesions and was noted to have concomitant HIV and syphilis. The atypical presentation of the case highlights the challenges of accurate MPOX diagnosis in the setting of other disease comorbidities (Jang et al., 2023).

The association between STIs and MPOX should be understood in the context of how public health services in the United States have struggled to address these particular groups of diseases. The 2.4 million STIs recorded in the United States in 2020 represent a 45% increase in

gonorrhea, a 52% increase in syphilis, and a 235% increase in congenital syphilis over the past 5 years, with more than half of the STIs occurring in those 15 to 24 years old, and the most significant rise among non-Hispanic Blacks and African Americans (Tanne, 2022). The 2022 outbreak of MPOX further highlighted vulnerabilities in public health-based STI surveillance, the failure to normalize STI testing in all healthcare settings, and the ability to provide effective treatment (Laurence, 2022).

Incorporating MPOX surveillance into traditional testing for STIs has also proven problematic. An observational prospective cohort of 53 MSM with high-risk behavior in Germany was screened for MPOX in addition to PCR testing for chlamydia and gonococci using anorectal and oropharyngeal swabs (Pestel et al., 2022). The cohort participants were also asked to complete an online questionnaire to collect data about sexual orientation, sexual risk behavior, and STIs in their medical history. Most survey participants (64%) admitted having sex with five or more men in the past 6 months, and 57% reported an STI in their medical history (Pestel et al., 2022). However, none of the specimens collected returned positive for MPOX (Pestel et al., 2022). The findings are in contrast to a modified network model that was utilized to simulate an MPOX epidemic among Belgian MSM. The model relied on a theoretical population of 10,000 MSM individuals, of which 3,000 were categorized as higher-risk with increased rates of changing sexual partners. A baseline scenario of half of the MPOX cases going undiagnosed resulted in a median of 1,442 cases by day 720 of the epidemic—a disproportionately high number of cases (Van Dijck et al., 2022). Ferré et al. (2022) retrospectively performed testing for MPOX on 213 anorectal swabs collected from asymptomatic MSM as part of a screening program for chlamydia and gonorrhea. More than half (52%) of the MSM were living with HIV, and 78% of those HIV-positive individuals had undetectable viral loads. Of the 213 swabs

collected, 13 returned positive for MPOX, with eight of the MPOX-positive swabs collected from HIV-positive individuals (Ferré et al., 2022). The use of screening tests to detect asymptomatic cases of MPOX infection may not be a practical strategy for public health departments or other healthcare providers. Instead, educating at-risk groups to raise awareness of the signs and symptoms of active MPOX infection may represent a more efficient use of scarce resources.

Interestingly, the reverse scenario—detecting STIs and other infections in symptomatic MPOX patients—may have more potential. A cohort of 342 individuals seeking MPOX diagnosis in Rio de Janeiro, Brazil, underwent rapid tests for viral hepatitis, HIV infection, and STIs. Of the 78% with Hepatitis C (HCV) antibody data, 6.8% were anti-HCV positive (all identified as MSM). The prevalence increased in those with confirmed MPOX infection (9.9%), notably among those living with HIV (15.2%), which comprised 83% of the individuals who tested anti-HCV positive (Perazzo et al., 2022).

The rapid increase in the incidence of MPOX infections in the United States between May and August 2022 (CDC, 2022a) represented a watershed moment for the CDC, public health agencies, and community health departments still stinging from the considerable loss of public trust sustained during the COVID-19 pandemic (Pollard & Davis, 2022). The demographics of the affected groups have come into focus—96.4% of cases have been identified in males with a median age of 34 years, with individuals in the 18- to 44-year age group disproportionately accounting for 79.2% of cases (WHO, 2022c). Analysis by sexual orientation revealed that 84.1% identify as MSM, while 48.3% of all MPOX cases were additionally HIV-positive (WHO, 2022c). The affected populations, clinical presentation of MPOX symptoms, diagnostic methods of detection, and effectiveness of vaccination are now more thoroughly

understood (CDC, 2023a). The challenge for public health authorities and clinicians is to target groups vulnerable to MPOX infection with practical innovations backed by accurate and transparent information. The effectiveness of disseminating MPOX information can be accomplished by examining the literature and other online resources.

**MPOX Information and Resource Availability Online**

Most of the outreach information and initiatives related to MPOX available on commonly accessed websites (e.g., CDC, WHO) focuses predominantly on educating at-risk groups on the signs and symptoms of MPOX infection and the available mitigation strategies to reduce the risk of viral transmission, with vaccination promoted as one of the most effective methods. The CDC recommends several generic infection prevention practices for the general public, including avoiding close, skin-to-skin contact with people with a rash that looks like MPOX, not sharing everyday personal items (e.g., cups, dishes, bed linens), vaccination, and safer sex practices. Interestingly, although the CDC acknowledges that many MPOX initiatives will be driven by STI, HIV, or communicable diseases divisions within public health departments, there is no direct recommendation for these agencies to consider a combined approach to screening or testing for STIs, HIV, and MPOX (CDC, 2023).

Consideration for at-risk groups was given by the CDC, however, with the publication of the MPOX Equity and Anti-Stigma Toolkit (CDC, 2023b). Within the parameters of health equity, the CDC advocates that everyone has reliable access to accurate information and prevention education, as well as access to vaccination to prevent future outbreaks. In addition, reducing stigma in messaging and communication provided to at-risk groups is essential to combat discrimination against specific populations and behaviors that can disrupt prevention efforts. Combining this information with facts about MPOX transmission, at-risk behaviors, and

signs and symptoms of the disease can enable individuals to make well-informed decisions to protect their health and the health of their communities (CDC, 2023b).

**MPOX Knowledge and Awareness**

Implementing initiatives aimed at curbing the MPOX epidemic, as stated previously, began amid the ongoing COVID-19 pandemic. Comparing the two viral diseases is inevitable and highlights how COVID-19 has altered public health approaches to outbreak mitigation. An online survey by Winters et al. (2022) conducted in June 2022 of a representative sample of U.S. adults measured awareness of the MPOX outbreak, knowledge, risk perceptions, and self-efficacy around MPOX. A unique component of the survey, referred to as the Vaccine Trust Indicator (VTI), included six items around various aspects of vaccine trust (e.g., trust in vaccine manufacturers and pharmaceutical companies, understanding how vaccination enables the body to fight infections). Additional questions aimed to determine trusted sources of information, the preferred stakeholders to spearhead an outbreak response, COVID-19 vaccination status, and intentions to be vaccinated against MPOX if recommended to do so. Most respondents (79%) were aware of the MPOX outbreak, but almost half (47%) estimated their MPOX knowledge to be either poor or very poor. Healthcare professionals were deemed the most reliable sources to convey information about an outbreak, with 53% of the respondents tabbing their physician to handle the MPOX outbreak in the United States (only 20% put their faith in the CDC, potentially reflecting lower public opinion from the agency's handling of the COVID-19 pandemic). COVID-19 vaccination status strongly predicted willingness to receive an MPOX vaccine (adjusted Odds Ratio of 29.3), as was scoring high on the VTI (adjusted Odds Ratio of 5.4). The survey results underscore the importance of leveraging trusted sources of information, such as healthcare professionals, to convey clearly understood information on the preventive methods

and symptoms of MPOX (Winters et al., 2022). Interestingly, although the study authors acknowledged that individuals identified as MSM represented one of the most at-risk groups for MPOX, none of the survey results were grouped by that demographic.

A cross-sectional, internet-based questionnaire administered to 197 clinicians in Ohio assessed knowledge related to MPOX, the threat of the disease, and attitudes toward the ability to control transmission (Bates & Grijalva, 2022). Most participants (75.1%) reported no knowledge of MPOX before 2022, and 85.8% had not received university-level instruction on the disease (Bates & Grijalva, 2022). The ability to correctly answer the 23 questions on the MPOX knowledge portion of the questionnaire was surprisingly low (mean score of 11.24), suggesting relatively low knowledge of MPOX (Bates & Grijalva, 2022). Participants' attitudes related to MPOX were tepid, with respondents neither agreeing nor disagreeing that MPOX was a substantial risk (Bates & Grijalva, 2022). Participants were also ambivalent when asked about their confidence in the eventual control of MPOX. The lack of concern is noteworthy—clinicians who did not view MPOX as a severe public health threat in the United States fear that it might become a worldwide pandemic, or worry about extra burdens to the healthcare system due to MPOX were also less likely to intend to receive or deliver the vaccine (Bates & Grijalva, 2022). Clinicians serve as trusted sources of medical knowledge and advice for their patients; thus, the lack of accurate knowledge and relative apathy toward treating MPOX issues does not bode well for patients who may lack other sources of support.

An online survey by Hubach and Owens (2022) actively recruited MSM and transgender individuals via paid advertisements on Grindr, a popular sexual networking or hookup app for MSM. A diverse classification of sociodemographic characteristics was utilized, including sex assigned at birth, gender identity, sexual orientation, race and ethnicity, state and zip code of

residence (used to classify respondents as urban or rural), educational level, and annual household income. Over half (55.9%) of respondents indicated they had changed their sexual behaviors due to the MPOX outbreak. The most popular mitigation strategies employed were limiting the number of sexual partners (40.8%) and avoiding public settings such as bars, clubs, and parties (33.4%) where prolonged skin-to-skin contact was likely to occur. Most intriguing was that almost three-quarters of the respondents (73.3%) lived in an urban county, which was more strongly associated with changes in behavior. Rurality was determined to be negatively associated with behavior change (Hubach & Owens, 2022).

The perceived concern about MPOX and its determinants among MSM was the focus of a study from the Netherlands by Wang et al. (2022), who surveyed 394 MSM individuals and found that 52% expressed high to very high levels of perceived concern about MPOX, yet only 30% perceived themselves to be at high to very high risk of contracting the disease. Individuals who were not current users of pre-exposure prophylaxis (PrEP) medications for HIV and current PrEP users showed similar levels of perceived risk MPOX. Non-PrEP users showed a significantly higher concern about being infected with MPOX than current PrEP users. However, the researchers noted that at the time of the study, only PrEP users had access to the MPOX vaccine in the Netherlands, which may explain the increased concern among non-PrEP users. HIV status also impacted perceived MPOX concern and risk among MSM. Respondents with a positive or unknown/non-disclosed HIV status had a higher likelihood of perceived risk but not a higher perceived concern about MPOX. The awareness of risky sexual behavior and an elevated risk of MPOX infection could be one explanation for this finding. Equally plausible, however, is that MPOX was not regarded as problematic of an infection as HIV (Wang et al., 2022).

Torres et al. (2023) used an Internet-based survey to measure knowledge, stigma, and willingness to vaccinate for MPOX among sexual and gender minorities (SGM) in Brazil during the 2022 epidemic. Study findings focused more on the overall awareness of MPOX among SGM, with the Internet and television reported as the most frequent information sources. Survey participants were also asked if they had experienced symptoms consistent with MPOX infection, their sexual behavior history, and their HIV and STI status and testing history. Respondents indicated a willingness to receive the MPOX vaccine and follow social isolation if diagnosed, which the study authors interpreted as respondents demonstrating sufficient understanding of public health mitigation measures (Torres et al., 2023). Zheng et al. (2023) conducted a cross-sectional survey of MSM in China in July 2022 using an online questionnaire. The study aimed to assess the levels of MPOX-related knowledge among five domains—sources of infection, transmission routes, susceptible populations, treatment, and prevention. Only 36.9% of the 3,257 eligible participants demonstrated an awareness of MPOX. The study determined significant associations between sociodemographic, geographical, and HIV-status variables and MPOX-related knowledge among MSM. In contrast to the current study, one particularly striking finding is that MSM 33 years and older were more likely to have MPOX-related knowledge than those aged 22 and younger. The area of China where MSM resides was also determined to be a factor, with those living in the more rural western region of the country demonstrating a lower level of knowledge than in other regions.

The perception of the MPOX as a threat to the personal health of individuals, particularly those in the United States who identify as MSM, and any subsequent changes in behavior to preserve that health (including uptake of MPOX vaccination) would be essential information to have when assessing the impact of the 2022 MPOX epidemic. However, an extensive literature

search has not yielded significant research to assess MSM awareness and response to MPOX. The work by Delaney et al. (2022), relying on data from the American Men's Internet Survey, is the only known representation of research involving MSM in the United States. The paucity of research is troubling. An accurate assessment of MSM awareness of MPOX and its potential to affect one's health adversely is a necessary first step in designing intervention strategies.

**MPOX Outreach Approach Strategies for Education**

Initiatives targeting the dissemination of MPOX information and promoting the treatment and vaccination options need not occur in a vacuum—existing infrastructure and resources can be utilized, along with lessons learned from other public health efforts. An analysis of 85 videos posted to the popular social media platform TikTok used three validated tools for evaluating health information in six content categories to assess the video content, information quality, and audience engagement of MPOX-related videos (Shi et al., 2023). A combination of doctors (MDs and PhDs), science communicators, institutions, nurses and other healthcare workers, and general public users posted videos with varied MPOX information. Unfortunately, the overall quality of the video content was poor, with material on the MPOX outbreak frequently unreliable and incomplete, hindering public health efforts to disseminate accurate information on MPOX (Shi et al., 2023). A social media platform with an extensive worldwide installed user base can reach a significant number of a targeted population when planning an initiative. However, the dissemination of information should be done in collaboration with recognized experts and implemented according to validated criteria. Partnership with established agencies such as state and local public health departments may be helpful to ensure the distribution of actionable information.

Holloway (2022) observed that gay, bisexual, and other MSM had had a long-complicated relationship with public health, which has resulted in the potential barrier to MSM trusting and accessing healthcare services. A more sustainable collaboration between public health and MSM communities is required if MPOX vaccine coverage is to be improved. Holloway (2022) recommended four key strategies for strengthening the relationship. The first is to leverage the strengths of existing healthcare engagement with MSM groups, particularly those currently living with HIV. Many HIV-positive MSM are active users of HIV and sexual health clinics. In addition, hundreds of thousands of at-risk MSM are current users of HIV PrEP, a prevention strategy that requires quarterly STI testing. Establishing relationships with these locations as MPOX vaccination sites would benefit immunocompromised individuals and those considered at risk for MPOX infection due to sexual behaviors (Holloway, 2022).

The second strategy would be to engage with community-based organizations that serve MSM groups. Public health departments may not have previously established formal relationships with these agencies. However, as routine vaccine recipients (seen during the COVID-19 pandemic), these departments would be a logical starting point for distribution. In addition, many community-based organizations are federally qualified health centers or affiliated with healthcare networks that have established trust with MSM groups (Holloway, 2022). A distinct branch of this strategy is establishing partnerships with “sex-on-premises” venues catering to MSM, including bathhouses, saunas, raves, and other electronic music events, and other locations where close, intimate contact is likely to occur. Several locations already offer health services (e.g., HIV and STI testing), so including MPOX vaccination would be a logical next step (Holloway, 2022). It should be noted that many of these venues are primarily located in

urban areas, and Holloway does not suggest alternative sites in communities (such as rural towns) where MSM residents may not have ready access.

A third strategy targeting geosocial networking applications and websites could potentially capture MSM who utilize these electronic options to seek sexual partners. Although the dating app Grindr has been utilized for this type of outreach in the past, hundreds of additional niche apps and websites used by MSM may not be reachable by Grindr. Public health departments need to become more comfortable identifying these apps and developing advertising to raise awareness of MPOX and inform of opportunities for vaccination (Holloway, 2022).

Finally, Holloway (2022) suggested adapting the CDC popular opinion leader model, a risk reduction intervention for MSM who frequent gay bars. Both public health departments and community-based organizations can incentivize individuals willing to become vaccinated to be trained via workshops on talking to friends and acquaintances about MPOX. The strategy may be particularly helpful in promoting vaccine uptake among MSM of racial/ethnic minorities.

The concern over the disparities observed in racial and ethnic minorities is warranted when considering the uptake of the COVID-19 vaccine, where Black individuals trailed their White counterparts for both the primary series and booster doses (Kaiser Family Foundation, 2022). In addition, the JYNNEOS vaccine has been estimated to be 67% effective after the first dose in individuals with HIV and 96% effective after the second dose; it is essential to note that the data was generated from groups of HIV-positive patients who were virally suppressed. Black and Latino MSM are less likely to be virally suppressed and could subsequently have worse outcomes with MPOX infection. Community-based and public health agencies with experience working directly with minority populations need to be supported and encouraged to work with

clinicians and other stakeholders to engage these most vulnerable groups (Rodríguez-Díaz et al., 2022).

**MPOX Strategies for Vaccination Program Implementation**

Lo Piccolo et al. (2023) described the MPOX vaccination model utilized by NYC Health and Hospitals/Bellevue, who collaborated with the New York City Department of Health and Mental Hygiene at the beginning of the U.S. MPOX epidemic in Spring 2022. The partnership enabled leveraging systems developed during the COVID-19 pandemic, such as a contact tracing unit, to rapidly identify individuals exposed to MPOX and refer them to post-exposure vaccination prophylaxis. In addition, the use of just-in-time training for staff, effective public education and outreach, prioritization of highest-risk individuals, and increasing the accessibility of vaccines helped to ensure a successful MPOX vaccination campaign (Lo Piccolo et al., 2023). Millman et al. (2022) described a health equity approach the State Department of Health used to target Black MSM in Georgia in September 2022. Vaccination events were held in collaboration with five metropolitan local health departments at clinics and venues acceptable and convenient for Black MSM, including large event spaces, bars, clubs, and mobile vans. Social media, community-based organizations, and field outreach were used to promote the vaccination events (Millman et al., 2022).

**Social-Ecological Model and High-Risk MSM**

Van Tieu et al. (2018) anchored their discussion on MSM and HIV infection with theoretical pathways that link neighborhood- and network-level factors and outcomes related to HIV care. One potential route includes a stress/coping pathway whereby neighborhood conditions (e.g., segregation, community violence, physical disorders) negatively affect mental health, substance abuse, or other destructive coping mechanisms. A stigma/resilience pathway

would involve neighborhood characteristics (e.g., social norms around living with HIV/AIDS, LGBTQ+ individuals, and social support) and how these factors could impact mental and physical health and feelings of community connection or alienation. Finally, an access/resource pathway examines how material and transit-related resources (e.g., healthcare facilities, access to transit) can directly increase access to HIV medical care and services (Van Tieu et al., 2018). The components of these pathways and the interconnected nature of how each pathway can potentially influence an MSM individual concerning HIV are also closely parallel with a discussion on MPOX infection. Examining the behavioral theories and models to explain these interactions yields the social-ecological model (SEM) as a logical basis for further research on MSM and MPOX.

Initially conceived by Bronfenbrenner (1977), SEM deals with the complex interactions between individuals, relationships, community, and societal factors. Brown (2023) noted that the SEM framework has five distinct stages as depicted in Figure 4.

**Figure 4**

*Social-Ecological Model*


Source: Lee, B. C., Bendixsen, C. G., Liebman, A. K., & Gallagher, S. S. (2017). Using the socio-ecological model to frame agricultural safety and health interventions. Journal of Agromedicine. https://doi.org/10.1080/1059924x.2017.1356780

The individual level involves knowledge and skills, enabling an individual to understand the seriousness of the disease and the potential for susceptibility. The interpersonal level deals with an individual's relationships with other people—family, friends, and acquaintances. The organizational level concerns agencies such as healthcare facilities, neighborhoods, schools, and other bodies that can affect multiple people in different community sections. The community level is the culmination of the organizations and agencies in an area. Resources and ideas can be pooled together to benefit the members of that community. Finally, the public policy level incorporates the governing bodies (e.g., local, state, and federal governments), establishing the agencies and laws to spearhead public health programs and initiatives (Brown, 2023). The CDC notes that action across multiple levels of the SEM at the same time may be required to sustain prevention efforts over time and achieve population-level impact (CDC, 2022h).

The use of the SEM to study MSM groups and high-risk behavior has been previously established in the literature. Hergenrather et al. (2021) used significant findings from identified studies framed with the individual, relationship, and community levels of the SEM to create the Masculinity 10, a 10-item assessment to explore the influence of masculinity on MSM HIV risk behavior. The assessment incorporated several of the themes found by the study authors in the literature, which included unfavorable attitudes toward sexual minorities, feelings of psychological distress, beliefs regarding the importance of having larger anatomy, perceived femininity, substance use, dominance during sex, access to HIV prevention, social support and sex, and health-seeking behaviors (Baucom, 1980; Berger et al., 2005; Blazina et al., 2007; Hamilton & Mahalik, 2009; Keiller, 2010; Levant et al., 2013; Liu & Iwamoto, 2007; Magnus et al., 2013; Mahalik et al., 2003, 2006, 2007; Migliaccio, 2009; Moskowitz & Hart, 2011; Murgo et al.,2017; Mustanski et al., 2011; Springer & Mouzon, 2007; Thompson & Whearty, 2004; Wong et al., 2013). The perceptions of MSM regarding societal or cultural expectations of masculinity and their internal views have a distinct impact on multiple levels of the SEM, specifically the individual, relationship, and community levels. For example, at the individual level, MSM who believe they fail to meet societal or cultural expectations of masculinity may experience internalized homophobia. At the relationship level, maintaining multiple partners is associated with masculinity and feeling sexually desirable. At the community level, men who adhered to masculinity were more reluctant to seek health services or adhere to health-seeking behavior. HIV prevention providers that can help clients identify and understand these self-perceptions of masculinity can enable clients to understand their internal thoughts better and demonstrate behaviors in alignment with the risk of HIV (Hergenrather et al., 2021).

Baral et al. (2013) created a modified social ecological model to define the multi-level domains of HIV infection risk among MSM populations, including the stage of the HIV epidemic, policy, community, social and sexual networks, and the individual. Arnold et al. (2021) utilized this model to explore the geospatial distribution of sexual activities among African American MSM in Jackson, Mississippi. Understanding where HIV transmission occurred, the activity spaces where individuals performed routine daily activities, and the hotspot clusters of HIV infection within activity spaces in Jackson became possible. Combining geospatial mapping with qualitative participatory discussion helped to create a comprehensive picture of knowledge of and attitudes toward HIV risk (Arnold et al., 2021).

Utilizing the literature analyzed for this study (notably Hergenrather et al., 2021; Delaney et al., 2022; and Glicksman, 2022), Table 1 has been developed using the SEM framework to show the multiple levels of influence and the factors in each level that could affect MSM knowledge of MPOX infection and subsequently contribute to a modification in sexual behavior.

**Table 1**

*Social-Ecological Model and MPOX Infection Among Rural MSM*

| Level of Social-Ecological Model | Potential Impact Factor |
|---|---|
| **Individual**<br>Knowledge, Attitudes, Skills | Ability to maintain anti-homosexual beliefs, social isolation from loss of social support, issues related to masculinity self-perception, substance use/abuse |
| **Interpersonal**<br>Families, Friends, Social Networks | Maintaining multiple partners, frequent changing of partners, pursuing high levels of sexual intimacy, size and type of social network support |
| **Organizational**<br>Organizations, Social, Institutions | Access to health services, community-based support agencies, anti-LGBTQ organizational policies (e.g., refusal to provide services) |
| **Community**<br>Relationships Between Organizations | Reluctance to seek health and preventative services; social stigma; threats/acts of violence against LGBTQ+ individuals and agencies providing services |
| **Public Policy**<br>National, State, and Local Laws and Regulations | Laws and regulations discriminating against LBTQ+ groups |

## Gaps in the Literature

Most of the MPOX literature has focused on the MSM population and sexual behavior practices during the MPOX epidemic that began in 2022. Likewise, much of the information and studies related to MPOX preventive health practices, diagnosis, treatment, and vaccination have been documented during the height of the epidemic. As the availability of epidemiological data for MPOX has considerably dwindled to a few periodic updates, the apparent academic and societal interest in this disease has waned. Further, the long-term implications of the MPOX epidemic on MSM sexual behavior practices have gone unaddressed. The impact of MPOX on MSM individuals living in rural or suburban areas has also been largely ignored in the literature, even when the incidence of the disease was at its highest in the United States.

## Summary

Understanding the factors affecting MSM disease awareness and willingness to seek information, treatment, and other preventive services could have broader public health implications. No published literature has been found that investigates the knowledge of rural MSM individuals regarding MPOX infection and its impact on changing attitudes and sexual behaviors. This project will examine the application of these factors among MSM living in predominantly suburban-rural areas of central New York State. Therefore, the proposed study will evaluate MSM individuals living in rural and suburban areas—their awareness of MPOX, how the 2022 epidemic impacted attitudes and behaviors, and if their sexual practices have changed now that MPOX has largely been forgotten.

The next chapter, Chapter 3, will address the methodologies used in the proposed study. An in-depth examination of the purpose of the study, research questions to be explored, the research designs incorporated in the study, the data sample selection, identified sources of data,

and the impacted MSM population. A discussion of the collection and management of data used in the study, the procedures for data analysis, and the new information synthesized from that analysis will be presented. Chapter 3 will close with a summary of the methodologies used in the study.

# Chapter 3: Methodology

## Introduction

This study aimed to determine potential relationships between MPOX knowledge, perceived risk of MPOX infection compared to STIs, willingness to change sexual behavior practices, and MPOX vaccine uptake in MSM individuals living in rural and urban areas. While previous research has been conducted on MSM and risk behaviors related to HIV and STIs, an investigation of the impact of the 2022 MPOX epidemic on MSM sexual behavior practices, particularly in individuals not living in urban locations, has not yet been conducted in the United States where the incidence and prevalence of MPOX have substantially decreased. As a result of this study, new knowledge can be disseminated regarding viral infection and its impact on vulnerable groups living in non-endemic countries. The lessons learned from a public health perspective could have broader implications for future education and prevention initiatives. The first section of this chapter includes a description and justification of the study design. Next, the Setting and Sample section describes the population from which the sample will be drawn, the sampling method, the sample size, and participant eligibility criteria. A description of the study instrument and the required processes for completion will also be discussed. The chapter will conclude with a summation of the research questions and the proposed format for the study.

## Study Design and Justification

For this study, a cross-sectional survey design was used, and data was collected using Smartsheet, a secure Internet-based application used to create online surveys. A cross-sectional survey utilizes an observational method to measure the exposures and outcomes of the study participants at a single point in time. The cross-sectional design is frequently used for population-based surveys and for determining disease prevalence in clinic-based samples (Setia,

2016). There are several advantages of cross-sectional studies, including that they can be conducted relatively faster and are inexpensive compared to other survey designs, can provide a baseline when planning a cohort study, and can prove helpful for public health planning, monitoring, and evaluation (Setia, 2016). Shinde et al. (2009) used a cross-sectional analysis to measure HIV prevalence and risk behaviors in male sex workers and the association between HIV and sociodemographic factors. The administration of questionnaires and clinical and serological evaluation for STIs (including HIV) were crucial components of this cross-sectional study (Shinde et al., 2009). Compared to case–control studies (selection of participants determined by outcome status) or cohort studies (selection of participants determined by exposure status), participants in cross-sectional studies are picked according to the inclusion and exclusion criteria set for the study (Setia, 2016). The cross-sectional format, therefore, was selected to assess potential relationships between MPOX knowledge, perceived risk of MPOX infection compared to STIs, willingness to change sexual behavior practices, and MPOX vaccine uptake in MSM individuals. The exploration of these issues was accomplished by posing the following research questions and testing their respective hypotheses:

**RQ1**: Compared to sexually transmitted infections (STIs) and HIV, do MSM perceive MPOX as a risk to their health?

H1.1$_O$: There is no difference in MSM perception of MPOX as a risk to health compared to HIV or other STIs.

H1.1$_A$: MSM perceive MPOX as a more significant risk to health than HIV or other STIs.

H1.2$_A$: MSM perceive HIV as a more significant risk to health than MPOX or other STIs.

$H1.3_A$: MSM perceive STIs as a more significant risk to health than MPOX or HIV.

**RQ2**: Are MSM sexual behaviors related to the level of MPOX knowledge?

$H1.1_O$: There is no relation to sexual behavior in MSM in response to the level of knowledge of MPOX.

$H1.1_A$: Sexual behavior in MSM is related to the level of knowledge of MPOX.

**RQ3**: Was there a difference in the MPOX vaccination uptake between MSM individuals living in rural areas and MSM living in urban locations?

$H1.1_O$: There is no difference in the MPOX vaccination uptake among MSM individuals living in rural areas and MSM living in urban locations.

$H1.1_A$: MSM living in rural areas have a lower MPOX vaccination uptake when compared to MSM living in urban areas.

$H1.2_A$: MSM living in rural areas have a higher MPOX vaccination uptake when compared to MSM living in urban areas.

## Setting and Sample

### Study Population

The study population consisted of a convenience sample of MSM patients who obtained services from HIV clinics in Chemung and Tompkins counties of New York State. The clinic provides comprehensive diagnosis and treatment options for HIV-positive individuals living in South Central New York and Northern Pennsylvania and coordinates access to medical, psychological, and social services. Clinic locations are based in Elmira, New York, in Chemung County (where approximately 210 patients receive services), and Ithaca, New York, in Tompkins County (where 70 patients regularly receive services), to provide coverage to regional residents with a diverse range of ages and a predominantly White non-Hispanic racial/ethnic background.

**Sampling Method**

The study utilized a non-experimental approach to assess potential relationships between MPOX knowledge, perceived risk of MPOX infection compared to STIs, willingness to change sexual behavior practices, and MPOX vaccine uptake in MSM individuals. Non-probability sampling methods, including convenience and purposive sampling, were utilized in this study. An advantage of convenience sampling is the ease of implementation and the ability to generate data quickly. However, the disadvantages include selection bias and the inability to generalize findings to the target population (Stratton, 2021). The study attempted to survey all patients of the Arnot Health HIV clinics who identify as MSM and reside within Chemung, Steuben, or Tompkins counties of New York State. The selection of the three counties is primarily due to convenience since the location of the Elmira clinic (Chemung County) and the Ithaca clinic (Tompkins County) routinely provides health services to residents of these counties. A potential concern of the convenience sampling method was the inadvertent exclusion of MSM individuals who seek services from other healthcare providers in the region.

**Sample Size**

The study population (including the Elmira and Ithaca clinics) included approximately 150 clinic patients who identified as MSM. The survey demographic questionnaire that asks about sexual identity has three possible responses—homosexual or gay, bisexual, or other sexual identity (participants can enter information into a free text field).

**Inclusion Criteria**

Any individual at least 18 years of age and older who sought services from either the Elmira, NY, or Ithaca, NY, HIV Clinics of Arnot Health were invited to participate in this study. This included individuals who were assigned the gender of a male at birth as well as individuals

assigned female at birth who have transitioned and now identify as a member of the male gender. Access to a cell phone or computer was also required for inclusion in the study.

**Exclusion Criteria**

All HIV Clinic patients under the age of 18 were excluded from this study. Any individuals who are not patients of the Elmira, NY, or Ithaca, NY, HIV clinic were also excluded.

## Instrumentation and Measures

Participants were surveyed electronically using an adaption of the American Men's Internet Survey (AMIS), an annually administered cross-sectional online HIV behavioral survey of cisgender gay, bisexual, same-gender loving, and other men who have sex with men in the United States (Emory AMIS, 2022). The survey contains a core questionnaire (demographics, sexual behavior, HIV and STI testing and diagnosis history, drug and alcohol use, pre-exposure prophylaxis [PrEP], use of HIV prevention services, mental health, stigma, and social support) with options for additional subset questions (Emory AMIS, 2022). An MPOX-specific follow-up survey was administered in August 2022 to a convenience sample of AMIS respondents to assess changes in sexual behavior practices (Delaney et al., 2022). The study utilized a modified version of the MPOX-specific follow-up survey. Specifically, the number of questions in the original AMIS survey has been substantially reduced for this study.

The first part of the survey instrument asked questions to determine eligibility for survey participation. Question #1 asked the respondents' ages; any answer less than 18 automatically ended the survey. Successful completion of the first section redirected the survey respondent to the consent page, ensuring that all answers were kept confidential. In addition, a disclaimer was included stating that the survey contains some personal questions that the respondent may choose

not to answer. Two radio button options (“I agree to participate in the survey,” “I do not agree to participate in the survey”) were given; selecting agreement to participate redirected the respondent to the main survey questionnaire.

The second section of the survey instrument was composed of demographic questions related to race and ethnicity, employment status, health insurance/healthcare coverage, gender identity, and sexual identity.

The third section of the survey instrument asked questions related to the respondent’s sexual behavior with male partners. Questions related to social habits (e.g., attendance at raves, dance clubs, or private parties), use of dating apps, number of partners (including the total number of partners within the previous 3 months, number of new partners, and number of partners within the previous 14 days), number of group sex encounters, and number of partners according to anal or oral sex practice. Finally, questions about encounters where anal sex was performed without a condom were included.

The fourth section of the survey instrument contained the bulk of the questions for this project, including MPOX awareness, knowledge, history of diagnoses, and uptake of the MPOX vaccines. The first subsection assessed the respondent’s knowledge of MPOX, including symptoms, transmission methods, prevention methods, and availability of vaccination. The second subsection was dedicated to testing for MPOX, including a history of confirmed MPOX testing. The third subsection focused on the uptake of the MPOX vaccine. The fourth subsection asked about the respondent’s awareness and attitude about MPOX, including the level of concern for infection, changes in behavior if the respondent developed symptoms consistent with MPOX infection, and changes in social and sexual behavior in response to concerns about MPOX.

Before the initiation of the study, the researcher provided the AMIS authors with a proposed draft survey questionnaire for review. Feedback was also sought from the HIV clinic director, and Arnot Health leadership (including the chief compliance officer) reviewed a final copy of the questionnaire before distribution. Upon completing the survey, participants were allowed to enter into a drawing for two $100 Amazon gift cards. A weblink redirected the participant to another website where contact information could be entered for the gift card drawing.

**Data Collection**

Initially, survey distribution was to be accomplished by sending invitations via text message. However, the software selected for the blast distribution of text messages failed its pilot, prompting a change in methodology. The survey invitation and link to the questionnaire were instead mailed to clinic clients by HIV clinic management at the initiation of the study. The invitation contained a QR code, a brief description of the survey, and the opportunity to enter a drawing for Amazon gift cards. Patients interested in participating could access the survey via the QR code included in the survey invitation. An additional 2-week block of time was added to the duration of the study after 1 month had elapsed due to low initial response.

**Data Analysis**

Data entered in the Smartsheet online survey database was exported to the IBM Statistical Package for Social Sciences (SPSS) program (version 27). Missing values were coded as “System Missing” for purposes of analysis. As noted in Appendix A, the researcher created a codebook defining each variable in the study dataset, including survey information, variable name and value, and the data type. Table 2 outlines the data analysis processes utilized to determine answers to the research questions proposed by this project.

**Table 2**

*Data Analysis*

| (IV = Independent Variable; DV = Dependent Variable) | | | | | | |
|---|---|---|---|---|---|---|
| # | Hypotheses | IV(s) | IV(s) Data | DV(s) | DV Data | Statistical Test |
| **RQ1: Compared to sexually transmitted infections (STIs) and HIV, do MSM perceive MPOX as a risk to their health?** | | | | | | |
| # | Hypotheses | IV(s) | IV(s) Data | DV(s) | DV Data | Statistical Test |
| $H1.1_A$ | MSM will perceive MPOX as a more significant threat to health than other STIs or HIV | SEXID | Categorical | HIVORSTI | Categorical | Descriptive |
| $H1.2_A$ | MSM will perceive HIV as a more significant threat to health than MPOX or other STIs | SEXID | Categorical | HIVORSTI | Categorical | Descriptive |
| $H1.3_A$ | MSM will perceive other STIs as a more significant threat to health than MPOX or HIV | SEXID | Categorical | HIVORSTI | Categorical | Descriptive |
| **RQ2: Are MSM sexual behaviors related to the level of MPOX knowledge?** | | | | | | |
| # | Hypotheses | IV(s) | IV(s) Data | DV(s) | DV Data | Statistical Test |
| $H1.1_A$ | There will be a difference in sexual behavior change in MSM in response to the potential for MPOX infection | KNOWTOTAL (Total score on MPOXKNOWQ1-15) | Continuous | MPOXCHANGE (Total score on MPOXCHANGEQ1-16) | Continuous | Descriptive |
| **RQ3: Was there a difference in the MPOX vaccination rate between MSM individuals living in rural areas and MSM living in urban locations?** | | | | | | |
| # | Hypotheses | IV(s) | IV(s) Data | DV(s) | DV Data | Statistical Test |
| $H1.1_A$ | MSM living in rural areas will have a lower MPOX vaccination rate when compared to MSM living in urban locations | ZIP | Categorical | MPOXVAX | Categorical | Descriptive |
| $H1.2_A$ | MSM living in rural areas will have a higher MPOX vaccination rate when compared to MSM living in urban locations | ZIP | Categorical | MPOXVAX | Categorical | Descriptive |

Data analysis for the project involved descriptive statistics. The first analysis will be descriptive and will utilize a two-step process. The study population will first be described using demographic variables. Each essential variable was reviewed according to the most appropriate

statistical category (i.e., mean, range, frequency). Inferential statistics were not used due to an insufficient number of survey responses received.

## Institutional Review Board

Due to the involvement of human subjects, approval from the Radford University Institutional Review Board (IRB) was secured before this study's initiation. Approval from Arnot Health and Lake Erie College of Medicine SRB was also secured following approval from Radford University IRB.

## Study Considerations

### *Limitations*

The most significant potential limitation of this study was the population. The sample was non-randomized (purposive sample based on convenience); thus, the potential for selection bias must be acknowledged. Characteristics of the larger MSM population in upstate New York may not be reflected and could compromise the study's internal validity. For example, potential survey participants may engage in sexual activity with men but identify as heterosexual and fail to meet eligibility criteria. It was anticipated, however, that the vast majority of survey participants will identify with a sexual orientation other than heterosexual. The sample size was small, so the precision of the study and the ability to draw valid conclusions may be impacted. The use of a survey instrument with self-reported data introduces the possibility of either social desirability (responding in a less honest but more socially acceptable way) or response bias (a tendency to respond in a certain way regardless of the question) in survey responses (Salters-Pedneault, 2023). Consistency in survey responses, particularly the questions related to sexual behavior change and vaccine uptake, were tracked to support the hypothesis that alterations in these behaviors reflect a perception of MPOX as a threat to health.

## Summary

The associations between MPOX knowledge, perceived risk of MPOX infection compared to HIV and STIs, willingness to change sexual behavior practices, and MPOX vaccine uptake in MSM individuals living in rural and suburban areas represent a new frontier in quantitative research. To the best knowledge of the researcher, no studies have directly investigated the impact of the 2022 MPOX epidemic on sexual behavior practices in MSM individuals living outside of metropolitan and other urban locations.

The study utilized a quantitative, non-experimental, cross-sectional investigative design to analyze the relationship of variables. A four-part survey instrument (screening questions, demographics, sexual behavior and social habits, MPOX knowledge, and impact on sexual behavior) based on the AMIS Monkeypox Survey was administered to MSM patients of the Arnot Health Elmira, NY, and Ithaca, NY HIV clinics. As a result of this study, new knowledge can be synthesized regarding the impact of a novel viral infection on a rural/suburban region of upstate New York. Future education and prevention initiatives in similar settings can utilize the findings from this study to help implement more effective interventions.

## Chapter 4: Data Analysis and Results

This project assessed the knowledge of MPOX disease, transmission methods, and recommended prevention strategies (including sexual behavior changes and vaccination) in MSM patients of the Elmira, NY, or Ithaca, NY, HIV clinics operated by Arnot Health. A total of 150 survey invitations were printed and mailed by HIV clinic staff to clinic patients in September 2023. Each invitation contained a brief description of the survey and the opportunity to enter into a drawing for a $100 Amazon gift card. A QR code in the invitation enabled participants to access the survey online. The survey response window remained open for 6 weeks for patients to receive the survey invitations and respond. No reminders were sent due to the anticipated delay that would have resulted from seeking an amendment to the study protocol. After 6 weeks, 15 survey entries had been recorded on the Smartsheet program (a secure Internet-based application used for surveys, data storage, and data management) for an overall response rate of 10%. The low response rate limited the analysis of the data to descriptive statistics and prohibited the use of inferential methods for additional analysis.

All data from the Smartsheet application was downloaded and organized using Microsoft Excel. The data were then coded according to the parameters established by the Codebook in Appendix B. The Excel spreadsheet was imported into IBM's SPSS version 27 Descriptive statistics were utilized to analyze the data, and frequencies, modes, and distribution of responses were determined.

### Survey Section 2: Demographic Characteristics of Survey Respondents

As shown in Table 3, survey respondents shared demographic characteristics. All 15 of the respondents reported a sexual identity of homosexual or gay, and the majority (13 of 15) stated a gender identity of male. Most respondents (14 of 15) stated their race as White. A

plurality of respondents reported being employed full-time, purchasing health insurance through their employer, and never being tested for MPOX. None of the respondents reported ever being diagnosed with MPOX. Figure 5 shows the distribution of age by survey respondents.

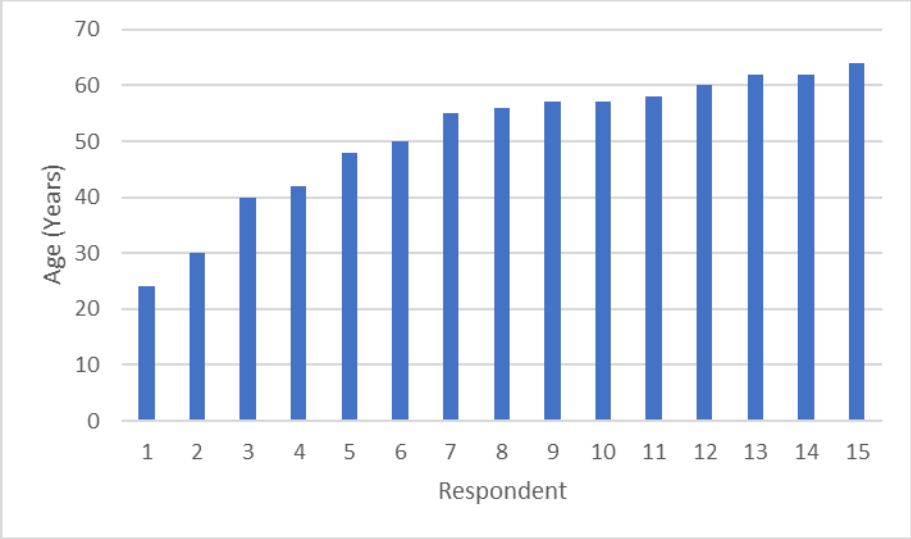
**Table 3**

*Survey Respondent Demographic Characteristics*

| Demographic | Response | N (Frequency) |
|---|---|---|
| **Gender Identity** | Male | 13 (87%) |
| | Genderqueer, gender non-conforming, non-binary | 2 (13%) |
| **Sexual Identity** | Homosexual or gay | 15 (100%) |
| **Race** | White | 14 (93%) |
| | Hispanic, Latino, or Spanish | 1 (7%) |
| **Employment** | Employed part-time | 2 (13.3%) |
| | Employed full-time | 6 (40%) |
| | Self-employed | 3 (20%) |
| | Not employed | 2 (13.3%) |
| | Unable to work (disabled) | 2 (13.3%) |
| **Health Insurance** | Medicaid/Medicare | 5 (33.3%) |
| | Private health plan through employer | 7 (46.7%) |
| | Private health plan through exchange | 2 (13.3%) |
| | Health plan through parents | 1 (6.7%) |
| **Tested for MPOX** | Yes | 3 (20%) |
| | No | 12 (80%) |
| **Diagnosed with MPOX** | Yes | 0 (0%) |
| | No | 15 (100%) |
| **Age Distribution** | 18-24 | 1 (6.7%) |
| | 25-34 | 1 (6.7%) |
| | 35-44 | 2 (13.3%) |
| | 45-54 | 2 (13.3%) |
| | 55-64 | 9 (60%) |
| **Geographic Categorization** | Metropolitan | 7 (46.7%) |
| | Micropolitan | 5 (33.3%) |
| | Rural | 3 (20.0%) |

**Figure 5**

*Age (Years) by Survey Respondent*




**Survey Section 3: Sexual Behavior Practices of Survey Respondents**

The third section of the survey instrument attempted to determine the current sexual behaviors and social habits of the respondents during the previous 12 months. The questions were posed to the survey population to gain additional insight into behavior change that may have been prompted by the MPOX epidemic that began in May 2022. The topics covered included the number of different men with which the participant had oral or anal sex in the previous 12 months, the number of new oral or anal sex partners in the previous 12 months, male sex partners within the previous 14 days, anal sex partners in the previous 12 months, oral sex partners in the previous 12 months, anal sex partners in the previous 12 months where no condom was used, the number of group sex partners in the previous 12 months, and the number of sex partners during the last group sex encounter where no condom was used. Table 4 details the sexual behaviors where the mode for the distribution of responses could be calculated.

**Table 4**

*Frequencies of Sexual Behavior Among Survey Respondents*

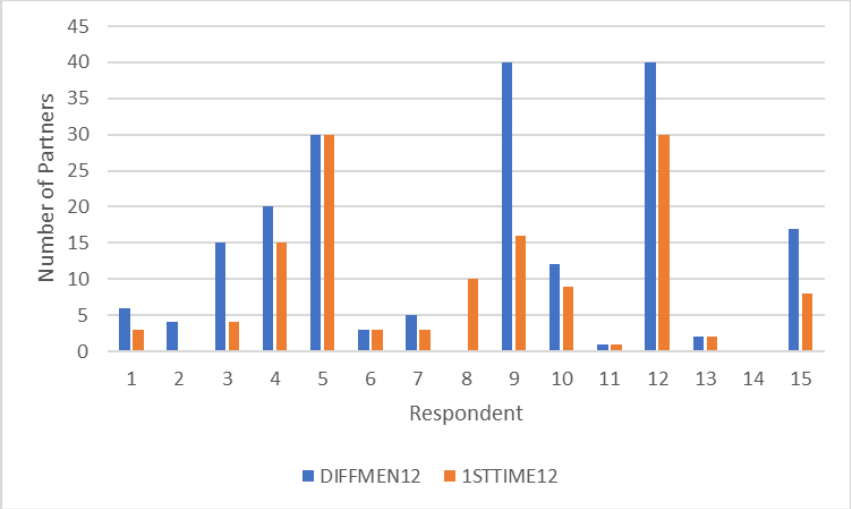
| | DIFFMEN12 | 1STTIME12 | ANAL12 | ORAL12 | NOCONDOM |
|---|---|---|---|---|---|
| **N (Valid)** | 14 | 14 | 14 | 14 | 15 |
| **N (Missing)** | 1 | 1 | 1 | 1 | 0 |
| **Mode** | 40 | 3 | 0 | 1 | 0* |
| **Range** | 40 | 30 | 34 | 30 | 40 |
| **Minimum** | 0 | 0 | 0 | 0 | 0 |
| **Maximum** | 40 | 30 | 34 | 30 | 40 |
| **Median** | 9 | 6 | 1.5 | 5.5 | 2 |

* Multiple modes exist. The smallest value is shown.

Figure 6 details the number of different oral or anal sex partners compared to the number of new sexual partners reported by survey respondents over the previous 12 months. A wide range in the number of different partners was noted, from a low of zero to as many as 40, with six respondents claiming to have had at least 10 partners during the past year. The number of new oral or anal sex partners over the previous 12 months also reflected a substantial range in the number reported. As few as zero new partners were reported by one individual, while as many as 30 were noted by two respondents. Four respondents claimed to have had more than 10 new partners over the past year.

**Figure 6**

*Number of Different Male Partners vs. First-Time Partners, By Respondent*




In order to provide a more defined picture of sexual activity, respondents were asked to report the number of sexual partners within the past 2 weeks of taking the survey. As shown in Table 5, four respondents reported zero partners; three reported one partner; three reported two partners; one noted three partners; and two claimed five partners over the previous 2 weeks.

**Table 5**

*Male Sex Partners Within the Previous 14 Days*

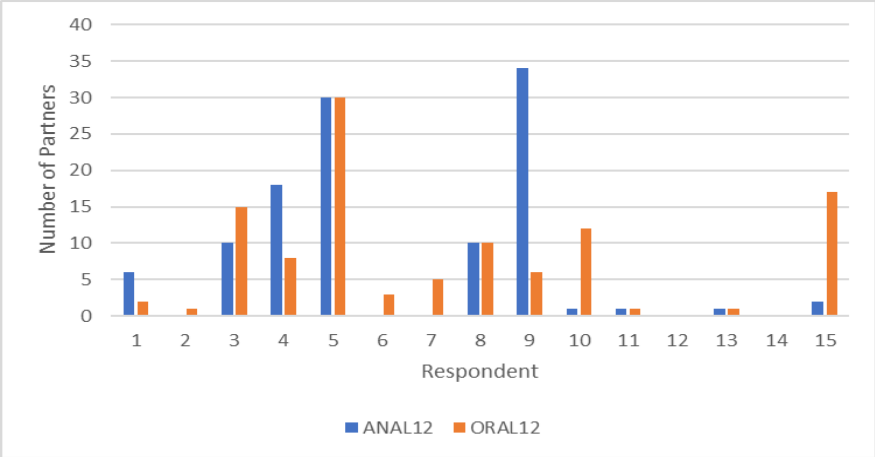
| Number of Partners | Frequency | Percent |
|---|---|---|
| **0** | 6 | 40.0 |
| **1** | 1 | 6.7 |
| **2** | 1 | 6.7 |
| **3** | 2 | 13.3 |
| **5** | 1 | 6.7 |
| **6** | 2 | 13.3 |
| **10** | 1 | 6.7 |
| **25** | 1 | 6.7 |

As shown in Figure 7, survey respondents noted a considerable number of oral and anal sex partners over the previous 12 months. Five of the respondents reported having double-digit

anal partners, including two who reported to have had 30 partners. Seven respondents, however, reported no more than one partner over the prior year. The number of oral sex partners also had a wide range of responses. Similar to what was reported with anal sex encounters, 10 or more partners were reported by two respondents, while 13 reported fewer than 10.

**Figure 7**

*Oral vs. Anal Sex Partners in the Previous 12 Months, By Respondent*




As shown in Table 6, 11 survey respondents reported engaging in anal sex without a condom at least once over the previous 12 months. Three of the respondents reported not using a condom between 10 and 15 times, and three respondents claimed between 30 and 40 encounters.

**Table 6**

*Anal Sex Partners With No Condom in the Previous 12 Months*

| Number of Partners | Frequency | Percent |
|---|---|---|
| **0** | 3 | 20.0 |
| **1** | 3 | 20.0 |
| **2** | 2 | 13.3 |
| **6** | 1 | 6.7 |
| **10** | 2 | 13.3 |
| **15** | 1 | 6.7 |
| **30** | 1 | 6.7 |
| **34** | 1 | 6.7 |
| **40** | 1 | 6.7 |
| **Total** | 15 | 100.0 |

A majority of survey respondents reported engaging in at least one group sex encounter over the previous 12 months. As shown in Table 7, several respondents claimed to have participated in multiple encounters, including one respondent noting 10 encounters and another noting 25.

**Table 7**

*Number of Group Sex Partners in the Previous 12 Months*

| Number of Partners | Frequency | Percent |
|---|---|---|
| **0** | 6 | 40.0 |
| **1** | 1 | 6.7 |
| **2** | 1 | 6.7 |
| **3** | 2 | 13.3 |
| **5** | 1 | 6.7 |
| **6** | 2 | 13.3 |
| **10** | 1 | 6.7 |
| **25** | 1 | 6.7 |
| **Total** | 15 | 100.0 |

Building on the survey question regarding participation in group sex, an additional question asked about the number of group sex encounters without the use of a condom. The distribution of responses shown in Table 8 indicated that six respondents had engaged in these behaviors at least twice over the previous 12 months, including one who claimed 10 encounters.

**Table 8**

*Number of Group Sex Encounters With No Condom in the Previous 12 Months*

| Number of Encounters | Frequency | Percent |
|---|---|---|
| **Blank** | 3 | 20.0 |
| **0** | 4 | 26.7 |
| **1** | 2 | 13.3 |
| **2** | 2 | 13.3 |
| **3** | 1 | 6.7 |
| **5** | 1 | 6.7 |

| | | |
|---|---|---|
| **9** | 1 | 6.7 |
| **10** | 1 | 6.7 |
| **Total** | 15 | 100.0 |

Table 9 sums up the total number of sexual encounters queried in the eight sexual behavior questions, with the average number of encounters equal to 54.7. Two of the respondents reported more than 150 sexual encounters (158 and 175, respectively) over the previous 12 months.

**Table 9**

*Sexual Behavior Total Score*

| Sexual Behavior Total Score | Frequency | Percent |
|---|---|---|
| **0** | 1 | 6.7 |
| **6** | 1 | 6.7 |
| **7** | 1 | 6.7 |
| **10** | 1 | 6.7 |
| **12** | 1 | 6.7 |
| **15** | 1 | 6.7 |
| **29** | 1 | 6.7 |
| **43** | 1 | 6.7 |
| **54** | 1 | 6.7 |
| **55** | 2 | 13.3 |
| **81** | 1 | 6.7 |
| **120** | 1 | 6.7 |
| **158** | 1 | 6.7 |
| **175** | 1 | 6.7 |
| **Total** | 15 | 100.0 |

**Survey Section 4: MPOX Knowledge, Behavior Change, and Vaccine Uptake**

The research questions of this study focused primarily on the assessment of survey respondent knowledge of MPOX and subsequent behavior change and willingness to receive vaccination. Results from the fourth section of the survey will be presented in context with the relevant research question.

**RQ1**: Compared to sexually transmitted infections (STIs) and HIV, do MSM perceive MPOX as a risk to their health?

$H1.1_A$: MSM perceive MPOX as a more significant risk to health than HIV or other STIs.

$H1.2_A$: MSM perceive HIV as a more significant risk to health than MPOX or other STIs.

$H1.3_A$: MSM perceive STIs as a more significant risk to health than MPOX or HIV.

As detailed in Table 10, approximately one-third of the respondents expressed equal concern between MPOX, HIV, or STIs as a risk to their health, while an additional one-third viewed STIs as the predominant risk to health. Only two respondents identified HIV as the most significant health risk, while one-fifth stated no concern over contracting MPOX, HIV, or STIs. Of note, none of the survey respondents reported any history of testing positive for MPOX, although only four respondents (26.7%) reported previously being tested for MPOX.

**Table 10**

*Perception of MPOX, HIV, and STIs as Health Risks*

| Response | N (Frequency) |
|---|---|
| More concerned with getting HIV | 2 (13.3%) |
| More concerned with getting STI | 5 (33.3%) |
| Equally concerned with getting MPOX, HIV, STI | 5 (33.3%) |
| Not concerned with getting any infections | 3 (20%) |

Trusted sources of information can tremendously impact an individual's perception of health risks. As shown in Table 11, 10 of the 15 respondents (66.7%) identified their doctor or healthcare provider as the most reliable source for accurate information on MPOX.

**Table 11**

*Trusted Sources of MPOX Information*

| Information Source | N (Frequency) |
|---|---|
| My doctor or healthcare provider | 10 (66.7%) |
| Centers for Disease Control and Prevention | 2 (13.3%) |
| World Health Organization | 1 (6.7%) |
| State or local public health officials | 1 (6.7%) |
| Health information websites such as WebMD | 1 (6.7%) |

**RQ2**: Are MSM sexual behaviors related to the level of MPOX knowledge?

$H1.1_A$: Sexual behavior in MSM is related to the level of knowledge of MPOX.

The first question of the MPOX knowledge section provided survey respondents with a brief description of the symptoms of MPOX infection and its most common transmission methods. Respondents were then asked to estimate the extent to which they had seen, read, or heard about MPOX. Only three respondents (20%) selected "A lot," with six (40%) selecting "Some" or "A little," and six (40%) selecting "None."

The survey questions coded as MPOXKNOW 1 to 15 in the Codebook measured participant knowledge of MPOX using a Likert scale ranging from "Strongly Agree" to "Strongly Disagree," with zero to three points assigned for each answer depending on the ability of the respondent to select the best possible option for each question. For example, the selection of "Strongly Agree" in response to the statement "Condoms can prevent you from getting MPOX during sex" received three points, while selecting "Strongly Disagree" received zero points. A possible total score (KNOWTOTAL) of 45 points would suggest a high degree of knowledge regarding MPOX and its transmission methods. The median score amongst the 15 survey respondents was 28. As shown in Table 12, a median of 3 was calculated for three of the MPOX knowledge questions (1, 14, 15). These questions related to the vulnerability of MSM to MPOX infection and the MPOX vaccine. Conversely, a median of 1 was calculated for three of the

knowledge questions (5, 7, 13). These questions related to the severity of MPOX symptoms, the low probability of MPOX transmission via semen, and the rapid protective ability of the MPOX vaccine. Table 13 lists the sum of the knowledge questions scored by the respondents.

**Table 12**

*Descriptive Statistical Summary of Responses to MPOXKNOW Survey Questions*

| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 15 | 15 | 15 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 13 | 14 | |
| Mean | 2.53 | 2.00 | 2.00 | 1.86 | 1.36 | 2.36 | 1.43 | 1.79 | 1.64 | 1.29 | 1.64 | 2.43 | 1.14 | 2.38 | 2.57 | 26.80 |
| Median | 3 | 2 | 2 | 2 | 1 | 2.5 | 1 | 2 | 2 | 2 | 2 | 2.5 | 1 | 3 | 3 | 28 |

**Table 13**

*MPOXKNOW Total Score, By Respondent*

| Respondent | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Score | 37 | 25 | 29 | 30 | 26 | 33 | 25 | 23 | 28 | 29 | 22 | 33 | 25 | 9 | 28 | 26.8 |

The survey questions coded as MPOXCHANGE 1 to 16 in the Codebook measured the degree of participant sexual behavior change in response to knowledge of MPOX infection. A Likert scale ranging from “Has decreased because of MPOX” to “Has increased because of MPOX” was utilized, with zero to two points assigned for each answer depending on the ability of the respondent to select the best possible option for each question. For example, the selection of “Has increased because of MPOX” in response to the statement “Use of condoms” received two points, while selecting “Has decreased because of MPOX” received zero points. A possible total score of 46 points would suggest the participant made substantial changes in their sexual behavior practices in response to the risk of MPOX infection. The median score of the 16 questions among the 15 survey respondents was 9, which suggests that respondents had made

very few changes to reduce the risk of MPOX infection. As shown in Table 14, a median of 0 was calculated for five questions (8, 11, 13, 14, 16) and a median of 1 for 10 questions (1, 2, 3, 4, 5, 6, 7, 9, 10, 12). Table 15 lists the sum of the behavior change questions scored by the respondents.

**Table 14**

*Descriptive Statistical Summary of Responses to MPOXCHANGE Survey Questions*

| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 14 | 15 | 15 | 15 | 15 | 15 | 14 | 14 | 14 | |
| Mean | 0.8 | 0.7 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.5 | 0.6 | 1.3 | 0.9 | 1.1 | 0.8 | 0.4 | 1.2 | 0.6 | 12.0 |
| Median | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0.5 | 0 | 9 |

**Table 15**

*MPOXCHANGE Total Score, By Respondent*

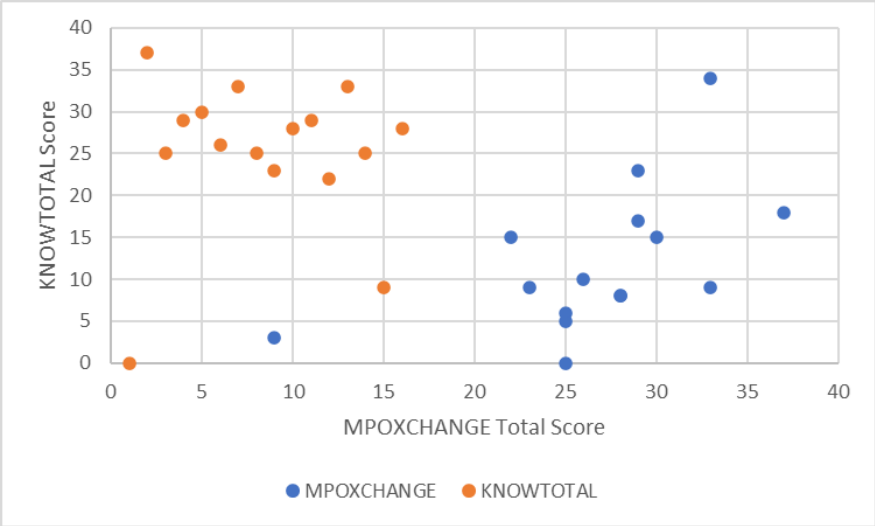
| Respondent | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Score | 18 | 5 | 23 | 15 | 10 | 34 | 6 | 9 | 8 | 17 | 15 | 9 | 0 | 3 | 8 | 12 |

The number of sexual partners did not appear to have a significant impact on respondent desire to change sexual behavior in response to the risk of MPOX. Four of the respondents reported three or fewer new partners or different sexual partners over the previous 12 months. Only one of those respondents had a total score higher than 30 (out of a possible 46) in the MPOX behavior change questions. The other three respondents scored 0, 3, and 15 points, respectively. Likewise, four of the respondents reported between 20 to 40 different partners and between 15 to 30 first-time partners over the previous 12 months. The sum of their MPOX behavior change questions (8, 9, 10, and 15, respectively) indicated little desire to change sexual behavior practices in response to the risk of MPOX infection.

Figure 8 shows a scatter plot comparing the MPOX knowledge scores (KNOWTOTAL) and changes in sexual behavior (MPOXCHANGE). The lack of a discernable pattern between how the data points are trending suggests that there is no correlation between demonstrated knowledge of MPOX and a change in sexual behaviors. A direct association between knowledge and behavior would have resulted in a positive scatter plot trending linearly.

**Figure 8**

*MPOX Knowledge (KNOWTOTAL) vs. Sexual Behavior Change (MPOXCHANGE)*




**RQ3**: Is there a difference in the MPOX vaccination uptake between MSM individuals living in rural areas and MSM living in urban locations?

H1.1$_A$: MSM living in rural areas have a lower MPOX vaccination uptake when compared to MSM living in urban areas.

H1.2$_A$: MSM living in rural areas have a higher MPOX vaccination uptake when compared to MSM living in urban areas.

For the purposes of this study, rural and urban categorization for each respondent was accomplished using the U.S. Department of Agriculture Economic Research Service Rural-Urban Commuting Area (RUCA) 2010 codes last updated on August 17, 2020. The RUCA codes

classify U.S. census tracts utilizing measures of population density, urbanization, and daily commuting. The classifications are then applied to ZIP code areas by transferring RUCA values from the census tracts that comprise each area. The most current RUCA codes derive data from the 2010 decennial census and the 2006–10 American Community Survey. The classification uses whole numbers on a scale of 1 to 10 to delineate metropolitan, micropolitan, small-town, and rural commuting areas based on the size and direction of the largest commuting flows (U.S. Department of Agriculture Economic Research Service, 2023). Study participants were asked for the ZIP code of their current residence when completing the online survey. The RUCS code categorization and the MPOX vaccination status of each respondent are shown in Table 16.

**Table 16**

*Rural-Urban Categorization, By Respondent*

| Respondent | ZIP Code | RUCA Code | RUCA Categorization | MPOX Vaccine Received |
|---|---|---|---|---|
| 1 | 14859 | 5 | Micropolitan | Yes, 2 doses |
| 2 | 14901 | 1 | Metropolitan | No |
| 3 | 14901 | 1 | Metropolitan | Yes, 2 doses |
| 4 | 14830 | 4 | Micropolitan | Yes, 2 doses |
| 5 | 14901 | 1 | Metropolitan | Yes, 2 doses |
| 6 | 14456 | 4 | Micropolitan | Yes, 2 doses |
| 7 | 14830 | 4 | Micropolitan | Yes, 2 doses |
| 8 | 14840 | 10 | Rural | Yes, 1 dose |
| 9 | 14901 | 1 | Metropolitan | Yes, 2 doses |
| 10 | 14837 | 10 | Rural | Yes, 2 doses |
| 11 | 14901 | 1 | Metropolitan | No |
| 12 | 14837 | 10 | Rural | Yes, 2 doses |
| 13 | 18810 | 4 | Micropolitan | No |
| 14 | 14850 | 1 | Metropolitan | No |
| 15 | 14845 | 1 | Metropolitan | Yes, 2 doses |

As shown in Table 17, four of the seven individuals (57.1%) categorized as metropolitan residents reported MPOX vaccine uptake of the recommended two JYNNEOS doses, with three individuals reporting not receiving the vaccination. Of the five respondents categorized as

micropolitan, five (80%) reported receiving both MPOX vaccine doses, while one micropolitan respondent reported not receiving the vaccination. Finally, of the three respondents categorized as rural, two (66.7%) reported receiving two MPOX vaccine doses, while the third rural respondent reported not receiving the vaccination. By comparison, among MSM groups in New York City, 91% received one vaccination dose, while 46% who received the first dose completed the two-dose regimen (CDC, 2023f). Data for MSM individuals in New York City who did not receive or refused MPOX vaccination was not disclosed by the CDC.

**Table 17**

*MPOX Vaccination Status by RUCA Categorization vs. New York City*

| MPOX Vaccination Status by RUCA Code | N (Frequency) |
|---|---|
| **Metropolitan** | **7** |
| One dose | 0 |
| Two doses (completed series) | 4 (57.1%) |
| No MPOX vaccination | 3 (42.9%) |
| | |
| **Micropolitan** | **5** |
| One dose | 0 |
| Two doses (completed series) | 4 (80%) |
| No MPOX vaccination | 1 (20%) |
| | |
| **Rural** | **3** |
| One dose | 1 (33.3%) |
| Two doses (completed series) | 2 (66.7%) |
| No MPOX vaccination | 0 |
| | |
| **New York City** | |
| One dose | 91% |
| Two doses (completed series) | 46% |

## Summary of Results

In summary, the results of this analysis of an online survey of MSM patients of the Elmira, NY, and Ithaca, NY, HIV clinics operated by Arnot Health yielded distinct trends among the respondents of the survey. The age range of the respondents (24 to 64) spanned three generations (Baby Boomers, Generation X, and Millennials), identifying as White (93%), male (87%), and homosexual (100%). The majority of respondents (86.6%) were also noted to be over

40, and most (60.0%) had access to private health insurance. Chapter 5 will discuss leveraging primary care providers to act as trusted sources of health information for patients with these unique demographic characteristics.

The results of the sexual behavior analyses demonstrated wide variation in the number and frequency of reported partners and behaviors. The higher-risk sexual behaviors also had considerable response ranges, with several respondents stating multiple encounters. In particular, the number of group sex encounters over the previous 12 months and group sex encounters where no condom was used were claimed multiple times by several respondents. The willingness of MSM individuals to engage in high-risk sexual behavior despite the risk of HIV, MPOX, and other STIs will also be discussed in Chapter 5.

The low average score (26.8) and a median score of 28 out of a possible 45 points for questions related to MPOX and its transmission methods indicated a low level of knowledge among survey respondents. An average score of 12 and a median score of 9 out of a possible 46 points for the behavior change questions indicates a low perception among survey respondents that MPOX was a driving factor behind changes in social and sexual behavior practices. Despite the apparent perception among survey respondents that MPOX posed little risk to their health, the high uptake of MPOX vaccine was noteworthy. The juxtaposition between this perception and the high uptake of MPOX vaccination among survey participants will also be discussed in Chapter 5.

## Chapter 5: Discussion

This non-experimental, quantitative study attempted to assess the knowledge of MSM clients of HIV clinics in Elmira, NY, and Ithaca, NY, regarding MPOX and its impact on sexual behavior and vaccine uptake. The study was conducted in September 2023, more than 1 year since the first disease cases were identified in the United States. The low response rate received for the online survey represents the most significant limitation of this study and was anticipated when considering the target population. Magnani et al. (2005) noted the difficulties in adequate surveillance of hard-to-reach and "hidden" subpopulations in efforts to contain the HIV epidemic in low-prevalence settings and in slowing the rate of transmission in high-prevalence settings. Conventional facility and survey-based surveillance data collection strategies were noted to be ineffective when involving communities where behaviors may be considered illegal or illicit (Magnani et al., 2005). The identification of LGBTQ members within a community may also be problematic. Meyer and Wilson (2009) argued that not all lesbian, gay, or bisexual (LGB) individuals define themselves as LGB until a developmental task along their respective coming out process has been achieved. The stigmatization associated with sexual identity also needs to be taken into consideration. Although there have been advancements in the social environment of LGBTQ individuals, many individuals who identify as a member of this group can take a tremendous risk by disclosing their sexual minority status. Discrimination at their place of employment, potential rejection from friends and family, and becoming the subject of physical and verbal abuse are some of the potentially harmful consequences. As a result, many LGBTQ individuals, understandably, may not be willing to disclose their identities to researchers or discuss sensitive topics (Meyer & Wilson, 2009).

The method utilized in this study of mailing a paper survey invitation (containing a QR code to the online survey) to the target population instead of a text message sent directly to a smartphone may have inadvertently caused selection bias. The addresses on file may have been incorrect or outdated, or the intended recipients may have been reluctant to open unexpected mail. The survey invitations were sent using Arnot Health branded envelopes, so there may have been a reluctance to engage with a healthcare provider. Some recipients may not have had access to a smartphone or computer and would have been unable to participate in the survey even if interested. Additionally, paper mailing limited the ability to send reminders to the target population. Sending a paper reminder would have incurred additional time, expense, and effort by HIV clinic staff.

The invitation could have included the option to complete a paper-based survey, although there is no guarantee that this would have increased the response rate. Ebert et al. (2018) relied on paper (N = 3,588) and digital surveys (N = 3,594) to distribute a survey questionnaire to randomly selected citizens among the general public population in Denmark. The overall response rate in the digital group was 36.3%, almost 10 percentage points lower than in the paper group (46%). The most significant difference was seen in the age group 30 to 39 years, with only 35.8% (N = 1,198) responding via paper and 23.2% responding via digital (N = 1,195). Nonrespondents tended to be male, have lower income and less education, and were less likely to be employed than respondents (Ebert et al., 2018). In comparison, the survey respondents for this study were all male and tended to be employed. Information on the income and education status of the HIV clinic population was not gathered in preparation for this study but may have helped explain the lower survey response rate.

**Demographic Characteristics of Survey Population**

The demographic characteristics of the survey respondents, a population considered at-risk of MPOX infection, drew an interesting comparison between previous MPOX cases identified in the United States. The average age of men diagnosed with MPOX in 2022 was between 21 and 45 years (CDC, 2022d). In contrast, 11 of the survey respondents were reportedly older than this average range, with six respondents over the age of 50 and four of the respondents older than 60 years. Although none of the survey respondents had any history of being diagnosed with MPOX, these individuals were identified by the Arnot Health HIV Clinic as members of an at-risk group (HIV-positive or high-risk behavior MSM) and offered MPOX vaccination. The completion of the two-dose MPOX vaccine series in this older MSM group (66.7%) compared to at-risk groups in New York City (46%) and New York State (31%) raises the question of the impact of age on vaccine uptake and bears further study. Interestingly, there did not appear to be a direct correlation between age and changes in reported sexual behavior. Older survey respondents were just as likely as their younger counterparts to report having had multiple sexual partners, not using condoms, or engaging in group sex encounters during the previous 12 months. Older LGBTQ adults are as likely to remain sexually active as older heterosexuals; however, gay and bisexual men are also more likely than heterosexual men to report some sexual problems. Older adults as a group are unlikely to have their sexual health needs addressed in healthcare settings, with the problems of older LGBTQ adults made worse by ageism and heterosexism (Brennan-Ing et al., 2020).

The employment and health insurance demographic information indicated that most respondents were employed part-time or full-time and obtained their health insurance through a private health plan. The impact of health insurance on behavior has been evaluated in previous

research, with a decline in certain negative behaviors (i.e., heavy alcohol consumption and smoking) among low-income individuals linked to gaining access to care (Soni, 2020). The ability to access healthcare could potentially be a vital avenue for the distribution of MPOX information and vaccination via the enlistment of healthcare professionals. When asked what sources would be considered the most trustworthy for accurate sources of MPOX information, 67% of the survey respondents indicated their doctor or healthcare provider as their primary source of information. A healthcare professional could, therefore, be viewed as a trusted figure when engaging in the sensitive conversations inherent to sexual behavior discussions. In addition, the provider could incorporate MPOX into a broader conversation about STI prevention and screen patients at risk for syphilis, gonorrhea, and sexually transmitted infections that have seen significant increases in Chemung County (Chemung County Sexual Health Taskforce, 2023). The acceptance of healthcare providers by the majority of respondents as a trusted source of health information contrasts with what was previously reported in the literature. Winter (2012) observed that approximately 30% of LGBTQ adults do not seek healthcare services or lack a regular healthcare provider. In addition, LGBTQ adults are also more likely to avoid or delay seeking healthcare compared to heterosexuals, which can result in treatment delays and worse health outcomes (Shields et al., 2012).

The disproportionate breakdown by race that was observed in U.S. MPOX cases, with 41% occurring in White individuals, 28% among Hispanics, and 26% among Blacks, noted by Philpott et al. (2022), and similar racial breakdowns reported nationally in March 2023 (CDC, 2022d), was also not observed among the survey population. The lack of racial diversity is not entirely unsurprising given that almost 88% of the population in the Chemung County region is White non-Hispanic, an estimated 6% is Black, and 3.5% is Hispanic or Latino (U.S. Census

Bureau, 2023). Similarly, the racial composition of the HIV clinic patient population reflects those observed in the county overall, with more than 90% of patients categorized as White non-Hispanic. The identification of MSM minority groups should be an issue of concern. Black people made up one-third of all new MPOX cases between May 2022 and January 2023 but comprised only one-tenth of all vaccine recipients (Gans, 2023). Further investigation is needed to determine if similar disparities exist among HIV clinic patients in Chemung County.

**Sexual Behavior Practices Reported by Survey Respondents**

The sexual behavior practices reported by survey respondents are similar to what was reported by Philpott et al. (2022) in their analysis of U.S. MPOX cases. In the 3 weeks preceding symptom onset, 27% reported one partner, 40% reported two to four partners, 14% reported five to nine partners, and 19% reported 10 or more partners. Among men with information available, 38% admitted to group sex. The finding of high-risk sexual behavior in adults 50 years and older in this study should be a cause for concern that is also reflected in the literature. Dilley et al. (2010) and Conron et al. (2010) found that older LGBTQ adults, in comparison to their heterosexual peers, are reported to have higher rates of poor mental health, smoking, and limitations of activities of daily living. Older LGBTQ adults with an HIV-positive status are considered a particularly vulnerable sub-population in the literature. Older adults living with HIV are more likely to live alone and be socially isolated than their younger counterparts (Emlet, 2006). Several social disparities between older LGBTQ adults with and without HIV infection have been determined, including structural, interpersonal, and intrapersonal differences. Older LGBTQ adults with HIV have experienced increased discrimination and less social support, are more likely to live alone, and are at increased risk of depression, anxiety, and suicidal thoughts (Fredriksen-Goldsen et al., 2012). Since several of the respondents for this study reported having

health insurance through either a public or private plan, leveraging their primary care providers to screen their patients for mental health concerns would be considered an appropriate measure in combination with STI screening. Young MSM living with HIV have also been discussed in the literature as vulnerable to health challenges. A study of a multisite cohort of racial and ethnic minority young MSM determined that individuals who had a sexual debut before the age of 16 reported more exchange sex; drug use; emotional and psychological problems related to substance use; and a history of suicide attempts, compared to participants with later MSM sexual debuts (Outlaw et al., 2011). Engaging in high-risk behavior has also been associated with an education level of high school or lower, residing in rural areas, younger age at sex debut with a man, current smoker, higher depressive symptoms, and sexual minority stress (Wei et al., 2022). Engaging in high-risk sexual behavior is exceptionally problematic in rural settings, where stigmatization, less access to resources, and smaller social networks can result in severely negative health outcomes.

**Perception of MPOX, HIV, and STIs as Health Risks**

The response of survey participants expressing concern about the risk of infection between MPOX, HIV, and STIs revealed a potentially fascinating compartmentalization. Approximately five of 15 respondents viewed STIs alone as the primary infection concern compared to one-third that believed MPOX, HIV, and STIs as equal risks to health. A missed opportunity was to query survey participants whether they viewed MPOX as primarily a sexually transmitted infection similar to syphilis, gonorrhea, or chlamydia or if MPOX was thought of as transmitted through other methods. The distinction can be critical for public health departments at the county, state, and federal levels—sexually transmitted diseases can be incorporated into mandatory reporting depending on the jurisdiction. In turn, interventions can be targeted toward

testing, treatment, and vaccination. At the federal level, the National Notifiable Diseases Surveillance System, overseen by the CDC, lists only four nationally notifiable sexually transmitted diseases: chlamydia, gonorrhea, syphilis, and chancroid (CDC, 2023c). Interestingly, one of the CDC's web pages dedicated to MPOX states, "Mpox is often transmitted through close, sustained physical contact, almost exclusively associated with sexual contact in the current outbreak" (CDC, 2023d). The absence of MPOX as a nationally notifiable sexually transmitted disease represents a missed opportunity to track this infection and understand the true incidence and prevalence. In New York State, MPOX was added to the list of sexually transmitted diseases in January 2023. The declaration from the State cited barriers that can prevent or delay access to care for individuals at risk for MPOX infection, including denial and fear of their infection, misinformation, stigma, low self-esteem, lack of insurance, homelessness, substance use, mental health issues, and lack of adequate support systems. The regulations would enable better health outcomes and ensure the virus is not spread to others (NYSDOH, 2023).

The literature is divided on whether MPOX can be categorized as an STI. Allan-Blitz et al. (2022) argued a temporal association between sexual activity and MPOX, the link between certain sexual practices and the location of lesion development, a high frequency of sexual practices increasing the risk for other STIs among patients diagnosed with MPOX, the finding that MPOX virus can be isolated from sexual fluids that are subsequently infectious, and a high frequency of anogenital lesions spreading MPOX suggests that direct inoculation occurs during sexual activities. Hazra and Cherabie (2022) believe the focus on the disease classification of MPOX only serves to further stigmatize individuals for their sexual practices and disease burden. While sexual activity is a primary method of transmission, other established routes have also been recognized. Efforts are better served by emphasizing all transmission dynamics and

infection prevention methods, especially among sexual and gender minority individuals, adolescents, and youth (Hazra & Cherabie, 2022).

**MPOX Knowledge and Behavior Change**

Although the number of completed surveys limits the ability to draw definitive conclusions regarding the extent of MPOX knowledge among rural MSM individuals, some trends can be identified. The average total score (26.8) of a possible 45 points suggests that respondents demonstrated a limited understanding that MPOX can be transmitted primarily through sexual intercourse and close skin-to-skin contact. For example, six of the respondents to the statement “Condoms can prevent you from getting MPOX during sex” selected the “Mostly Disagree” or “Strongly Disagree” responses. The overarching concerns among survey respondents indicated more concern for HIV and sexually transmitted diseases exclusive of MPOX. However, the period in which this survey was administered should be considered. By September 2023, the incidence of MPOX in the United States had been dramatically reduced. Likewise, the responses to the sexual behaviors noted by respondents were also reported more than a year after the MPOX epidemic began in the United States, suggesting the risk of infection had minimal influence on minimizing risky sexual behavior or engaging in practices to better protect against MPOX, or that behaviors had reverted to a pre-epidemic state.

The responses to the MPOX behavior change survey questions further reinforce this assertion. The adoption of behaviors such as decreasing the number of sex partners, refraining from having group sex, using condoms, and decreasing the frequency of one-time sexual encounters would represent significant behavior changes to reduce the risk of MPOX infection. Likewise, the adoption of protective behaviors, including the use of clothing during sex to reduce skin-to-skin contact, asking a partner if they had symptoms of MPOX or a recent diagnosis

before sex, getting tested for MPOX, asking if a partner has been vaccinated against MPOX, and discussing how to reduce the risk of MPOX during sex would indicate a desire to minimize the risk of MPOC infection. The average total score of 12 of a possible 46 points among survey respondents indicates an unwillingness to change or the perception that the adoption of these protective behaviors is not necessary. It should be noted that many of these practices and behavior modifications have been included in other recommendations to help protect against other sexually transmitted infections (CDC, 2023e). Future research could explore the motivations (including the desire to protect against HIV or specific STIs) behind safer sex practices by MSM individuals.

Although the educational status of the respondents was not measured in the current study, most participants reported being employed on a part-time or full-time basis with access to health insurance. Smith et al. (2023) investigated MPOX attitudes, beliefs, and intended behaviors in a general population sample and three MSM subpopulations (gay, bisexual, or men who have sex with men but do not identify as homosexual) in the United Kingdom from September to October 2022. High vaccination rates in the MSM groups were associated with a predominantly educated and working population, and thus, they were more likely to be health literate and engaged with services (Smith et al., 2023). Determining the education level achievement of the population involved in the current study and employment status could have provided further insight.

**Comparison Between Rural and Urban MSM MPOX Vaccine Uptake**

The vaccine uptake reported by the survey respondents contradicts the lack of demonstrated knowledge of MPOX or reported behavior change in response to the 2022 epidemic. One possible explanation is that receiving the vaccine would confer sufficient protection against MPOX and nullify the perceived need to alter other social or sexual practices.

The vaccine uptake rate of the total MSM patient population served by the Arnot Health clinics, New York City, and the United States should be noted in comparison. Previous findings comparing urban and rural jurisdictions indicated a higher uptake among urban MSM populations (81%) compared to their rural counterparts (1.9%) (Owens et al., 2023). This study utilized New York City for comparison, where 91% of at-risk individuals received one vaccine dose, while 46% who received the first dose completed the two-dose regimen (CDC, 2023f). New York State (exclusive of New York City) reported that 53% of at-risk individuals received one dose of the vaccine, while only 31% completed the series. Nationally, only 23% of the population at risk for MPOX infection were fully vaccinated (CDC, 2023f). The vaccination initiatives in urban environments described by Lo Piccolo et al. (2023) and Millman et al. (2022) show the advantages of ample resources, personnel, and vaccine availability and access sites. The lower rates of individuals who complete the two-dose MPOX vaccine regimen, however, highlight the challenges observed when utilizing a vaccine that requires more than one dose to achieve the necessary protection.

In contrast, this study noted that 57.1% of the respondents categorized as metropolitan, 80% of the micropolitan respondents, and 66.7% of the rural respondents reported completing the two-dose regimen. Of the seven respondents categorized as metropolitan, five reported a ZIP code of 14901. Previous health needs assessments conducted within Chemung County have noted that upwards of 20% of residents in the 14901 area of Elmira live below the federal poverty level (Chemung County, 2022). The inability to access the MPOX vaccine due to a lack of transportation or awareness of a need for the vaccine may help to explain the lack of uptake in both the metropolitan and rural areas of Chemung County. Understanding all of the barriers to vaccine uptake, including MPOX and other recommended immunizations, is essential when

designing future vaccine programs in the region. Collectively, a total of 10 of the 15 (66.7%) survey respondents reported receiving two doses. Of the 280 patients of the Arnot Health HIV clinics, only 28.6% completed the two-dose series. The low survey response rate for this study prohibits the ability to determine why vaccine uptake among this patient population remains low despite cases being identified in Chemung County as recently as October 2023 (Chemung County Sexual Health Taskforce, 2023a).

Implementing a successful health intervention in a rural setting is a complicated endeavor due to reduced availability of personnel, smaller infrastructure, and fewer available resources. The challenges for MSM individuals and other LGBTQ groups are the same as those faced by many other rural Americans. Limited access to healthcare, education, housing, substance abuse, and job loss are issues further compounded by the fact that few providers have the required cultural competency to handle LGBTQ health issues, which often leads to worse outcomes (O'Connor et al., 2022). Chemung County is no stranger to some of those adverse health outcomes. Increases in the number of STIs in the overall population, particularly syphilis, have been observed in Chemung County (Chemung County Sexual Health Taskforce, 2023). The number of reported cases that could be attributed to MSM and other LGBTQ groups would require additional research to determine the extent of the problem. Execution of a health intervention targeted to MSM and other LGBTQ groups in a rural setting such as Chemung County, therefore, would require considerable collaboration between stakeholders and the infusion of resources, including funding, expertise, and infrastructure. One example of a successful program was recently utilized to combat the COVID-19 pandemic. The Rural Health Clinic Vaccine Confidence Program was a Health Resources and Services Administration (HRSA) initiative implemented from 2021 to 2022 to improve vaccine confidence and counter

hesitancy to receive the COVID-19 vaccine in rural communities. Funding was provided to Medicare-certified Rural Health Clinics and organizations to increase vaccine confidence and uptake, reinforce essential messages about disease prevention and treatment, improve access to vaccination, and coordinate with existing vaccination sites and public health partners to identify isolated or vaccine-hesitant populations (Health Resources and Services Administration, 2022). The establishment of a similar program adapted from the HRSA model could be targeted to MSM and other LGBTQ groups in Chemung County. The model could be adapted to advance MPOX and other immunization campaigns and could be leveraged to promote other critical health issues, such as STI screening and treatment. The CDC recommendation to include HIV testing for all sexually active patients (unless already known to be HIV-positive) at the time of MPOX testing (Miller et al., 2022) should also be taken into consideration when designing interventions. Implementation would require involvement with public health and community-based organizations to help ensure long-term sustainability. The existence of possible stakeholders within Chemung County should be further explored for incorporation into an intervention. For example, the Ray of Hope Church, founded and fostered by LGBTQ residents, could partner with Chemung County Public Health, Arnot Health, and the New York State Health Department to create an LGBTQ-based health improvement initiative.

**Study Limitations and Suggestions for Future Research**

The small number of completed surveys easily represents the major limitation of this study due to the inability to conduct an inferential statistical analysis of the data. In addition, a small sample size can potentially impact the ability to determine if a particular outcome is a true finding, a false positive, or an overestimated magnitude of association (Hackshaw, 2008). In turn, the findings of this study cannot be generalized to other MSM clients of the Arnot Health

HIV clinics or MSM populations in other rural and urban areas. In addition, the low survey response rate also restricts the ability of this study to perform a direct comparison of MPOX vaccine uptake between urban and rural MSM groups. The ability to accept or reject the null hypotheses of the research questions posed by this study, therefore, cannot be accomplished due to the lack of statistical evidence.

The use of a quantitative online survey may not be the most effective methodology when attempting to study MSM groups, particularly in rural settings where increased stigmatization of LGBTQ groups may further inhibit participant interest in research studies. Meyer and Wilson (2009) emphasized caution when selecting a sampling approach when studying the LGBTQ population since a broad spectrum of population definitions (i.e., the number of sexual and gender identities present) is plausible. One strategy Meyer and Wilson (2009) recommended is respondent-driving sampling (RDS). As conceived by Heckathorn (1997), RDS was designed for sampling "hidden" populations, which are defined as populations where important characteristics are unknown and members are not readily identified due to stigma. Similar to snowball sampling, RDS assumes members of the population are best able to reach their peers through social networks. What makes RDS more exacting than snowball sampling is the use of a two-tiered incentive system for recruitment. The initial wave of respondents (called seeds) are given recruitment coupons to invite peers who meet inclusion criteria to participate in the study. The coupon that identifies the seed is presented when the peer is enrolled. The seed receives a reward for the successful referral (secondary incentive). In turn, enrolled study participants (called recruiters to differentiate them from the seeds) are offered the same dual incentive plan— a reward for participating in the study and bringing new participants from their social networks into the study (Meyer & Wilson, 2009). The use of RDS in a rural setting may be advantageous

since MSM social networks may be smaller compared to urban areas. The dual incentives in RDS could have benefitted this study, with an Amazon gift card for participation and a subsequent reward for recruiting others. More importantly, the use of the RDS model could have helped provide legitimacy to the study among the targeted population. Receiving an invitation to participate in a survey from a trusted friend is a considerably different request than an unexpected appeal from an unknown individual or organization.

Another possible method, known as disproportionate stratification, could also be considered for small MSM populations. The benefit of this method is identifying areas where a target population is more highly concentrated and then sampling a higher fraction of that population within those areas. As a result, LGBTQ populations could be effectively screened while ensuring population estimates can be calculated (Institute of Medicine, 2011). The California LGBT Tobacco Survey, for example, relied on disproportionate stratification when it used areas identified by the 2000 U.S. Census as having a high proportion of unmarried same-sex partners and applied a weighting scheme to enable the sample to be representative of the gay and lesbian population of California (Carpenter & Gates, 2008).

In addition, more qualitative methods may warrant consideration when studying MSM and other LGBTQ groups. These methods would allow for a more in-depth exploration of understudied topics, social settings, and behaviors that may not be sufficiently studied through quantitative means. A qualitative study could help build the knowledge base of crucial issues that could be refined for a subsequent quantitative approach. One-on-one interviews, focus groups, and cognitive interviews could all be potential data collection methods (Institute of Medicine, 2011). The RDS model described by Meyer and Wilson (2009) could be used as a framework for

any of these qualitative methods to recruit participants and continuously build on a knowledge base.

Limitations related to the use of self-reported data should also be acknowledged. Given the sensitive nature of several of the survey questions, social desirability bias is a possibility. This type of bias, defined as providing answers to sensitive questions with socially desirable rather than truthful answers, can result in over-reporting and under-reporting of a particular viewpoint (Johnson & Johnson, 2023). The stigma associated with MPOX disease may have had an impact on survey response as well as interest in participating in the survey at all.

**Conclusion**

The rapid emergence of MPOX onto the global stage while recovery from the COVID-19 pandemic was still in progress represented a formidable challenge to public health and the communities most at risk of infection. In particular, MSM groups endured both the effects of MPOX infection as well as the stigmatization that quickly became associated with the disease. The ready acceptance of behavior changes and uptake of vaccination enabled this novel epidemic to be curtailed quickly. The results of this study suggest that MSM patients of the Arnot Health HIV Clinics who responded to the survey made few efforts to change their sexual behaviors in response to the threat of MPOX. In addition, there is a clear need to focus preventative health interventions on MSM and other LGBTQ individuals living in rural communities. Given the lack of funding and other critical resources often present in many rural jurisdictions, public health agencies must establish a collaborative relationship with primary care providers to engage these vulnerable groups and provide the necessary support. Specifically, the risk of MPOX infection needs to be incorporated into a more extensive discussion on sexual health and the critical importance of behavior modification and vaccination to minimize the health risks. The lack of

response to the survey invitation raises several unanswered questions related to MPOX and the overall topic of sexual health among MSM in Chemung County. Specifically, it remains unknown if accurate and timely information on MPOX and STIs has been effectively disseminated to groups considered vulnerable to infection and adverse health outcomes. Have MSM in Chemung County been educated on the risks of these infections and chosen to ignore those recommendations, or have the messages never been received by their intended audiences? The use of a quantitative survey, on its own, has been demonstrated by this study to be ineffective at answering every aspect of that question. Additional research, incorporating a qualitative component, is needed to explore the perception, beliefs, and motivation behind MSM health issues and the barriers specific to rural settings that may inhibit engaging in more preventative health behaviors.

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## Appendix A – Survey Tool

### Title: Southern Tier MPOX Study

**Introduction: Welcome! The purpose of this study is to measure the level of knowledge that individuals in the Southern Tier region may have about MPOX (formerly known as monkeypox). We are also interested in learning how knowledge of MPOX may have affected other aspects of your daily life. To help answer those questions, the survey will ask a series of questions beginning with some basic eligibility and demographic questions. The next questions will ask about your health, social and sexual behavior practices. The remainder of the survey will ask a series of questions related to MPOX.**

**Completion of the survey will grant eligibility to be entered into a drawing for one of two $100 Amazon gift cards (delivered electronically or in person at your next clinic appointment).**

**Section 1 – Eligibility Screening**

1. How old are you? [Free text field]

Thank you for your interest in the survey!

Before beginning the survey, please note:

- Your answers are confidential: no identifiable information about who you are beyond the questions you answer will be collected.
- This survey includes some personal questions. You can choose not to answer any questions that make you feel uncomfortable answering.

Please indicate whether you agree to participate in the survey. Selecting response #1 indicates your consent to participate.

- I agree to participate in the survey

- I do not agree to participate in the survey

**Section 2 – Demographics**

1. What is your current ZIP code? [free text field]
2. Which best describes your current employment status?
    a. Employed for wages full-time
    b. Employed for wages part-time
    c. Self employed
    d. A homemaker
    e. Retired
    f. Not employed
    g. Unable to work (disabled)
3. What is your race or ethnicity?
    a. White, for example: German, Irish, English, Italian, Polish, French, etc.
    b. Hispanic, Latino, or Spanish, for example: Mexican or Mexican American, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.
    c. Black or African American, for example: African American, Jamaican, Haitian, Nigerian, Ethiopian, Somali, etc.
    d. Asian, for example: Chinese, Filipino, Asian Indian, Vietnamese, Korean, Japanese, etc.
    e. American Indian or Alaska Native
    f. Middle Eastern or North African, for example: Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, etc.

g. Native Hawaiian or Other Pacific Islander, for example: Native Hawaiian, Samoan, Chamorro, Tongan, Fijian, Marshallese, etc.

h. Some other race, ethnicity, or origin [free text field]

4. What kind of health insurance or health care coverage do you currently have? Choose all that apply. Health insurance--health plans people get through employment or purchased directly as well as government programs (like Medicare and Medicaid) that provide medical care or help pay medical bills.

   a. My parent's health plan

   b. A private health plan purchased through an employer

   c. A private health plan purchased through an exchange (i.e. Obamacare)

   d. Medicaid or Medicare

   e. Some other Medical Assistance program

   f. TRICARE (CHAMPUS)

   g. Veterans Administration coverage

   h. Some other health care plan

   i. I don't currently have any health insurance

5. How do you describe your current gender identity?

   a. Female

   b. Male

   c. Trans female, trans woman or transfeminine

   d. Trans male, trans man or transmasculine

   e. Genderqueer, gender nonconforming, or non-binary

   f. Another gender [Free text field]

6. How do you describe your current sexual identity?
    a. Homosexual or Gay
    b. Bisexual
    c. Another sexual identity [free text field]

**Section 3 – Sexual Behavior and Social Habits**

1. In the past 12 months, with how many different men have you had oral or anal sex?
    - [Free text field]
    - I prefer not to answer
2. With how many of the male oral or anal sex partners did you have sex for the very first time in the past 12 months?
    - [Free text field]
    - I prefer not to answer
3. How many male oral or anal sex partners did you have sex with within the past 14 days?
    - [Free text field]
    - I prefer not to answer
4. In the past 12 months, with how many different men have you had anal sex?
    - [Free text field]
    - I prefer not to answer
5. In the past 12 months, with how many different men have you had oral sex?
    - [Free text field]
    - I prefer not to answer

6. In the past 12 months, how many male anal sex partners did you have anal sex with without using a condom?
    - [Free text field]
    - I prefer not to answer
7. In the past 12 months, how many times did you have sex with more than one man in the same encounter (threesome or group sex)?
    - [Free text field]
    - I prefer not to answer
8. The last time you had group sex, with how many men did you have anal sex without a condom?
    - [Free text field]
    - I prefer not to answer
9. In the past 12 months, have you used any of the following kinds of internet sites to meet or socialize with gay men? Check all that apply.
    a. Social network websites (such as Facebook)
    b. Dating websites directed towards gay men
    c. Mobile phone apps (such as gay chat, dating, and hookup apps)
    d. None of the above
10. In the past 12 months, which dating/hookup smartphone apps have you used? Check all that apply.
    a. Grindr
    b. Scruff
    c. Tinder

d. Jack'd
e. Adam 4 Adam/RADAR
f. GROWLr
g. Daddyhunt
h. Hornet
i. Squirt
j. Sniffies
k. Recon
l. Other (please specify): [free text field]
m. None of the above

**Section 4 – MPOX**

1. The next set of questions will assess your knowledge and awareness about MPOX, a disease caused by a virus that

   can make people sick with a fever, headache, muscle aches, swollen lymph nodes, exhaustion and a rash or blisters on the body that typically lasts 2 to 4 weeks. MPOX is spread from person-to-person, including during intimate contact

   and sex. Up until now, how much have you seen, read or heard about MPOX?

   a. A lot
   b. Some
   c. A little
   d. None

| | For each statement below, please tell us if you strongly agree, mostly agree, mostly disagree, or strongly disagree | | | |
|---|---|---|---|---|
| | Strongly Disagree | Mostly Disagree | Mostly Agree | Strongly Agree |
| Only gay and bisexual men can get MPOX | | | | |
| I feel confident that I can protect myself from getting MPOX | | | | |
| The media is exaggerating the seriousness of MPOX | | | | |
| Most people infected with MPOX will experience severe pain | | | | |
| Most people infected with MPOX will experience mild symptoms | | | | |
| MPOX is very contagious | | | | |

| | For each statement below, please tell us if you strongly agree, mostly agree, mostly disagree, or strongly disagree | | | |
|---|---|---|---|---|
| | Strongly Disagree | Mostly Disagree | Mostly Agree | Strongly Agree |
| MPOX can be transmitted by semen | | | | |
| MPOX can be transmitted by saliva | | | | |
| MPOX can only be transmitted to others while people are experiencing the rash | | | | |
| Condoms can prevent you from getting MPOX during sex | | | | |
| Wearing clothing can prevent you from getting MPOX during close contact | | | | |
| There is a vaccine that can prevent MPOX | | | | |
| The MPOX vaccine provides immediate protection against MPOX | | | | |
| You need one dose of the MPOX vaccine to be protected | | | | |
| You need two doses of the MPOX vaccine to be protected | | | | |

17. Have you ever had a test for MPOX?
    a. Yes
    b. No
18. Have you ever been diagnosed with MPOX?
    a. Yes
    b. No
19. Have you ever received a MPOX vaccine?
    a. Yes, one dose
    b. Yes, two doses
    c. Yes, more than two doses
    d. No
20. How concerned are you about getting MPOX compared to HIV or an STI?
    a. More concerned with getting HIV
    b. More concerned with getting an STI
    c. Equally concerned with getting MPOX, HIV, or an STI
    d. Not concerned with getting any of these infection
21. What sources would you trust for accurate information about MPOX? Please check all that apply.
    a. My doctor or healthcare provider
    b. Social media (i.e., Facebook, Instagram, or Twitter)
    c. Dating apps (ex. Grindr or Scruff)
    d. News media
    e. State or local public health officials

f. Health information websites (ex. WebMD)

g. US Centers for Disease Control and Prevention

h. World Health Organization

i. I don't trust any of these sources

| | Since you learned of MPOX, how have the following things changed for you, if at all? | | | |
|---|---|---|---|---|
| | Has decreased because of MPOX | Has not changed or has changed for reasons other than MPOX | Has increased because of MPOX | Not applicable |
| Number of sex partners | | | | |
| Having group sex | | | | |
| Use of condoms | | | | |
| Sex with a partner met on a dating app or at a sex venue | | | | |
| Use of dating/hookup apps to meet partners in-person | | | | |
| One-time sexual encounters | | | | |
| Wore clothing during sex to reduce skin-to-skin contact | | | | |
| Going to sex venues or events, such as bathhouses or sex parties | | | | |
| Going to social events with close contact, such as dance parties or raves | | | | |
| Wore clothing during social events with close contact to reduce skin-to-skin contact | | | | |

Please review the set of questions below, and then rank how often you would ask them of someone prior to engaging in sexual activity:

| | Always | Most Times | Sometimes | Rarely | Never |
|---|---|---|---|---|---|
| Ask if they have symptoms of MPOX such as fever, headache, or genital, oral, or anal rash? | | | | | |
| Ask if they have been around anyone diagnosed with MPOX in the last 10-14 days? | | | | | |
| Discuss precautions that you have each taken to reduce the risk of MPOX? | | | | | |
| Get tested for MPOX? | | | | | |
| Request that they get tested for MPOX? | | | | | |
| Ask if they have been vaccinated against MPOX? | | | | | |
| Discuss how to reduce the risk of MPOX while having sex? | | | | | |

**Thank you for taking the survey! We appreciate your participation!**

**To be entered into the drawing for the Amazon gift card, please click on the weblink below to provide your contact information.**

Please click Here to Enter the Drawing

**If you win and prefer to receive the gift card at your next HIV Clinic appointment, please provide your name and phone number. Your survey responses will not be associated with your e-mail or any of your contact information.**

**To get more information about MPOX, please visit: https://www.cdc.gov/poxvirus/monkeypox/index.html**

**Otherwise, you can close your browser.**

## Appendix B - Codebook

| Question/Issue | Variable Name | Values* | Data Type |
|---|---|---|---|
| *Any question or issue that is left blank, marked as not applicable (N/A), or answered 'I prefer not to answer' will be coded in SPSS as "System Missing" | | | |
| **Section 1: Eligibility Screening Questionnaire** | | | |
| 1. How old are you? | AGEYEARS | 18 to N | Continuous |
| **Section 2: Demographics Questionnaire** | | | |
| 1. What is your current ZIP code? | ZIP | Free Text Field | Categorical (Nominal) |
| 2. Which best describes your current employment status? | EMPLOYMENT | 1. Employed for wages full-time<br>2. Employed for wages part-time<br>3. Self-employed<br>4. Homemaker<br>5. Retired<br>6. Not employed<br>7. Unable to work (disabled) | Categorical (Nominal) |
| 3. What is your race or ethnicity? | RACE | 1. White, for example: German, Irish, English, Italian, Polish, French, etc.<br>2. Hispanic, Latino, or Spanish, for example: Mexican or Mexican American, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.<br>3. Black or African American, for example, African American, Jamaican, Haitian, Nigerian, Ethiopian, Somali, etc.<br>4. Asian, for example: Chinese, Filipino, Asian Indian, Vietnamese, Korean, Japanese, etc.<br>5. American Indian or Alaska Native<br>6. Middle Eastern or North African, for example: Lebanese, Iranian, | Categorical (Nominal) |

| | | | |
|---|---|---|---|
| | | Egyptian, Syrian, Moroccan, Algerian, etc.<br>7. Native Hawaiian or Other Pacific Islander, for example: Native Hawaiian, Samoan, Chamorro, Tongan, Fijian, Marshallese, etc.<br>8. Some other race, ethnicity, or origin [free text field] | |
| 4. What kind of health insurance or healthcare coverage do you currently have? | INSURANCE | 1. My parent's health plan<br>2. A private health plan purchased through an employer<br>3. A private health plan purchased through an exchange (i.e., Obamacare)<br>4. Medicaid or Medicare<br>5. Some other Medical Assistance program<br>6. TRICARE (CHAMPUS)<br>7. Veterans Administration coverage<br>8. Some other healthcare plan<br>9. I don't currently have any health insurance | Categorical (Nominal) |
| 5. How do you describe your current gender identity? | GENDER | 1.Female<br>2.Male<br>3. Transfemale, transwoman or transfeminine<br>4. Transmale, transman or transmasculine<br>5. Genderqueer, gender nonconforming, or non-binary<br>6. Another gender | Categorical (Nominal) |
| 6. How do you describe your current sexual identity? | SEXID | 1. Homosexual or Gay<br>2. Bisexual<br>3. Another sexual identity [free text field] | Categorical (Nominal) |
| **Section 3: Sexual Behavior and Social Habits** | | | |

| | | | |
|---|---|---|---|
| 1. In the past 12 months, with how many different men have you had oral or anal sex? | DIFFMEN12 | [Free text field] | Continuous |
| 2. With how many of the male oral or anal sex partners did you have sex for the very first time in the past 12 months? | 1STTIME12 | [Free text field] | Continuous |
| 3. How many male oral or anal sex partners did you have sex with within the past 14 days? | TWOWEEKS | [Free text field] | Continuous |
| 4. In the past 12 months, with how many different men have you had anal sex? | ANAL12 | [Free text field] | Continuous |
| 5. In the past 12 months, with how many different men have you had oral sex? | ORAL12 | [Free text field] | Continuous |
| 6. In the past 12 months, how many male anal sex partners did you have anal sex with without using a condom? | NOCONDOM | [Free text field] | Continuous |
| 7. In the past 12 months, how many times did you have sex with more than one man in the same encounter (threesome or group sex)? | GROUPSEX | [Free text field] | Continuous |
| 8. The last time you had group sex, with how many men did you have anal sex without a condom? | GROUPNOCONDOM | [Free text field] | Continuous |

| | | | |
|---|---|---|---|
| 9. In the past 12 months, have you used any of the following kinds of Internet sites to meet or socialize with gay men? Check all that apply | INTERNETSITE | 1. Social network sites (Such as Facebook)<br>2. Dating websites directed towards gay men<br>3. Mobile phone apps (gay chat, dating, hookup aps)<br>4. None of the above | Categorial (Nominal) |
| 10. In the past 12 months, which dating/hookup aps have you used? Check all that apply. | DATINGAPP | 1. Grindr<br>2. Scruff<br>3. Tinder<br>4. Jack'd<br>5. Adam 4 Adam/RADAR<br>6. GROWLr<br>7. Daddyhunt<br>8. Hornet<br>9. Squirt<br>10. Sniffies<br>11. Recon<br>12. Other (please specify)<br>13. None of the above | Categorical (Nominal) |
| Sexual Behavior Total Score | SEXTOTALSCORE | Sum of Answers to Questions 1-8 | Continuous |
| **Section 4: MPOX** | | | |
| 1. The next set of questions are about monkeypox (MPOX), a disease caused by a virus that can make people sick with a fever, headache, muscle aches, swollen lymph nodes, exhaustion, and a rash or blisters on the body that typically lasts 2 to 4 weeks. MPOX is spread from person-to-person, including during intimate contact and sex. Up until now, how much have you seen, read or heard about MPOX? | MPOXINFO | 1. A lot<br>2. Some<br>3. A little<br>4. None | Categorical (Ordinal) |

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| 2. Only gay and bisexual men can get MPOX | MPOXKNOWQ01 | Strongly Disagree: 3<br>Mostly Disagree: 2<br>Mostly Agree: 1<br>Strongly Agree: 0 | Discrete (Ordinal) |
| 3. I feel confident that I can protect myself from getting MPOX | MPOXKNOWQ02 | Strongly Disagree: 0<br>Mostly Disagree: 1<br>Mostly Agree: 2<br>Strongly Agree: 3 | Discrete (Ordinal) |
| 4. The media is exaggerating the seriousness of MPOX | MPOXKNOWQ03 | Strongly Disagree: 3<br>Mostly Disagree: 2<br>Mostly Agree: 1<br>Strongly Agree: 0 | Discrete (Ordinal) |
| 5. Most people infected with MPOX will experience severe pain | MPOXKNOWQ04 | Strongly Disagree: 0<br>Mostly Disagree: 1<br>Mostly Agree: 2<br>Strongly Agree: 3 | Discrete (Ordinal) |
| 6. Most people infected with MPOX will experience mild symptoms | MPOXKNOWQ05 | Strongly Disagree: 3<br>Mostly Disagree: 2<br>Mostly Agree: 1<br>Strongly Agree: 0 | Discrete(Ordinal) |
| 7. MPOX is very contagious | MPOXKNOWQ06 | Strongly Disagree: 0<br>Mostly Disagree: 1<br>Mostly Agree: 2<br>Strongly Agree: 3 | Discrete (Ordinal) |
| 8. MPOX can be transmitted by semen | MPOXKNOWQ07 | Strongly Disagree: 3<br>Mostly Disagree: 2<br>Mostly Agree: 1<br>Strongly Agree: 0 | Discrete (Ordinal) |
| 9. MPOX can be transmitted by saliva | MPOXKNOWQ08 | Strongly Disagree: 0<br>Mostly Disagree: 1<br>Mostly Agree: 2<br>Strongly Agree: 3 | Discrete (Ordinal) |
| 10. MPOX can only be transmitted to others while people are experiencing the rash | MPOXKNOWQ09 | Strongly Disagree: 3<br>Mostly Disagree: 2<br>Mostly Agree: 1<br>Strongly Agree: 0 | Discrete (Ordinal) |
| 11. Condoms can prevent you from getting MPOX during sex | MPOXKNOWQ10 | Strongly Disagree: 0<br>Mostly Disagree: 1<br>Mostly Agree: 2<br>Strongly Agree: 3 | Discrete (Ordinal) |
| 12. Wearing clothing can prevent you from getting MPOX during close contact | MPOXKNOWQ11 | Strongly Disagree: 0<br>Mostly Disagree: 1<br>Mostly Agree: 2<br>Strongly Agree: 3 | Discrete (Ordinal) |

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| 13. There is a vaccine that can prevent MPOX | MPOXKNOWQ12 | Strongly Disagree: 0<br>Mostly Disagree: 1<br>Mostly Agree: 2<br>Strongly Agree: 3 | Discrete (Ordinal) |
| 14. The MPOX vaccine provides immediate protection against MPOX | MPOXKNOWQ13 | Strongly Disagree: 0<br>Mostly Disagree: 1<br>Mostly Agree: 2<br>Strongly Agree: 3 | Discrete (Ordinal) |
| 15. You need one dose of the MPOX vaccine to be protected | MPOXKNOWQ14 | Strongly Disagree: 3<br>Mostly Disagree: 2<br>Mostly Agree: 1<br>Strongly Agree: 0 | Discrete (Ordinal) |
| 16. You need two doses of the MPOX vaccine to be protected | MPOXKNOWQ15 | Strongly Disagree: 0<br>Mostly Disagree: 1<br>Mostly Agree: 2<br>Strongly Agree: 3 | Discrete (Ordinal) |
| MPOX Knowledge Total Score | KNOWTOTAL | Sum of MPOXKNOWQ01 through MPOXKNOWQ15 | Continuous |
| 17. Have you ever had a test for MPOX? | MPOXTEST | 1. Yes<br>2. No | Categorical (Dichotomous) |
| 18. Have you ever been diagnosed with MPOX | MPOXDIAGNOSE | 1. Yes<br>2. No | Categorical (Dichotomous) |
| 19. Have you ever received the MPOX vaccine? | MPOXVAX | 1. Yes, one dose<br>2. Yes, two doses<br>3. Yes, more than two doses<br>4. No | Categorical (Nominal) |
| 20. How concerned are you about getting MPOX compared to HIV or an STI? | HIVORSTI | 1. More concerned with getting HIV<br>2. More concerned with getting an STI<br>3. More concerned with getting MPOX<br>4. Equally concerned with getting MPOX, HIV, or an STI<br>5. Not concerned with getting any of these infections | Categorical (Nominal) |
| 21. What sources would you trust for accurate information about MPOX? | MPOXINFO2 | 1. My doctor or healthcare provider<br>2. Social media (Facebook, Instagram, Twitter)<br>3. Dating apps, like Grindr or Scruff | Categorical (Nominal) |

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| | | 4. News media<br>5. State or local public health officials<br>6. Health information websites, like WebMD<br>7. U.S. Centers for Disease Control and Prevention (CDC)<br>8. World Health Organization (WHO)<br>9. I don't trust any of these sources | |
| 22. Number of sex partners | MPOXCHANGEQ01 | Has decreased because of MPOX: 2<br>Has not changed or has changed for reasons other than MPOX: 1<br>Has increased because of MPOX: 0<br>Not applicable: 0 | Discrete (Ordinal) |
| 23. Having group sex | MPOXCHANGEQ02 | Has decreased because of MPOX: 2<br>Has not changed or has changed for reasons other than MPOX: 1<br>Has increased because of MPOX: 0<br>Not applicable: 0 | Discrete (Ordinal) |
| 24. Use of condoms | MPOXCHANGEQ03 | Has decreased because of MPOX: 0<br>Has not changed or has changed for reasons other than MPOX: 1<br>Has increased because of MPOX: 2<br>Not applicable: 0 | Discrete (Ordinal) |
| 25. Sex with a partner met on a dating app or at a sex venue | MPOXCHANGEQ04 | Has decreased because of MPOX: 2<br>Has not changed or has changed for reasons other than MPOX: 1<br>Has increased because of MPOX: 0<br>Not applicable: 0 | Discrete (Ordinal) |
| 26. Use of dating/hookup apps to meet partners in-person | MPOXCHANGEQ05 | Has decreased because of MPOX: 2<br>Has not changed or has changed for reasons other than MPOX: 1 | Discrete (Ordinal) |

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| | | Has increased because of MPOX: 0<br>Not applicable: 0 | |
| 27. One-time sexual encounters | MPOXCHANGEQ06 | Has decreased because of MPOX: 2<br>Has not changed or has changed for reasons other than MPOX: 1<br>Has increased because of MPOX: 0<br>Not applicable: 0 | Discrete (Ordinal) |
| 28. Wore clothing during sex to reduce skin-to-skin contact | MPOXCHANGEQ07 | Has decreased because of MPOX: 0<br>Has not changed or has changed for reasons other than MPOX: 1<br>Has increased because of MPOX: 2<br>Not applicable: 0 | Discrete (Ordinal) |
| 29. Going to sex venues or events, such as bathhouses or sex parties | MPOXCHANGEQ08 | Has decreased because of MPOX: 2<br>Has not changed or has changed for reasons other than MPOX: 1<br>Has increased because of MPOX: 0<br>Not applicable: 0 | Discrete (Ordinal) |
| 30. Going to social events with close contact, such as dance parties or raves | MPOXCHANGEQ09 | Has decreased because of MPOX: 2<br>Has not changed or has changed for reasons other than MPOX: 1<br>Has increased because of MPOX: 0<br>Not applicable: 0 | Discrete (Ordinal) |
| 31. Ask if they have symptoms of MPOX such as fever, headache, or genital, oral, or anal rash? | MPOXCHANGEQ10 | Always: 4<br>Most times: 3<br>Sometimes: 2<br>Rarely: 1<br>Never: 0 | Discrete (Ordinal) |
| 32. Ask if they have been around anyone diagnosed with MPOX in the last 10-14 days? | MPOXCHANGEQ11 | Always: 4<br>Most times: 3<br>Sometimes: 2<br>Rarely: 1<br>Never: 0 | Discrete (Ordinal) |
| 33. Discuss precautions that you have each taken to reduce | MPOXCHANGEQ12 | Always: 4<br>Most times: 3<br>Sometimes: 2<br>Rarely: 1 | Discrete (Ordinal) |

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| the risk of MPOX? | | Never: 0 | |
| 34. Get tested for MPOX? | MPOXCHANGEQ13 | Always: 4<br>Most times: 3<br>Sometimes: 2<br>Rarely: 1<br>Never: 0 | Discrete (Ordinal) |
| 35. Request that they get tested for MPOX? | MPOXCHANGEQ14 | Always: 4<br>Most times: 3<br>Sometimes: 2<br>Rarely: 1<br>Never: 0 | Discrete (Ordinal) |
| 36. Ask if they have been vaccinated against MPOX? | MPOXCHANGEQ15 | Always: 4<br>Most times: 3<br>Sometimes: 2<br>Rarely: 1<br>Never: 0 | Discrete (Ordinal) |
| 37. Discuss how to reduce the risk of MPOX while having sex? | MPOXCHANGEQ16 | Always: 4<br>Most times: 3<br>Sometimes: 2<br>Rarely: 1<br>Never: 0 | Discrete (Ordinal) |
| Total Score Behavior Change Due to MPOX | MPOXCHANGE | Sum of MPOXCHANGE Q01-Q16 | Continuous |