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Journal Title: Open Forum Infectious Diseases
Volume: Volume 2, Number 1
Publisher: Oxford University Press (OUP) | 2015-01, Pages ofv016-ofv016
Type of Work: Article | Final Publisher PDF
Publisher DOI: 10.1093/ofid/ofv016
Permanent URL: https://pid.emory.edu/ark:/25593/pqpws

Final published version: http://dx.doi.org/10.1093/ofid/ofv016

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Knowledge and Awareness of Acute Human Immunodeficiency Virus Infection Among Mobile App-Using Men Who Have Sex With Men: A Missed Public Health Opportunity

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In a national online survey, we assessed awareness and knowledge of acute human immunodeficiency virus (HIV) infection manifestation among 1748 men who have sex with men (MSM). Only 39% of respondents were aware that acute HIV infection may be accompanied by symptoms. Education and increased access to acute HIV testing may facilitate MSM to appropriately seek acute HIV testing.

Keywords. acute infection; HIV; MSM.

More than one million people in the United States are infected with human immunodeficiency virus (HIV), and approximately 50 000 people are newly infected each year. Studies show that men who have sex with men (MSM) are disproportionately burdened and account for more than 60% of these new infections [1].

Immediately after HIV infection, an acute period occurs that is characterized by a steep rise in viral load [2]. During acute infection, an estimated 50%–90% of those infected experience at least 1 symptom such as a high fever (median maximum temperature, 38.9°C), headache, fatigue, rash, myalgia, lymphadenopathy, and pharyngitis [2, 3]. This symptomatic period is estimated to persist for 2 to 4 weeks [4]. Awareness of acute infection symptoms is important because the period of acute infection is the only symptomatic event that can lead to early HIV testing and entry into care. After acute infection resolves, people may live with asymptomatic HIV infection for years to decades.

Opportunities to bring those with acute HIV infection into care are valuable for the clinical benefit to the individual and the HIV prevention benefit to the public. Initiation of antiretroviral therapy (ART) during acute HIV infection has been associated with enhanced clinical outcomes including improved likelihood of recovery of $CD4^+$ T-cell counts [5], normalization of CD4/CD8 ratio [6], and reduction, but not prevention, of the latent HIV reservoir [7, 8]. Beyond the potential clinical benefits of ART initiation during acute infection, there are extensive clinical benefits for those who avoid late entry into care [9]. A substantial number of men are not tested sufficiently frequently to avoid late HIV diagnosis. For MSM diagnosed with HIV in 2011, half (10 654 of 21 005) developed acquired immune deficiency syndrome within 12 months [10].

Antiretroviral therapy-mediated viral suppression also has prevention value for heterosexuals and MSM by reducing the likelihood of HIV transmission for vaginal and anal sex; based on 374 years of HIV serodiscordant couples anal-sex follow-up in which the positive partner maintained viral suppression, the PARTNER study's best estimate was a zero HIV transmission rate [11]. Moreover, identifying cases in the acute phase may have further prevention benefit, because viral load peaks during acute infection and remains elevated for 1–4 months above eventual viral set point [12]. The impact of this elevated viral load on transmission may be considerable, as one phylogenetic study among MSM in Michigan estimated that 45% of HIV transmissions occurred in the first year after host infection [13]. Given both clinical and prevention benefits, there is substantial value in detecting acute HIV infections, and one potential cue for MSM to seek testing for acute infection could be early symptomatic events.

For such a mechanism, at-risk MSM would need to have knowledge of acute infection and access to acute testing. Knowledge has been assessed in 2 previous studies: 96 of 150 (64%) of MSM in Seattle identified at least 1 symptom [3], and 46 of 100 (46%) of MSM students at a conference had heard that there can be symptoms after recent HIV infection [14]. The present study explores awareness of acute infection and knowledge of symptom manifestation pertinent to care-seeking among a large, national sample of US MSM.

METHODS

A cross-sectional online survey was conducted among MSM who used a geosocial networking smartphone/tablet application

Received 11 November 2014; accepted 27 January 2015.

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Open Forum Infectious Diseases

DOI: 10.1093/ofid/ofv016

(app) in the United States in May and June, 2014. The app used for recruitment has a target audience of MSM, and its primary purpose is to facilitate social or sexual networking; examples of such apps include Grindr, Tinder, Jack'D, Scruff, Recon, and Hornet. Eligible participants were men ≥18 years reporting sex with another man in their lifetime, HIV-negative or unknown serostatus, and clicked on a recruitment advertisement on the geosocial networking app. This study received ethical approval from the Emory University Institutional Review Board.

Measures sought to assess knowledge of acute infection and its manifestations. An initial question assessed whether participants were aware of the existence of acute infection symptoms. Participants who knew that symptoms might occur shortly after HIV infection were asked questions to ascertain knowledge of specific acute infection symptoms, with a focus on information that would inform test seeking. This included the time from infection to onset of symptoms, the length of symptomatic period, the proportion of those infected with HIV who experience symptoms during the acute period, and identification of symptoms through a checklist of 4 common symptoms (fever, fatigue, muscle soreness, and headache) and 3 distractor symptom options (sweaty hands, thirst, and excessive urination). To assess whether depth of knowledge correlates with potential predictors, a 10-point knowledge score variable was created, consisting of the 3 knowledge items, the 4 symptoms, and the 3 distractor symptoms (scale indicated moderate reliability, alpha = 0.68). For this scale, each item correctly answered added a point. See the Supplementary Appendix A for the full text of survey items. We used unadjusted counts and percentages to explore participant awareness and understanding of acute HIV infection, and we described associations with χ^2 tests and unadjusted linear regressions.

RESULTS

Of the 5262 potential participants who clicked on the survey advertisement, 88 were disqualified, 2812 did not complete the survey and were excluded, and 2362 completed the survey. Of those completing the survey, 1748 responded to the survey item that assessed awareness of acute infection and were HIV negative at their last test or had never been tested. The sample was predominantly white, non-Hispanic (65%), with the remainder Hispanic (20%), black, non-Hispanic (6%), Asian or Pacific Islander (4%), or multiracial/other (5%). Participants were predominantly highly educated: 55% were college graduates, 35% had an associate's degree or completion of some college coursework, and 10% had a high school education or less. A majority (59%) reported household income greater than or equal to $40 000 per year. The median age of participants was 30 (interquartile range 24 to 41), most identified as gay (83%) or bisexual (17%), and most had received an HIV test in the last year (68%) and at least 1 test in their lifetime (92%). One third (33%) of all participants reported ever experiencing any symptoms perceived as indicative of HIV infection, and 61% and 50% were previously aware of pre-exposure prophylaxis (PrEP) and nonoccupational postexposure prophylaxis (nPEP), respectively.

Table 1. Awareness and Knowledge of Acute HIV Infection Manifestation Among Mobile App-Using MSM[a]

	%	n
Awareness		
Are there symptoms after HIV infection?		
Yes	39%	674 of 1748
No	48%	846 of 1748
Don't Know	13%	228 of 1748
Depth of knowledge among those aware of acute infection[b]		
What percent of people with acute HIV infection show symptoms?		
0%–24%	35%	222 of 643
25%–49%	36%	231 of 643
50%–90%	28%	183 of 643
91%–100%	1%	7 of 643
How long after exposure do symptoms usually occur?		
1 day	1%	8 of 674
3 days	4%	29 of 674
1 week	11%	72 of 674
2–4 weeks	68%	455 of 674
Don't know	16%	110 of 674
How long do symptoms usually last?		
1 day	0.5%	3 of 672
3 days	9%	60 of 672
1 week	25%	168 of 672
2–4 weeks	26%	174 of 672
Don't know	40%	267 of 672
Which of the following symptoms?		
Fever	76%	514 of 674
Fatigue	75%	503 of 674
Muscle of joint soreness	60%	406 of 674
Headache	51%	342 of 674
Distractor symptoms (mean)[c]	18%	–

Abbreviations: App, Application; HIV, human immunodeficiency virus; MSM, men who have sex with men.

[a] Italics indicates an option considered as a correct response.

[b] Only respondents aware that there can be symptoms after HIV infection ($n = 674$) were asked subsequent items regarding knowledge of acute infection.

[c] Mean percent agreement across 3 distractor items indicative of diabetes.

Participants were from 47 of the 48 contiguous states: South Dakota was not represented. In addition, 54.7% of participants were from the 100 most populous counties (which account for 50% of the US population) in the contiguous states. A map of participants by county can be seen in Supplementary Appendix B.

Most participants did not think acute HIV symptoms occur (48%) or were unsure whether they occur (13%) (Table 1). The minority (39%) who were aware that symptoms may appear after HIV infection were asked a series of knowledge items,

and they were found to have mixed levels of knowledge. Over two thirds correctly identified the time period in which symptoms occur (2–4 weeks postinfection), but only one quarter knew how long symptoms usually last (2–4 weeks). Most (71%) underestimated the proportion of infections in which symptoms occur, but each symptom was correctly selected by a majority of participants. Three quarters correctly selected fever and fatigue, although detractor items were incorrectly selected on average by 18%.

There were no significant bivariate associations between demographic variables (race, age, income, and education) and awareness that symptoms may appear after acute infection. Factors associated with awareness were knowledge of nPEP (43% vs 34%; $P < .001$) and having experienced symptoms perceived as indicative of HIV (48% vs 34%; $P < .001$). A separate analysis among the minority of participants aware of acute infection was conducted to assess correlations between depth of knowledge and demographic and other theoretically relevant predictor variables. This assessment found that higher scores on the 10-point acute infection knowledge assessment were associated with college education (linear regression correlation coefficient [B: 0.40], 95% confidence interval [CI]: 0.1, 0.7), income ≥$40 000 (B: 0.37, 95% CI: 0.1, 0.7), ever testing for HIV (B: 1.05, 95% CI: 0.6, 1.5), awareness of PrEP (B: 0.73, 95% CI: 0.2, 1.2), awareness of nPEP (B: 0.93, 95% CI: 0.7, 1.2), and having experienced symptoms perceived as indicative of HIV (B: 0.51, 95% CI: 0.2, 0.8).

DISCUSSION

We found low knowledge of acute infection, with the plurality of respondents believing that acute HIV infection symptoms do not occur. Lack of awareness of acute infection symptoms indicates a missed public health opportunity, because symptoms such as a high fever could serve as a trigger for some recently infected MSM to seek testing for acute infection. To fully leverage this opportunity, MSM must have knowledge of acute infection and easy access to testing for acute infection. Increasing the pool of MSM testing at the acute stage has potential clinical benefits from early entry into care, certain clinical benefits of initiation of ART, and prevention benefits from less aggregate time in which those infected are not in care.

Previous studies reported low awareness of acute infection [14, 15], and our study replicates and extends those findings with a larger and more geographically diverse sample of MSM. Participants in our study who were aware of acute infection often had mixed knowledge. In line with previous research [3, 14, 16], most were able to correctly identify acute HIV infection symptoms. However, the majority underestimated the frequency in which symptoms occur and the length of time symptoms persist. Demographic factors that commonly vary with health knowledge were not correlated with awareness of acute infection, indicating that programs should be implemented across the spectrum of at-risk MSM. The correlation of nPEP awareness with awareness of acute infection and higher levels of knowledge regarding acute infection may indicate that there is a subset of MSM who seek more information about HIV prevention once they are aware of an issue. Exploring this group, their sources of knowledge, and how they use this knowledge may be useful for future program planning.

Several promising programs have increased detection of acute infections by teaming knowledge campaigns with acute HIV infection screening, including interventions in New York City [17] and Vancouver [18]. In Seattle, an informational campaign increased knowledge but did not impact the rate of acute HIV case finding [16]. Another promising area of ongoing research is provision of acute HIV infection training to ambulatory care providers [19, 20]. Increasing acute infection knowledge among providers, particularly regarding the window period and diagnostic testing for acute HIV infection, is an important area for future intervention. Moreover, a modeling study found that acute infection detection through increased screening of symptomatic MSM would be cost effective [21]. Another approach to increase detection of acute HIV infections involves 4th-generation HIV testing that can detect the HIV-1 p24 antigen. The new Centers for Disease Control and Prevention HIV testing algorithm recommends and provides guidance regarding antibody and antigen tests, and because that guidance is implemented an increasing number of acute and early HIV infections will be detected.

Findings from this study are subject to several limitations. Foremost, the sample was drawn from a geosocial networking application and may not be representative. The study did not incentivize participation, to minimize fraudulent participation, but this method may also lead to higher levels of volunteer bias, for example, those who volunteer to take a men's health survey may be more likely to be interested in and aware of health topics. For the analysis of depth of knowledge among those aware of acute infection, our calculations had limited power to detect differences by socioeconomic variables such as race. Due to length of survey limitations, we did not assess the prevalence of having received testing for acute infection; this is an area that should be addressed in future research.

CONCLUSIONS

Given that a sizable proportion of those with acute HIV infection experience symptoms, interventions that deliver acute infection screening based on these symptoms have the potential to substantially increase the early detection of HIV in the United States. A start to this effort may be information dissemination from public health representatives and programs, including materials such as checklists of acute infection symptoms and places to receive testing. Given the dearth of acute infection

knowledge among MSM, such educational efforts are warranted. However, knowledge alone is likely insufficient to have a substantial impact. There is a need for multilevel interventions that target domains most relevant to behavioral change, such as stigma reduction, self-efficacy building, and structural facilitators. Future research should focus on the development and formal testing of such approaches.

Supplementary Material

Supplementary material is available online at *Open Forum Infectious Diseases* (http://OpenForumInfectiousDiseases.oxfordjournals.org/).

Acknowledgments

Potential conflicts of interest. All authors: No reported conflicts.
All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest.

References

1. Centers for Disease Control and Prevention. Estimated HIV incidence in the United States, 2007–2010. HIV Surveillance Supplemental Report. **2012**; 17:1–26.
2. Schacker T, Collier AC, Hughes J, et al. Clinical and epidemiologic features of primary HIV infection. Ann Intern Med **1996**; 125:257–64.
3. Stekler J, Collier AC, Holmes KK, et al. Primary HIV infection education: knowledge and attitudes of HIV-negative men who have sex with men attending a public health sexually transmitted disease clinic. J Acquir Immune Defic Syndr **2006**; 42:123–6.
4. Gay C, Dibben O, Anderson JA, et al. Cross-sectional detection of acute HIV infection: timing of transmission, inflammation and antiretroviral therapy. PLoS One **2011**; 6:e19617.
5. Le T, Wright EJ, Smith DM, et al. Enhanced CD4+ T-cell recovery with earlier HIV-1 antiretroviral therapy. N Engl J Med **2013**; 368: 218–30.
6. Thornhill J, Inshaw J, Oomeer S, et al. Enhanced normalisation of CD4/CD8 ratio with early antiretroviral therapy in primary HIV infection. J Int AIDS Soc **2014**; 17 (4 Suppl 3):19480.
7. Ananworanich J, Schuetz A, Vandergeeten C, et al. Impact of multi-targeted antiretroviral treatment on gut T cell depletion and HIV reservoir seeding during acute HIV infection. PLoS One **2012**; 7:e33948.
8. Buzon MJ, Martin-Gayo E, Pereyra F, et al. Long-term antiretroviral treatment initiated at primary HIV-1 infection affects the size, composition, and decay kinetics of the reservoir of HIV-1-infected CD4 T cells. J Virol **2014**; 88:10056–65.
9. Severe P, Juste MA, Ambroise A, et al. Early versus standard antiretroviral therapy for HIV-infected adults in Haiti. N Engl J Med **2010**; 363:257–65.
10. Centers for Disease Control and Prevention. HIV Surveillance Report, 2011. Available at: http://www.cdc.gov/hiv/topics/surveillance/resources/reports/. Accessed 25 May 2013.
11. Rodger A, Bruun T, Cambiano V, et al. HIV transmission risk through condomless sex if HIV+ partner on suppressive ART: PARTNER Study. In: 21st CROI: Conference on Retroviruses and Opportunistic Infections; 3–6 March, 2014; Boston, MA.
12. Huang X, Chen H, Li W, et al. Precise determination of time to reach viral load set point after acute HIV-1 infection. J Acquir Immune Defic Syndr **2012**; 61:448–54.
13. Volz EM, Ionides E, Romero-Severson EO, et al. HIV-1 transmission during early infection in men who have sex with men: a phylodynamic analysis. PLoS Med **2013**; 10:e1001568; discussion e1001568.
14. Grin B, Chan PA, Operario D. Knowledge of acute human immunodeficiency virus infection among gay and bisexual male college students. J Am Coll Health **2013**; 61:232–41.
15. Remien RH, Higgins JA, Correale J, et al. Lack of understanding of acute HIV infection among newly-infected persons-implications for prevention and public health: The NIMH Multisite Acute HIV Infection Study: II. AIDS Behav **2009**; 13:1046–53.
16. Stekler JD, Baldwin HD, Louella MW, et al. ru2hot?: A public health education campaign for men who have sex with men to increase awareness of symptoms of acute HIV infection. Sex Transm Infect **2013**; 89:409–14.
17. Silvera R, Stein D, Hutt R, et al. The development and implementation of an outreach program to identify acute and recent HIV infections in New York City. Open AIDS J **2010**; 4:76–83.
18. Gilbert M, Cook D, Steinberg M, et al. Targeting screening and social marketing to increase detection of acute HIV infection in men who have sex with men in Vancouver, British Columbia. AIDS **2013**; 27: 2649–54.
19. Remien RH. Structural intervention to increase screening and testing for HIV. **2014**. Available at: http://projectreporter.nih.gov/. Accessed 22 October 2014.
20. Pilcher CD. A pilot of intervention to promote acute HIV testing by ambulatory care providers. **2014**. Available at: http://projectreporter.nih.gov/. Accessed 22 October 2014.
21. Cipriano LE, Zaric GS, Holodniy M, et al. Cost effectiveness of screening strategies for early identification of HIV and HCV infection in injection drug users. PLoS One **2012**; 7:e45176.