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RESEARCH PAPER

Uptake of the HPV vaccine among people with and without HIV, cisgender and transgender women and men who have sex with men and with women at two sexual health clinics in Mexico City

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ABSTRACT

Our aim was to better understand Human Papillomavirus (HPV) vaccine acceptance among Mexican adults including people with and without HIV, cisgender men who have sex with men (MSM) or with women (MSW), cisgender and transgender women. A computer-assisted, self-administered questionnaire was completed by healthcare users and participants recruited through community organizations, and the first dose of the quadrivalent HPV vaccine was offered at no cost at a large sexual health clinic in Mexico City, from May to December 2018. Socio-demographic characteristics and factors associated with HPV vaccine acceptance were analyzed using logistic regression.

The sample of 1915 participants included 1341 cisgender men (70.9%, 1247 MSM and 94 MSW), 396 (20.7%) cisgender women and 178 (9.3%) transwomen; 615 people (32.1%) were HIV positive. Uptake of the HPV vaccine was higher in men and transwomen (91.5% and 87%, respectively) than among cisgender women (81.8%; $p < .001$). Cisgender women (OR 0.43, 95%CI 0.30–0.61, $p < .05$) were less likely to accept HPV vaccination than men. Married/partnered people were less likely to accept HPV vaccination compared to those who were single (OR 0.70, 95%CI 0.51–0.97). People living with HIV were not significantly more likely to accept HPV vaccination (OR 1.7; 95%CI 0.86–1.61).

HPV vaccine acceptance was high among adult Mexican study participants; it may be higher than among other Mexican adults given most of these individuals are engaged in care. Modifications will be needed in national and international recommendations on HPV vaccination in adults if healthcare personnel are to recommend the vaccine to the population groups studied.

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Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection (STI) among women and men worldwide.[1] The association between certain types of cancer (cervical, vulvar, vaginal, anal, penile, and oropharyngeal cancers) and infection with oncogenic types of the human papillomavirus (HPV) has been clearly established.[2] High-risk oncogenic HPV types 16, 18, 31, 33, 45, 52, and 58 are associated with 92% of HPV-attributable cancers.[3] In addition, non-oncogenic HPV (HPV-6/11) is responsible for approximately 90 % of genital warts.[4,5] Almost 5% of cancers that occurred worldwide in 2008 were attributable to HPV infection.[6] Thus, the burden of diseases related to HPV represents a major public health problem worldwide.[6]

The incidence of HPV-related cancers and genital warts is higher among certain groups, such as men and women living with HIV,[7,8] transgender women[9,10] and men who have sex with men (MSM),[11–14] as compared to the general population.[15,16] Among people living with HIV this may be due to a syndemic relationship between HIV and HPV (and specifically HPV-associated cancers) where two epidemics interact synergistically and contribute to an excess burden of disease.[17] In addition to a biological synergy between two infections, among certain population groups such as MSM and transgender women there may also be a syndemic of HPV-associated cancers and negative social conditions such as stigmatization and discrimination, sexism, victimization, child sexual abuse, intimate partner violence and structural violence in general, as well as depression and poverty in some cases.[18] Cisgender women may also be subject to a syndemic between HPV-associated cancers and some of these social conditions. Another set of factors that can lead to higher rates of HPV-related cancers among people who are HIV-negative are sexual behaviors, such as number of sexual partners, number of concurrent partners or receptive anal intercourse as well as other, non-sexual behaviors such as tobacco smoking and use of illegal drugs.[19–23] Sexual behaviors are also mediated by social context which can impede changes in that behavior which could lead to lower levels of risk.[24]

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A unique feature of HPV-associated cancers is that they are potentially preventable through vaccination. The bivalent (2vHPV) and quadrivalent (4vHPV) HPV vaccines were the first to be developed and approved for use. The 4vHPV (Gardasil) by MSD Merck (which we used in this study) protects against HPV 6/11/16/18 and was approved by the FDA in 2006.[25] Research has shown that the 4vHPV is safe and effective against HPV infections with the specific types included in the vaccine.[26] Studies have been able to demonstrate: a.) the safety profile; b.) a reduction of 100% in HPV 6/11/16/18 related disease in women; c.) that immune response is maintained for 5 years after the application of at least the first dose of the vaccine; d.) its efficiency in protecting against cervical, vaginal and vulvar disease, as well as prevention of persistent infection, neoplasia and genital warts caused by HPV 6/11/16/18, and e.) immune response to the vaccine appears to prevent reinfection or reactivation of the disease with the types of HPV included in the vaccine.[27–30] Studies have shown an efficacy of 99% for grade 2/3 cervical epithelial neoplasia related to HPV 16/18, adenocarcinoma in situ or cervical cancer in women who were negative for HPV 16/18 when they received the 4vHPV.[31] The nonavalent (9vHPV) vaccine has now replaced the 4vHPV in most countries and protects from HPV types 6, 11, 16, 18, 31, 33, 45, 42 and 58 (all but the first two of these are oncogenic genotypes).[32,33]

The Advisory Committee on Immunization Practices (ACIP) recommends that girls and boys be routinely vaccinated at age 11 or 12 years; for those who were not vaccinated when younger, ACIP recommends that girls/young women through age 26 years and boys/young men through age 21 years be vaccinated. ACIP also recommends that gay, bisexual, and other men who have sex with men be vaccinated up to the age of 26 while the FDA has recently approved use of the HPV vaccine in men and women aged 27–45 (although ACIP has not yet provided recommendations for this age range).[34,35]

By 2012 over 100 countries had licensed HPV vaccines and some higher- and middle-income countries had reached vaccination rates between approximately 60% to 80%.[36–38] Nevertheless, HPV vaccination rates have varied, with decreases in rates during some years, in some countries.[39–41] However, most lower- and lower-middle-income countries, and some middle income countries have little or no HPV vaccination coverage, although these populations carry most of the burden of cervical cancer.[6,28]

In Mexico, the 4vHPV and 2vHPV vaccines were rolled-out for application in girls ages 9–13 years (with older girls included for catch-up) beginning with a pilot study for implementation of vaccination among girls in 2007 and then implementation among girls 12 to 16 years old in the most disadvantaged (poor and underserved by healthcare) communities.[42] Vaccination among 9 year-old girls was then scaled up to include increasing numbers of communities and in 2012 the HPV vaccine was included as a nationally required vaccine for girls in fifth grade in elementary school or who are 11 years old and not in school. HPV vaccination of girls is funded by the government and offered for free, through both public schools and the public healthcare system.[43,44] In Mexico the HPV vaccine has mainly been distributed to adults through randomized trials and demonstration studies[45–48] or through private medical care and is not currently recommended for adults or for boys in official public policy. Acceptance of the HPV vaccine has been high in Mexico among mothers of adolescent girls[49] and in small samples of adult women and men,[50,51] including high rates of acceptance in adults living with HIV.[45]

Recommendations for HPV vaccination have focused primarily on girls (and sometimes boys) or young adolescents and therefore where HPV vaccine coverage has been achieved, it has been among younger cohorts.[28] However, HPV-related cancers most often impact adults.[7–14,52] HPV vaccination has proven to be an effective strategy to reduce the incidence of cervical cancer.[53,54] The success of this strategy (vaccinating girls against HPV) seems to indicate that increasing the uptake of the HPV vaccination among adults could also yield similar success in reducing other types of HPV-related cancers.[55,56] Also, these recommendations are based on sex assigned at birth and little is known about HPV vaccination rates (much less benefits) in transgender youth or adults.[57,58]

However, as mentioned, the HPV vaccine has only recently been approved for use among adults and there is a lack of clear recommendations for those over 26 years of age.[24,25] This is in spite of the fact that HPV vaccines have the potential to considerably reduce HPV-related morbidity and mortality in adult men and women.[59–61] For example, extending routine vaccination against HPV among women 30 years or older (up to 50 years of age) has been proposed as part of a screen-and-vaccinate protocol that could possibly achieve an even greater decline in cervical cancer incidence.[48,62]Also, the HPV vaccine has been found to be safe and effective for people living with HIV.[63,64] Therefore, the evidence seems to indicate that HPV vaccination would benefit a range of adults.[65,66]

Nevertheless, there can be important barriers to achieving adequate HPV vaccination coverage in adults, including those with specific healthcare needs such as men and women living with HIV, as well as transgender women and men who have sex with men (MSM); among other issues, MSM and transgender women can face disproportionate barriers to healthcare access compared with general population.[58,67–73] While there has been some research on HPV vaccine uptake among MSM,[14,45] very few studies have been done with men and women living with HIV or transgender people.[57,58]

Innovative and targeted strategies aimed at increasing HPV vaccine uptake in these groups of adults with different healthcare needs are required, and in order to develop them more evidence on HPV vaccine acceptability in a broad range of adults is necessary. In order to begin to address this gap in the evidence, the objective of this study was to explore HPV vaccine acceptability and associated factors in men and women living with HIV, MSM and MSW, transgender women as well as in adult cisgender (non trans) women in Mexico City.

Results

Between May and December 2018, 1,915 men and women with and without HIV aged 14–45 were enrolled in the study, recruited through two large clinics providing services related to sexual health, HIV care and transgender health in Mexico

City. The study sample included 396 (20.7%) cisgender (or nontrans) women, 178 (9.3%) transwomen and 1,341 (70%) cisgender men, of whom 1,247 were MSM and 94 were MSW. Of the total sample, 1,278 (66.7%) people reported they did not have HIV, 615 (32.1%) reported they were living with HIV and 22 participants (1.2%) did not respond to this item on the questionnaire (Table 1).

The average age of the study population was 29.4 ± 7.6 (mean ± SD) (Table 1). Mean age at first sexual intercourse was higher among cisgender women and lowest in transwomen. About a third of participants (32.1%) have HIV; 9.0% of women, 23.6% of transwomen and 40.0% of men participating in the study reported they live with HIV. A little over half the study population (54.3%) reported previous sexually transmitted infections (STI) while 39.0% reported 2–5 sexual partners in the previous 3 months. About three fourths (76.2%) of the study population was single. Fewer transwomen (10.1%) and cisgender women (17.0%) reported they have done sex work as compared to men (23.7%).

Overall, 1,706 participants (89.1%) received the first dose of the 4vHPV vaccine (protecting them from HPV types 6, 11, 16 and 18) (Table 2). Uptake of the HPV vaccine was higher in men and trans women (91.5% and 87%, respectively) than among cisgender women (81.8%), and this was a statistically significant difference ($p < .001$). HPV vaccine uptake decreased slightly with fewer years of education: 91.4% of those with 18 or more years of education accepted the vaccine while 86.5% of those with 12 or less years of education did so, and this difference was statistically significant ($p < .05$). More single participants accepted the vaccine as compared to those who were married or living with a partner (90.1% vs 86%), also a statistically significant difference ($p < .05$).

HPV vaccine uptake was higher in people living with HIV (90.1%) as well as those who reported ever having had a sexually transmitted infection (89.7%), but these differences were not statistically significant ($p > .05$). Uptake of the first dose of the HPV vaccine among participants who have ever done sex work was higher compared to those who did not (93% vs 88%), and this difference was statistically significant ($p < .05$) as was also the case for participants reported having had more than 1 sexual partner in the last 3 months.

In the final analysis, HPV vaccine uptake was examined with and without adjusting for marital status, living with HIV and number of sexual partners in the last 3 months (Table 3). Cisgender women (OR 0.43, 95%CI 0.30–0.61) and transwomen (OR 0.61, 95%CI 0.37–1.00) were less likely to accept HPV vaccination than men, and for cisgender women this was statistically significant ($p < .05$). Married or partnered people were less likely to accept HPV vaccination compared to those who were single (OR 0.70, 95%CI 0.51–0.97), and this finding was also statistically significant. Participants 25 years of age or older were less likely to accept vaccination compared to younger participants (25–34 years: OR 0.75, 95%CI 0.52–-1.08; 35+ years: OR 0.77, 95%CI 0.50–1.16), although this finding was not statistically significant.

On the other hand, people with more years of formal education were more likely to accept the HPV vaccine than those with less education. People who reported having ever done sex work were more likely to accept the HPV vaccine

Table 1. Selected socio-demographic characteristics of the study population, recruited at two sexual health, HIV treatment and transgender health clinics in Mexico City, Mexico, 2018.

		Gender identity		
Characteristics	Study Population [§] n = 1,915	Women 396 (20.7)	Men 1341 (70.0)	Transwomen 178 (9.3)
Age (Mean ± SD)	29.4 ± 7.6	30.4 ± 7.5	28.7 ± 7.3	32.6 ± 9.0
Years of education (Mean ± SD)	13.9 ± 11.0	12.7 ± 4.3	14.5 ± 4.0	11.7 ± 3.9
Marital status				
Married/partnered	447 (23.3)	125 (31.6)	274 (20.4)	48 (27.0)
Single	1460 (76.2)	267 (67.4)	1063 (79.3)	130 (73.0)
No response	8 (0.5)	4 (1.0)	4 (0.3)	-
Living with HIV (Self-reported)				
No	1278 (66.7)	357 (90.2)	785 (58.5)	136 (76.4)
Yes	615 (32.1)	36 (9.0)	537 (40.0)	42 (23.6)
No response	22 (1.2)	3 (0.8)	19 (1.5)	-
History of STIs (Self-reported)[f]				
No	851 (44.4)	262 (66.2)	489 (36.5)	100 (56.2)
Yes	1039 (54.3)	124 (31.3)	838 (62.5)	77 (43.3)
No response	25 (1.3)	10 (2.5)	14 (1.0)	1 (0.5)
Age at first sexual (vaginal or anal) intercourse (Mean, years ± SD)	17.9 ± 8.7	19.2 ± 11.0	17.8 ± 7.6	16.4 ± 10.9
Ever done sex work				
No	1502 (78.5)	325 (82.0)	1018 (76.0)	159 (89.3)
Yes	403 (21.0)	67 (17.0)	318 (23.7)	18 (10.1)
No response	10 (0.5)	4 (1.0)	5 (0.3)	1 (0.6)
Number of sexual partners in the last 3 months				
1	617 (32.2)	192 (48.5)	370 (27.6)	55 (31.9)
2–5	746 (39.0)	116 (29.3)	583 (43.5)	47 (26.4)
>5	321 (16.8)	36 (9.1)	243 (18.1)	42 (23.6)
No response	231 (12.0)	52 (13.1)	145 (10.8)	34 (19.1)

*HPV vaccine uptake was defined as when the study participant agreed to receive the first dose of the HPV vaccine and also actually received that first dose. In these groups, the women and men are cis gender or non-trans. SD: Standard Deviation. fSexually transmitted infections (chlamydia, gonorrhea, syphilis, trichomoniasis, hepatitis B or C)

§The total sample included 396 cisgender (or nontrans) women, 178 transwomen and 1341 men, of whom 1247 were men who have sex with men and 94 were men who had sex with women.

Table 2. HPV vaccine uptake in adults, recruited at two sexual health, HIV treatment and transgender health clinics in Mexico City, Mexico, 2018.

	HPV vaccine uptake*		
Characteristics	No 209 (10.9)	Yes 1706 (89.1)	P value
Gender identity			
Women	72 (18.2)	324 (81.8)	<.001
Men	114 (8.5)	1227 (91.5)	
Transwomen	23 (13.0)	155 (87.0)	
Age			
14–24 years	52 (9.2)	514 (90.8)	.2
25–34 years	103 (11.6)	786 (88.4)	
35+ years	54 (11.8)	404 (88.2)	
No response	-	2 (100.0)	
Years of education			
0–12 years	101 (13.5)	647 (86.5)	.008
13–17 years	73 (9.1)	726 (90.8)	
18 or more years	29 (8.6)	308 (91.4)	
No response	6 (19.3)	25 (80.7)	
Marital status			
Single	144 (9.9)	1316 (90.1)	0.01
Married/partnered	63 (14.0)	384 (86.0)	
No response	2 (25.0)	6 (75.0)	
Living with HIV (Self-reported)			
No	146 (11.4)	1132 (88.6)	.5
Yes	61 (9.9)	554 (90.1)	
No response	2 (9.0)	20 (91.0)	
History of STIs (Self-reported)§			
No	100 (11.8)	751 (88.2)	.5
Yes	107 (10.3)	932 (89.7)	
No response	2(8.0)	23 (92.0)	
Has done sex work			
No	179 (12.0)	1323 (88.0)	.01
Yes	28 (7.0)	375 (93.0)	
No response	2 (20.0)	8 (80.0)	
Number of sexual partners in the last 3 months			
1	84 (13.6)	533 (86.4)	.03
2–5	75 (10.0)	671 (90.0)	
>5	25 (7.8)	296 (92.2)	
No response	25 (10.8)	206 (89.2)	

*HPV vaccine uptake was defined as when the study participant agreed to receive the first dose of the HPV vaccine and also actually received that first dose. These are cis gender or non-trans women. SD: Standard Deviation. § Sexually transmitted infections (chlamydia, gonorrhea, syphilis, trichomoniasis, hepatitis B or C).

Table 3. Variables associated with HPV vaccine uptake among adults recruited from two sexual health, HIV treatment and transgender health clinics Mexico City, Mexico, 2018.

	HPV vaccine uptake*			
	Crude		Adjusted	
Variables	OR	95% CI	OR**	95% CI
Sociodemographic characteristics				
Gender identity				
Men	1	-	1	-
Transwomen	0.62	(0.38–1.01)	0.61	(0.37–1.00)
Women	0.41	(0.30–0.57)	0.43	(0.30–0.61)
Age				
14–24 years	1	-	1	-
25–34 years	0.77	(0.54–1.09)	0.75	(0.52–1.08)
35+ years	0.75	(0.50–1.13)	0.77	(0.50–1.16)
Years of education				
0–12 years	1	-	1	-
13–17 years	1.55	(1.12–1.13)	1.51	(1.09–2.10)
18+ years	1.65	(1.07–2.56)	1.54	(0.99–2.39)
Marital status				
Single	1	-	1	-
Married/partnered	0.6	(0.48–0.88)	0.70	(0.51–0.97)
Living with HIV (Self-reported)				
No	1	-	1	-
Yes	1.16	(0.86–1.56)	1.17	(0.86–1.61)
History of STIs (Self-reported)§				
No	1	-	1	-
Yes	1.16	(0.87–1.55)	1.09	(0.78–1.52)
Ever done sex work				
No	1	-	1	-
Yes	1.72	(1.15–2.58)	1.70	(1.12–2.56)
Number of sexual partners in the last 3 months				
1	1	-	1	-
2–5	1.40	(1.01–1.96)	1.31	(0.93–1.84)
>5	1.58	(1.09–2.29)	1.44	(0.98–2.11)

*HPV vaccine uptake was defined as when the study participant agreed to receive the first dose of the HPV vaccine and also actually received that first dose. § Sexually transmitted infections (chlamydia, gonorrhea, syphilis, trichomoniasis, hepatitis B or C)

** The model was adjusted for the following variables: marital status, self-reported HIV positivity and number of sexual partners in the last 3 months

compared to those who never engaged in sex work (OR 1.70 95%CI 1.12–2.56). Participants who reported more than 5 sexual partners in the last 3 months are more likely to be vaccinated than those who had fewer partners (OR 1.44, 95% CI 0.98–2.11), although this was not statistically significant. Living with HIV, self-reported STIs and number of sexual partners in the last 3 months were not significantly associated with HPV vaccine uptake.

Discussion

We examined HPV vaccination uptake – defined as whether the study participant actually gave signed, informed consent to be vaccinated and received the first dose of the vaccine – in an adult population including cisgender men (both MSM and MSW), cisgender women and transwomen; within these groups there were people with and without HIV. Study participants were either attendees at one of two large HIV/AIDS, sexual health and transgender health clinics in Mexico City or were invited through local organizations; they were invited to attend the clinic nearest to their residence in order to receive free HPV vaccination, STI testing and necessary treatment. Overall, a large majority of study participants accepted the HPV vaccine: 91.5% of cisgender men, 87.0% of transwomen and 81.8% of cisgender women received the vaccine. There was higher HPV vaccine uptake among men, among people who were single and those with more years of formal education. Also, people who had ever done sex work were more likely to accept HPV vaccination.

The high levels of uptake of the HPV vaccine observed in this study may be related to high levels of belief in the safety and effectiveness of vaccines in general in Mexico, which was reported in a worldwide survey done by Gallup: 88% of survey respondents in Mexico and Central America agreed that vaccines are safe and 90% agreed that vaccines are effective, while 98% agreed vaccines are important for children to have.[74] A previous study by members of our research team also found high levels of acceptance among adults attending HIV/AIDS and sexual health clinics in three states in Mexico, with somewhat higher levels among people living with HIV.[45] In addition, since most of the study participants were engaged in care at the clinics where the study was done, this may have meant they would be more likely to accept the vaccine because their health literacy may have been greater than that of the general population and they may have felt greater confidence or trust in a vaccine offered at their regular source of healthcare.

Also, the vaccine was offered free of charge. Since vaccines (and most other healthcare services) are provided free of charge in public healthcare services in Mexico, including the sexual healthcare clinics where this research was carried out, providing the

HPV vaccine free of charge in this study is in line with national standards and charging for the vaccine would not have been acceptable in ethical or practical terms. This could have led to greater uptake than would occur in other contexts since lower vaccine cost has been found to be positively associated with higher uptake or acceptance in other populations.[75–79]

Although uptake of the first dose of the vaccine was high in general in this study population, it was somewhat lower in cisgender women (about 10 percentage points lower than in cisgender men) and this difference was statistically significant. Studies in a variety of different countries have found that even though knowledge about cervical cancer, HPV and specifically the HPV vaccine may be low in women, vaccine acceptance can still be high;[80–84] thus, knowledge by itself appears not to be a sufficient condition to achieve high levels of uptake. On the other hand, in many contexts perceived safety and efficacy of the HPV vaccine have been associated with higher vaccine acceptance by women (for themselves or their daughters) while concerns about side effects has been linked to rejection of the vaccine.[78,85–89] Concerns about a possible effect on fertility of the HPV vaccine are also a reason some women do not accept vaccination against HPV (again, for themselves or their daughters).[81–85,90]

The lack of official recommendations for use of HPV vaccines in adults (including transgender individuals and people with HIV) could lead medical professionals to conclude that they should not recommend the vaccine to this age group.[45,91–93] This is significant since healthcare provider recommendation of the HPV vaccine is one of the principal factors related to uptake.[55–66,94,95] Modifications will be needed in national and international recommendations on HPV vaccination in adults if healthcare personnel are to recommend the vaccine to the population groups we studied, something which other studies have suggested would have positive health outcomes in terms of cancer reduction.[55,56,59–62,65,66] Our hope is that the current study findings (as well as future data from the larger study this analysis is part of) will contribute to the inclusion of adults, at least those with the greatest need, in official Mexican HPV vaccination recommendations. In combination with changes to official recommendations, previous studies indicate it would be most effective to focus on educating healthcare providers on the safety and efficacy of HPV vaccines for adults so they recommend vaccination to their patients[57–66,94,95] as well as providing public health education and promotion of the HPV vaccine to adult healthcare users focusing on the attitudes, perceptions and knowledge shown to be related to HPV vaccine acceptance in order to achieve primary prevention of HPV-related cancers.[96]

Limitations

The major focus of the larger study that this analysis is part of is to evaluate the effectiveness of a combined strategy of HPV vaccination and high-risk HPV screening in order to reduce neoplasms in the anogenital region and oral cavity among adults who are vulnerable to or at higher risk of these health issues.[97] For this reason, a number of limitations exist for the current analysis. This study did not address knowledge or awareness of HPV among study participants, or factors known to be related to HPV vaccine acceptability, such as the belief in vaccination benefits, concerns about vaccine side effects, perceived protection from being vaccinated, perceived threat of HPV infection, genital and anal warts or anal cancer as well as the motivation to seek out information about health issues related to the vaccine.[77,96] Also, participants are not likely to represent the general population of people living without HIV, people living with HIV who receive care at other healthcare institutions or who are not engaged in care, transgender women or cisgender women or men (MSM or MSW) in Mexico City, and of course not in the rest of the country. Rather, our study population may have a greater proportion of people who are more motivated to be vaccinated against HPV and have greater knowledge about HPV infection and vaccination, since they are probably more engaged in care and given that they may have been exposed to previous studies promoting HPV testing and HPV vaccination.

Conclusions

This study identified high levels of HPV vaccine acceptability in Mexican adults, many of whom are at higher risk of developing HPV-associated disease. HPV vaccination should be rolled-out for adults at higher risk of HPV-related disease, and in conjunction official recommendations should specify when vaccination of adults is appropriate. Also, education about and promotion of the HPV vaccine should be provided in order to achieve even higher acceptance rates.[96] To achieve this, physicians and other healthcare personnel should receive training about the safety and efficacy of the HPV vaccine for healthcare users living with HIV, other people at higher risk and adults in general, as well as educational activities that can help them develop positive attitudes and necessary skills in relation to recommending and counseling patients about HPV vaccination.[98,99] It is essential for providers to recommend the HPV vaccine to their patients since healthcare provider recommendation is one of the most important factors related to HPV vaccine uptake[45,100,101] and improving healthcare provider communication about HPV vaccination is critical to increasing vaccination coverage.[102]

Materials and methods

Study design, recruitment and vaccine application

The data presented here is part of a study that aims to evaluate 4vHPV efficacy in adults who may be at risk of developing HPV-related cancers in Mexico City (the complete study methods are described elsewhere).[97] The study was approved by the ethics, research and biosafety committees of the National Institute of Public Health and written, informed consent was obtained from all study subjects. Study participants were recruited either from among healthcare users of two large HIV/AIDS, sexual healthcare and transgender health (hormone treatment but not surgery) clinics in Mexico City or through inviting members of local organizations for sex workers, homeless people, transgender women, victims of sexual violence and women living in poverty to attend one of the clinics in order to participate in the study.

Questionnaires and vaccines were applied at the sexual healthcare clinics from May to December 2018. Although participants did not receive compensation for their participation, the

HPV vaccine, HPV and other sexually transmitted infection (STI) tests and treatment for any STI or HPV-related lesion detected were all provided free of charge, either by the study (vaccines and STI tests) or by the sexual healthcare clinics (treatment for STIs or lesions).

HPV status was unknown to the study participants at the time of the interview. Participants received the first dose of the 4vHPV when they completed both the questionnaire and HPV and STI testing; HPV vaccines were applied at a later date if on the day participants completed the questionnaire, sample collection was not feasible (due to having had sexual relations the day before) or if the anal sample was contaminated with excrement. (Two doses of the vaccine will be applied within the larger study, on a 0–6 month schedule.)

Interview

A comprehensive, structured questionnaire was administered with a computer-assisted program that queried socio-demographic information including sex at birth and current gender identity, sexual orientation, sexual history, legal and illegal drug use, self-reported STI symptoms, homelessness, and a series of psychosocial measures. The sexual history items included questions about lifetime number of sexual partners, occasional and regular sexual partners, participating in sex work or exchanging sex for gifts. The socio-demographic variables that were included were selected based on previous studies that have found associations between HPV vaccine uptake or acceptability and these variables.[57,103–106]

Statistical analysis

The database generated through the computer-assisted program was converted into Excel and then a .dta file and all analyses were conducted using STATA (version 15). HPV vaccine uptake was defined as the person having accepted the first dose of the vaccine. Associations between variables were examined using chi-square tests. The relationship between variables and acceptance of the first dose of the vaccine was evaluated using logistic regression to calculate odds ratios and 95% confidence intervals. The statistical model was adjusted for marital status, self-reported HIV serostatus and number of sexual partners in the last 3 months.

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Disclosure of potential conflicts of interest

The authors declare they have no conflicts of interest to disclose.

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