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Endorsement of Compulsory HIV Vaccination Policy Among Populations at High Risk of HIV Exposure (LAVOICES)

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Abstract Compulsory vaccination is a frequently implemented policy option for ensuring comprehensive vaccine coverage. Ongoing controversies around human papillomavirus vaccine dissemination, and suboptimal coverage, suggest the value of assessing acceptability of compulsory vaccinations—particularly among likely target populations—in advance of their public availability to support evidence-informed interventions. With the first HIV vaccine to demonstrate partial efficacy in a large-scale clinical trial, we examined individual

characteristics and attitudes associated with support for compulsory HIV vaccination policy among a diverse, representative sample of adults attending probable HIV vaccine dissemination venues in a large urban county. Participants were recruited using three-stage probability sampling from likely venues for future HIV vaccine dissemination. We used Audio-CASI to administer a 60-min structured questionnaire. Items included endorsement of compulsory HIV vaccination policy, sociodemographic characteristics, injecting drug use, vaccine attitudes and perceived HIV risk. Among 1,225 participants (mean age=36.8 years; 55.6 % males, 37.6 % non-English speaking Hispanic, 78.8 % heterosexual, 25.7 % injection drug users), almost half (48.2 %) endorsed a compulsory HIV vaccination policy. Non-English speaking Hispanics compared to whites, participants with less than high school education, higher positive vaccine attitude scores and higher perceived HIV risk were significantly more likely, and people who inject drugs significantly less likely to endorse compulsory HIV vaccination. Public health interventions to promote positive vaccine attitudes and accurate perceptions of HIV risk among vulnerable populations, and strategies tailored for people who inject drugs, may build support for compulsory HIV vaccination policy and promote broad HIV vaccine coverage.

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Vaccinations against infectious diseases have been lauded as one of the greatest public health achievements in the past century in dramatically improving health and life expectancy in the United States (US; Centers for Disease Control and Prevention 1999). As we enter the twenty-first century, much of the morbidity and health costs incurred in the US are attributable to HIV and other sexually transmitted infections (STI) (Chesson et al. 2011), for which we have few

vaccinations (Workowski and Berman 2010). Compulsory vaccination is a frequently implemented policy option for ensuring high population levels of vaccination. However, there has been little empirical study of the acceptability of compulsory vaccinations for preventable infectious diseases, particularly STIs. In the context of ongoing controversies around human papillomavirus (HPV) vaccine dissemination (Gabriel and Grady 2011; Haber et al. 2007) and anti-vaccine conspiracy theories (Bearman 2010; Roberts et al. 2005), assessing public perceptions and beliefs regarding the acceptability of compulsory vaccinations—in advance of their public availability—may support evidence informed dissemination strategies. Public reactions and social and policy challenges, as well as the public health impact, are likely to be particularly potent in the case of vaccines against HIV infection.

Compulsory HIV vaccination has the potential to yield the most comprehensive vaccine coverage. However, the implementation of compulsory HIV vaccination without prior assessment of public opinion—particularly among those for whom vaccinations are mandated—may lead to community backlash that seriously compromises the dissemination process. In the case of HPV vaccination, several US state legislatures and governing bodies attempted to pass compulsory middle school vaccination policies; these have ignited fervent public and political opposition from various constituencies (Gabriel and Grady 2011; National Conference of State Legislatures 2013). In response, a number of states altered their policies. For example, Texas overturned the governor's executive order for compulsory vaccination; and Virginia approved generous "opt-out" provisions (National Conference of State Legislatures 2013). While the potential benefits of HPV vaccines for preventing cervical cancer are not questioned and, undoubtedly, compulsory HPV vaccination would boost vaccination coverage, the pace of dissemination has been slowed. A dissemination plan based on systematic research in regard to the public's beliefs and concerns about compulsory HPV vaccination may have averted some of the polarizing debates that ensued, thus facilitating more widespread acceptance and, in turn, more comprehensive vaccine coverage.

HIV, similar to HPV, disproportionately affects marginalized populations in the US, such as African Americans and Latinos (Centers for Disease Control and Prevention 2012a). Understanding perceptions of possible compulsory HIV vaccine policies among these ethnic minority communities, as well as other populations at high risk for HIV exposure such as people who inject drugs, may support successful HIV vaccine policy and dissemination.

Several investigations have assessed factors that influence acceptance of mandatory school-based vaccinations among parents (Ferris et al. 2010; Kennedy et al. 2005; Salmon et al. 2005). A nationally representative survey of US parents

($n=1,527$) indicates that more positive beliefs about vaccines, belief that vaccines are necessary to prevent certain diseases, and that vaccines are important to children's health are associated with support of compulsory school vaccination (Kennedy et al. 2005). Conversely, in a survey of parents ($n=815$) in five US states who claimed non-medical exemptions for their school-age children for a broad range of mandatory vaccinations, the most common reasons were low perceived susceptibility and low perceived vaccine efficacy and safety (Salmon et al. 2005).

In the case of adults, the Advisory Committee on Immunization Practices (ACIP) and a variety of healthcare organizations support mandatory seasonal influenza vaccination for healthcare workers (HCW), particularly given three decades of low compliance with voluntary vaccination (Derber and Shankaran 2012; Ottenberg et al. 2011). Although mandatory vaccination policies have been shown to be the strongest predictor of compliance with seasonal influenza vaccine uptake among both hospital-based and nonhospital-based HCW's ($n=3,188$; Rebmann et al. 2012), institutional and HCW resistance to such policies persist, with few published studies of HCW's perspectives on such mandates (Derber and Shankaran 2012; Ottenberg et al. 2011).

Assessment of attitudes toward compulsory HIV vaccination among populations at elevated risk of HIV exposure, and in settings that might serve as venues for vaccine delivery, may support effective interventions to facilitate future HIV vaccine dissemination. The objective of this study is to examine individual characteristics and attitudes associated with support for compulsory HIV vaccination among an ethnically, socially and economically diverse, representative sample of adults attending probable HIV vaccine dissemination venues in a large urban county.

Methods

Participants

Participants at risk for HIV in Los Angeles (LA) County ($n=1,225$) were recruited using three-stage probability sampling. In stage I, we randomly selected sites from three venue-based strata: (a) LA County sexually transmitted disease (STD) clinics ($n=12$); (b) Latino community-based organizations (CBOs) offering HIV testing and other health-related services ($n=8$); and (c) needle exchange programs (NEP) providing clean needles or syringes in exchange for dirty needles ($n=8$). Probability-proportional-to-estimated size sampling assigned the sampling probability for each site to be proportional to its estimated client load. Stage II consisted of randomly selecting sessions of approximately 4 h in duration (morning, afternoon, or evening) within each site. A total of 75 sessions from each stratum were sampled (225 sessions across 3 strata). In stage

III, we randomly selected participants within each session at selected sites.

Eligibility criteria were being at least 18 years of age, not an employee of the recruitment site, and not known to be HIV-positive. Following informed consent, participants were reimbursed \$20 for engaging in a one-time, 60-min interview administered by trained interviewers using laptop computers programmed with Questionnaire Development System (QDS) software (NOVA Research Company). Sensitive questions on sexual risk behaviors and drug use were administered by Audio Computer-assisted Self-interviewing (ACASI), an approach successfully used in our formative research (Newman et al. 2006a, 2007). The study protocol was reviewed and approved by the Human Subjects Protection Committees of UCLA and the Los Angeles County Department of Public Health, and the Research Ethics Board of the University of Toronto. All participants provided written informed consent.

Measures

Main Outcome Compulsory HIV vaccine policy endorsement was the main outcome of interest. A dichotomous *HIV vaccine policy endorsement* variable was constructed from three items assessing whether respondents agreed about: “everyone to be vaccinated,” “all school children to be vaccinated,” and “all adults to be vaccinated” (for HIV). These items were asked on a 5-point Likert-type response scale from “strongly agree” to “strongly disagree”; “strongly agree” or “somewhat agree” was considered to be agreement. Participants who agreed to at least one of the three statements were considered to endorse compulsory HIV vaccine policy. Participants who disagreed in response to all three statements were considered to oppose compulsory HIV vaccine policy.

Sample Characteristics Sociodemographic characteristics collected for participants during the 60-min interview were age, gender, race/ethnicity, sexual orientation, education, having children, monthly income, health insurance, and access to medical care. The description of how the sample characteristics are measured is provided in Table 1.

Independent Variables The positive vaccine attitude scale was the average score of 7 vaccine attitude items reflecting positive attitudes towards vaccines, including an HIV vaccine (Cronbach’s $\alpha=0.61$). The items in the positive vaccine attitude scale were 4-point Likert responses to the statements: “I think it is a good idea to get flu shots,” “Existing vaccines have worked well to protect people against many diseases such as small pox and tetanus,” “Vaccines are important to protect children,” “Vaccines are important to keep me healthy,” “Everyone who gets an AIDS vaccine will be protected against HIV/AIDS,” “If I get an AIDS vaccine, I

can lower chances of getting infected with HIV/AIDS,” and “I would be one of the first people to get an AIDS vaccine.”

Perceived HIV risk was assessed with the statement “I am worried about getting HIV/AIDS.” Responses were measured on a 5-point Likert scale. Injecting drug use was assessed by asking participants whether they injected drugs in the past 30 days (yes/no).

Data Analysis

In order to account for the three-stage probability sampling strategy used in the study, all analyses were conducted using STATA 9.0 (College Station, TX) and its survey commands to adjust for the sampling strata, primary sampling units (PSU) and population weights. This approach permits the findings from the sample to represent the source population of persons at risk attending sites within the three strata.

Prior to estimating statistical models, distributional assumptions of the models were assessed. With only 2 missing observations (on the positive vaccine attitudes scale), we did not address non-random missingness explicitly. In order to avoid severe collinearity problems, we used a variance inflation factor (VIF) with a cutoff value of less than 4.0; as standard error is doubled with $VIF=4.0$, this is a commonly used criterion to determine if any factors are highly correlated with the other factors (Fox 1991). None of the variables were highly correlated. Exploratory bivariate analyses computing the Pearson chi-square statistic were performed to examine the associations of sociodemographic characteristics, vaccine attitudes and compulsory HIV vaccine policy endorsement. We then estimated a multivariable logistic regression model to examine the association between the outcome of compulsory HIV vaccine policy endorsement and the sociodemographic and independent variables. Variables were included in the model based on findings from the bivariate analyses (p value <0.1), in addition to variables selected a priori based on previous research (i.e., “age” and “have a regular place to go for medical care”). A systematic review of 20 studies recommended the inclusion of age as a demographic in future investigations of HIV vaccine acceptability (Newman and Logie 2010). The accessibility of medical care and vaccination, in addition to mandatory influenza vaccination policies, have been associated with seasonal influenza, including H1N1, vaccine compliance (Rebmann et al. 2012). Additionally, we tested possible interactions between race/ethnicity and vaccine attitudes, and IDU by perceived HIV risk, on endorsement of compulsory HIV vaccine policy. Weighted odds ratios (OR) and 95 % confidence intervals (CI) were computed for each variable in the multivariable logistic regression model.

Table 1 Associations of sociodemographic characteristics, vaccine attitudes, and compulsory HIV vaccine policy endorsement among a representative sample of persons attending likely dissemination venues in Los Angeles county ($n=1,225$)

Characteristics	Total sample ($n=1,225$)	Endorse compulsory HIV vaccine policy ^a		<i>p</i> value
		Yes ($n=590$)	No ($n=635$)	
Age in years, mean (SE)	36.8 (0.55)	36.4 (0.64)	37.2 (0.75)	0.400
Gender				
Male	55.6 %	43.3 %	56.7 %	
Female	44.4 %	54.0 %	46.0 %	0.001
Race/ethnicity				
Hispanic (English speaking)	12.4 %	38.7 %	61.3 %	
Hispanic (non-English speaking)	37.6 %	60.5 %	39.5 %	
White	17.7 %	30.3 %	69.7 %	
Black	20.0 %	46.5 %	53.5 %	
Other	12.3 %	47.5 %	52.5 %	<0.001
Sexual orientation				
Heterosexual	78.8 %	50.8 %	49.2 %	
Gay/lesbian/bisexual	21.2 %	38.0 %	62.0 %	0.002
Education				
Less than high school	29.5 %	61.8 %	38.2 %	
High school	27.3 %	45.6 %	54.4 %	
Some college	31.0 %	43.8 %	56.2 %	
Bachelors degree or above	12.2 %	31.3 %	68.7 %	<0.001
Have any children				
Yes	54.1 %	53.2 %	46.8 %	
No	45.9 %	42.0 %	58.0 %	0.001
Monthly income				
\$0–\$500	27.4 %	45.6 %	54.4 %	
\$501–\$1,000	21.8 %	55.2 %	44.8 %	
\$1,001–\$2,000	27.1 %	51.8 %	48.2 %	
>\$2,000	23.6 %	40.0 %	60.0 %	0.028
Health insurance				
Private insurance	20.8 %	41.9 %	58.1 %	
Public insurance	30.4 %	44.3 %	55.7 %	
No insurance	48.8 %	53.0 %	47.0 %	0.022
Positive vaccine attitude scale (SE)	3.01 (0.01)	3.09 (0.02)	2.94 (0.02)	<0.001
Perceived HIV risk (SE)	3.62 (0.04)	3.79 (0.06)	3.46 (0.05)	<0.001
Have a regular place to go for medical care				
Yes	68.6 %	49.6 %	50.4 %	
No	31.4 %	44.8 %	55.2 %	0.199
Injected drugs in the past 30 days				
Yes	25.7 %	34.1 %	65.9 %	
No	74.3 %	52.9 %	47.1 %	<0.001

Chi-square tests were conducted to compare the group differences in endorsement of compulsory HIV vaccine policy. Means and percentages adjusted for primary sampling units, strata, and sampling weights

SE standard error

^a Compulsory HIV vaccine policy was a dichotomous variable derived from three Likert-scale variables

Results

The mean age of participants ($N=1,225$) was 36.8 years. Male participants made up 55.6 % of the sample; Hispanics (non-English speaking) were 37.6 %; and heterosexuals were 78.8 %. Almost one third (29.5 %) reported having less than high school education; 54.1 % had children; and almost half (49.2 %) had a monthly income of \$1000 or less. Over two

thirds (68.6 %) reported having a regular place to go for medical care, but nearly half (48.8 %) were uninsured.

Table 1 highlights the bivariate associations of sociodemographic characteristics, vaccines attitudes, and perceived risk with compulsory HIV vaccine policy endorsement. About half ($n=590$, 48.2 %) endorsed a compulsory HIV vaccine policy. Females (54.0 %) were more likely than males (43.3 %) to endorse a compulsory HIV vaccine policy

($p=0.001$). Race/ethnicity was significantly associated with compulsory HIV vaccine policy endorsement ($p<0.001$). Other sociodemographic characteristics significantly associated with compulsory HIV vaccine policy endorsement were being heterosexual (50.8 %) compared with gay or bisexual (38.0 %; $p=0.002$); lower educational attainment ($p<0.001$); having children ($p=0.001$); and being uninsured ($p=0.022$). Positive vaccine attitudes ($p<0.001$) and perceived HIV risk ($p<0.001$) were significantly and positively associated with compulsory HIV vaccine policy endorsement. People who reported injecting drugs in the past 30 days were significantly less likely (34.1 %) than non-injection drug users (52.9 %) to endorse compulsory HIV vaccine policy ($p<0.001$).

Table 2 outlines the results of the multivariable logistic regression examining predictors of compulsory HIV vaccine policy endorsement. Consistent with the bivariate analyses, the following demographic characteristics were significantly associated with compulsory HIV vaccine policy endorsement: non-English speaking Latinos compared to whites (OR=1.69; 95 % CI 1.03, 2.76; $p=0.037$); having less than high school education, compared to bachelor's degree or above (OR=2.66; 95 % CI 1.56, 4.55; $p<0.001$); and having some college education, compared to bachelor's degree or above (OR=1.71; 95 % CI 1.03, 2.86; $p=0.039$). Participants who scored higher on the positive vaccine attitude scale were significantly more likely to endorse compulsory HIV vaccine policy (OR=2.48; 95 % CI 1.70, 3.61; $p<0.001$). In addition, those with higher levels of perceived HIV risk were significantly more likely to endorse compulsory HIV vaccine policy (OR=1.17; 95 % CI 1.04, 1.32; $p=0.008$). People who inject drugs were significantly less likely than non-injecting drug users to endorse a compulsory HIV vaccine policy (OR=0.66; 95 % CI 0.45, 0.97; $p=0.036$). The race/ethnicity-by-positive vaccine attitudes interaction term (OR=1.21; 95 % CI 0.91, 1.59; $p=0.18$) and IDU-by-perceived HIV risk interaction term (OR=1.02; 95 % CI 0.75, 1.39; $p=0.89$) were not significant when considered in the final model.

Discussion

Compulsory HIV vaccination was endorsed by just under half of this sample of racially/ethnically diverse adults from vulnerable communities at risk for HIV infection. Our sample was designed to represent likely priority populations for future HIV vaccine dissemination. Lack of support for a compulsory HIV vaccination policy among likely recipients could deter dissemination efforts. Evidence of low Hepatitis B virus (HBV) vaccination coverage among populations at high risk before the implementation of universal infant HBV vaccination policy in the U.S. indicates that efforts to vaccinate adults in a voluntary targeted manner may result in suboptimal uptake (Centers for Disease Control and Prevention 2006).

Table 2 Multivariable logistic regression examining predictors of compulsory HIV vaccination policy endorsement among a representative sample of persons attending likely dissemination venues in Los Angeles county ($n=1,225$)

Variables	Odds Ratio (OR)	95 % Confidence limits	
Age	0.99	0.98	1.01
Gender			
Female	1.00	–	–
Male	0.92	0.69	1.22
Race/ethnicity			
White	1.00	–	–
Hispanic (English speaking)	1.06	0.64	1.76
Hispanic (non-English speaking)*	1.69	1.03	2.76
Black	1.53	0.91	2.56
Other*	1.74	1.01	3.03
Sexual orientation			
Heterosexuals	1.00	–	–
Gay/lesbian/bisexual	0.84	0.56	1.26
Education			
Bachelor's degree or above	1.00	–	–
Less than high school**	2.66	1.56	4.55
High school	1.65	0.96	2.83
Some college*	1.71	1.03	2.86
Have any children	1.13	0.79	1.63
Monthly income			
>\$2,000	1.00	–	–
\$0–\$500	1.22	0.74	2.00
\$501–\$1,000	1.59	0.96	2.64
\$1,001–\$2,000	1.23	0.79	1.91
Health insurance			
Private insurance	1.00	–	–
Public insurance	0.79	0.50	1.23
No insurance	1.22	0.75	1.98
Positive vaccine attitude scale**	2.48	1.70	3.61
Perceived HIV risk*	1.17	1.04	1.32
Have a regular place to go for medical care	1.27	0.88	1.84
Injected drugs in the past 30 days*	0.66	0.45	0.97

OR Odds ratio adjusted for primary sampling units, strata, and sampling weights

* $p<0.05$; ** $p<0.01$

Sufficient HIV vaccine coverage may need to rely on some sort of compulsory vaccine policy. However, governmental and public health implementation of a compulsory HIV vaccination policy without an understanding of target populations' attitudes that may limit their acceptance of the policy may jeopardize successful implementation, as witnessed with HPV vaccine dissemination efforts (National Conference of State Legislatures 2013; Centers for Disease Control and Prevention 2012b).

In this study, we assessed compulsory HIV vaccine policy acceptance among different groups at elevated risk for contracting HIV and examined acceptance in terms of people's attitudes and behaviors. We found that persons with positive vaccine attitudes, persons with higher perceived risk for HIV, non-English speaking Latinos, heterosexuals and less educated persons were more likely to endorse a compulsory HIV vaccine policy. People who inject drugs were less likely to endorse a compulsory HIV vaccine policy.

Increasing the public's attention to the positive impact vaccinations overall have had in improving health and well-being in the US and globally may lay the foundation for greater acceptance of a compulsory HIV vaccination policy. Our data supports the concept that people with favorable attitudes toward vaccines in general are more likely to endorse compulsory HIV vaccination. This is consistent with other studies in which positive attitudes about vaccination were associated with higher pneumococcal and influenza vaccination acceptance rates by adults classified as high-risk for either of these vaccine-preventable infections (Nichol et al. 1996). Public and patient education and the media may play an important role in facilitating favorable attitudes towards vaccines, in general, and specifically in the case of HIV vaccines.

Our findings indicate that persons with higher perceived risk of acquiring HIV are more likely to agree to a compulsory HIV vaccination policy, a finding consistent with the Health Belief Model (Rosenstock et al. 1994). Higher perceived risk for HIV is associated with greater acceptance of HIV prevention technologies, such as HIV testing (Centers for Disease Control and Prevention 2002a; McGarrigle et al. 2005; Thomas et al. 2008), although HIV stigma is negatively associated with HIV testing uptake regardless of perceived risk (Fortenberry et al. 2002). Education and social marketing campaigns that promote accurate perceptions of risk among populations at high risk for HIV exposure may increase their willingness to support a compulsory HIV vaccination policy. Additionally, a broad based compulsory vaccination policy in the case of HIV may have corollary benefits in mitigating the stigma likely to be associated with HIV vaccination (Newman et al. 2004), which may further promote uptake.

In this study, people who inject drugs were strongly opposed to any type of compulsory HIV vaccination policy, which may create challenges in the acceptance and dissemination of HIV vaccines. People who inject drugs are at significantly elevated risk for HIV infection (Centers for Disease Control and Prevention 2012c) and are often homeless or near homeless, enmeshed in their addiction, publicly admonished, sometimes incarcerated and as such often have little trust in the government and other authorities (Centers for Disease Control and Prevention 2002b; Rhodes et al. 2005). Future HIV vaccine dissemination policies may benefit from paying careful attention to attitudes toward vaccination and issues of trust (i.e., in government) of marginalized groups in order to

facilitate receipt of vaccination rather than counterproductively engendering apprehension and distrust (Roberts et al. 2005).

Our findings did not demonstrate any difference in acceptance of compulsory HIV vaccination policy for African Americans and English-speaking Latinos compared to whites. Given the disproportionate prevalence of HIV in the African American community, these findings do not portend opposition to an HIV vaccine from African Americans; but further work is still necessary to increase endorsement among a community that is traditionally underserved by the healthcare system. Spanish-speaking Latinos in this study endorsed a compulsory HIV vaccination policy, which suggests some cross-cultural variation both within and across ethnicity. A statewide study of HPV vaccine acceptability, also conducted in California, suggests higher acceptability among Hispanics versus whites, however results were not disaggregated by primary language (Constantine and Jerman 2007). The lack of a significant ethnicity-by-vaccine attitude interaction on endorsement of compulsory HIV vaccination in the present study, in light of the narrow confidence intervals, suggests that rather than merely an inconclusive finding, we can rule out the possibility of large interaction effects. Thus other factors may influence differential endorsement by ethnicity. Future investigations of the impact of language and other cultural differences, as suggested for HPV vaccine promotion (Lechuga et al. 2011) and HIV vaccine trial preparedness (Newman et al. 2006b), may have important implications for the design of culturally tailored interventions to support HIV vaccine dissemination. This also serves as a reminder that dissemination efforts must be conducted in multiple languages.

The history of HBV vaccination in the US may provide relevant lessons for the present study. Soon after the vaccine against HBV was licensed in 1982, the ACIP recommended vaccination for adults at high risk for HBV infection. This risk-targeted approach missed a substantial proportion of the high risk, marginalized population and made no impact on the transmission of the disease; the incidence of hepatitis B infection remained constant (13.2 cases per 100,000) (Centers for Disease Control and Prevention 2002c). Over 30 % of these cases could not be attributed to any risk factor (Shapiro 1993). Ultimately, universal childhood and compulsory middle school vaccination against HBV was implemented in the US, with powerful results (Centers for Disease Control and Prevention 2006). Surveillance data from a Florida middle school, for example, indicated an over four-fold increase in HBV vaccination coverage in the year after the state legislated compulsory middle school HBV vaccination compared with the year prior to the state's endorsement of the policy (Centers for Disease Control and Prevention 1998). Overall, as a result of these new strategies, HBV infection declined 75 % in the US from 1990 to 2004, and infection in children comprised 94 % of that decline (Centers for Disease Control and Prevention 2006). This history of HBV vaccines suggests that

careful planning for HIV and other STI vaccine dissemination should include an evaluation of potential outcomes to vaccine policy implementation proposals as well as ongoing monitoring of policy outcomes and the willingness to change strategies to optimize vaccination coverage.

There are some limitations to this study to consider. For one, stated intentions are imperfect proxies for actual behavior; however, we aimed to assess attitudes toward compulsory HIV vaccination policy before rollout of a licensed vaccine. Second, the present sample, while representative of adults attending venues in Los Angeles that provide services to a range of persons at elevated risk for HIV infection, may not be generalizable to other locales or populations; further research on the acceptability of compulsory HIV vaccination policies among adults, and adolescents, in other HIV epicenters is warranted. Third, in any survey self-report data on sensitive items, such as injection drug use, may be underreported, which might impact the results. However, we used ACASI for sensitive items, which has been shown to improve the quality of assessments of sensitive risk behaviors (Metzger et al. 2000); and the present analysis had less than 1 % missing data. Additionally, in the case of people who inject drugs, we identified a significant negative association with endorsement of compulsory HIV vaccination. These factors suggest that missing data were unlikely to have significantly affected the results. Fourth, the positive vaccine attitudes scale we used was not a standardized scale and was developed by our group based on factor analysis of vaccine attitude items; the Cronbach's alpha of 0.61 is modest at best. This underscores the lack of reliable standardized scales in the field to measure vaccine attitudes. Fifth, we observed a somewhat nonlinear relationship between endorsement of compulsory HIV vaccine policy and education: those with less than high school and some college, compared to those with a bachelor's degree, reported higher odds of endorsing compulsory HIV vaccine policy. However, those with high school education did not have higher odds of endorsement compared to those with a bachelor's degree. This could be due to potential misclassification between the "high school" and "some college" groups. In general, our findings support the notion that those with less education tended to have higher odds of endorsing compulsory HIV vaccine policy.

Lastly, our outcome was the sum of both adult and childhood compulsory HIV vaccination policies. This combination scale may skew the true acceptance of one policy option. However, we conducted sensitivity analysis and considered the outcome by each of the groups they were endorsing (all children, everyone, all adults). The findings from the multi-variable logistic regression models were robust and consistent with the results from the single dichotomous outcome variable.

HIV vaccine dissemination will inevitably be a volatile public health issue. A compulsory HIV vaccination policy

may be slow to emerge; but the lessons learned from the failures of targeted voluntary vaccination efforts with HBV vaccination and the heated debate over dissemination of HPV vaccines, along with slow roll-out and suboptimal coverage, implicate the need for early discussions and research about the acceptability of proposed policies. HIV vaccine policy decisions should be based on dynamic and emerging biological, behavioral and social evidence. In the wake of the first candidate HIV vaccine to demonstrate efficacy in a large-scale clinical trial (Rerks-Ngarm et al. 2009), this study provides preliminary information about the attitudes and sociodemographic characteristics associated with acceptance of a compulsory HIV vaccination policy among vulnerable populations at risk for HIV in the US. The time to develop the groundwork for HIV vaccine policy decisions is not when a vaccine is commercially ready; attitudes take time to change and delayed uptake would result in unnecessary morbidity and mortality. With no abatement of HIV incident infections in the US in the past decade and over 1 million people living with HIV (Hall et al. 2008), developing evidence informed policy decisions and strategies in advance of product availability is crucial to ensuring efficient rollout of HIV vaccines.

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