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## **ORIGINAL ARTICLE**

## Vaccine characteristics and acceptability of HIV immunization among adolescents

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**Summary:** HIV immunization programmes will only be effective if sufficient numbers of persons accept the vaccine. Our aims were to evaluate HIV vaccine acceptability among adolescents and to examine how vaccine characteristics influence acceptability. We recruited 661 adolescents from community health clinics in Indianapolis, Indiana, USA to complete either written or computerized questionnaires, both of which assessed HIV vaccine acceptability as a function of efficacy, cost, type of vaccine, mode of delivery, and parental permission for immunization (required or not required).

For both the written and computer methods, efficacy had the strongest effect on acceptability, followed by type of vaccine and cost. Low efficacy, high cost, and live-attenuated vaccines were associated with lower acceptability.

These findings suggest that as efforts to develop HIV vaccines continue, it will be important, in parallel, to anticipate potential obstacles to vaccine acceptance, including the belief that a less efficacious HIV vaccine is unacceptable.

Keywords: Adolescence, AIDS vaccines, attitude, patient acceptance of health care

## INTRODUCTION

Effective HIV immunization programmes will require the development of a vaccine to prevent infection and a relatively widespread acceptance of vaccination. However, compared with the vaccine development literature, relatively little empirical work has addressed potential issues related to HIV vaccine acceptance<sup>1-10</sup> and most of these studies have focused principally on willingness to participate in vaccine trials<sup>1-6</sup>, rather than on the broader issues of vaccine acceptability. Yet, many AIDSrelated attitudinal issues (e.g. attitudes about modes of HIV transmission, the dread associated with AIDS, and the feelings of suspicion regarding AIDS-related public health policy) suggest that some individuals may be reluctant to accept HIV immunization<sup>8-11</sup>. In addition, research has demonstrated relatively low rates of acceptance of established vaccines, such as hepatitis B, influenza, and childhood infectious diseases<sup>12-14</sup>. This research on existing vaccines, along with the unique AIDS-related issues, suggests that HIV vaccine availability may not readily translate into widespread public acceptance of HIV immunization.

The information gathered from HIV vaccine acceptability research may help to inform future

HIV immunization programmes of some of the psychosocial and behavioural issues that could enhance or interfere with willingness to accept immunization. The purpose of the present study was to examine the acceptability of hypothetical HIV vaccination to urban adolescents and to explore the effects of cost, vaccine efficacy, mode of administration, type of vaccine, and parental permission requirements on acceptability. Given that adolescents may be a group targeted for HIV immunization, just as they are for hepatitis B immunization<sup>15</sup>, this sample is particularly relevant to the study of HIV vaccine acceptability.

#### METHODS

#### Subjects

All of the adolescent subjects included in this study were receiving health care at 3 community adolescent health clinics based in Indianapolis, Indiana, USA. The clinics serve an urban, predominantly lower socioeconomic status population. A convenience sample of 681 subjects were invited to participate in this study between January 1995 and June 1996. Seven adolescents refused (99% participation rate). Of the 674 participants, 661 (98%) returned useable questionnaires (i.e. all demographic information provided). Subjects eligible for this study were 13 to 21 years old. Written

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informed consent was obtained from each adolescent participant. The requirement for parental consent was waived because most of the adolescents come to the clinics for confidential health care. The study was approved by the university's institutional review board. Adolescents who agreed to participate were paid \$5.00 to compensate them for the time and effort required to complete the survey.

Each subject anonymously completed either a self-administered written questionnaire (SAQ) or a computer-aided self-administered interview (CASI). The CASI was developed using the 'Ci3 System for Computer Interviewing' from Sawtooth Technology<sup>16</sup> and was administered via a notebook computer. Subjects completed the questionnaires in the waiting rooms of the medical clinics prior to their clinic appointments.

#### Measures

Both the SAQ and CASI instruments included questions on demographic characteristics, sexual behaviour, and HIV vaccine characteristics. With the exception of the vaccine characteristics section, questions were identically worded and ordered in both the SAQ and CASI formats.

Demographic variables assessed included age, gender, race/ethnicity (African-American, Non-Hispanic White, Hispanic, Other), self-reported academic achievement (1=Mostly Fs, 5=Mostly As). Sexual behaviours evaluated included frequency of condom use over the past 3 months (1=Never, 5=Always), condom use at last intercourse, and number of partners over the past year.

On both the SAQ and CASI versions of the survey, the vaccine characteristic domains evaluated were vaccine cost (free, \$50, or \$100), efficacy (90%, 70%, or 50%), mode of vaccine delivery (oral, 1 injection, or 3 injections), type of vaccine (killed virus, synthetic, or live, attenuated virus), and requirement for parental permission for vaccination (no parental permission needed or parental permission required). To help subjects understand the type of vaccines presented, definitions were provided prior to and during the evaluation tasks. For example, a live, attenuated HIV vaccine was described as a vaccine 'made from live AIDS virus that has been changed to keep it from causing AIDS'.

On the SAQ, full-profile, ratings-based conjoint analysis<sup>17</sup>, a research technique often used in marketing research, was used to determine how vaccine characteristics might influence the acceptability of the vaccine. Sixteen items were used for the ratings-based conjoint analysis. Each item described a hypothetical vaccine uniquely defined along the 5 key dimensions described above (i.e. cost, efficacy, mode of delivery, type of vaccine, and parental permission requirements). For each vaccine, subjects rated the probability that they would choose to get immunized. Subjects used an 11-point response scale that ranged from 0 ('I would never get this vaccine') to 100 ('I would definitely get this vaccine') in increments of 10. Given that 4 of the vaccine dimensions assessed (i.e. cost, efficacy, delivery, and type) had 3 attribute levels and parental permission requirements had 2 attribute levels, a full factorial design involving every possible combination of attributes would have required subjects to rate 162 individual vaccines, which clearly was not feasible. As a result, a fractional factorial design with a representative set of 16 orthogonal vaccine descriptions was generated using the SPSS 6.1 Categories<sup>®</sup> module<sup>18</sup>. This fractional factorial approach made the task manageable, but carried with it the inherent limitation that interaction terms could not be evaluated; only main effects could be assessed. Table 1 presents the 16 vaccines generated by this procedure.

On the CASI, another conjoint analytic approach, choice-based conjoint analysis, was used to evaluate the relative importance of the 5 dimensions of vaccine characteristic<sup>19,20</sup>. In contrast to ratingsbased conjoint analysis, which requires subjects to evaluate the acceptability of individual vaccines on a rating scale, choice-based conjoint analysis is predicated on a different process which requires subjects to choose the most acceptable vaccine out of 2 vaccines presented. It is an approach wellsuited to computer administration. The use of the 2 different conjoint analysis methods (i.e. ratingsbased and choice-based) allowed for independent confirmation of the findings regarding vaccine characteristics. The choice-based conjoint analysis questionnaire was developed using the CBC System for Choice-Based Conjoint Analysis from Sawtooth Technologies<sup>21</sup> and was integrated into the CASI survey. Subjects were shown 12 sets of hypothetical vaccine pairs, with each vaccine described by a unique combination of attributes from the 5 dimensions: cost, efficacy, mode of delivery, type of vaccine, and parental permission requirements. Each of the 12 sets consisted of 2 vaccines and subjects were asked to select the vaccine they would be more likely to accept or to select a 'neither vaccine' option.

#### Statistical analysis

The full-profile, ratings-based conjoint analysis approach used on the SAQ resulted in the assignment of an importance score to each of the 5 vaccine dimensions, which reflected the relative influence of each dimension on vaccine acceptability. Importance scores summed across all dimensions always equal 100. The higher the importance score for a given dimension, the greater the influence on vaccine acceptability. This approach to conjoint analysis also provided a set of part-worth utilities for the particular attributes within each broadly defined dimension (i.e. cost is composed of 3 attributes: free, \$50, and \$100). These utilities

Vaccine No.*	Cost	Efficacy	Mode of delivery	Туре	Parental permission	$Mean^{\dagger}$	SD
Vaccine 12	\$100	50%	Oral	Synthetic	No	35.7	30.4
Vaccine 6	Free	50%	3 injections	Live	Yes	35.8	32.2
Vaccine 13	\$50	50%	1 injection	Killed	Yes	37.2	29.2
Vaccine 10	Free	50%	Oral	Killed	No	39.4	31.8
Vaccine 11	\$100	70%	Oral	Live	Yes	39.5	30.5
Vaccine 15	\$50	70%	3 injections	Killed	No	44.0	29.7
Vaccine 2	\$50	90%	Oral	Live	No	46.7	34.7
Vaccine 14	Free	70%	Oral	Killed	Yes	47.6	31.6
Vaccine 3	Free	70%	1 injection	Synthetic	No	50.1	32.9
Vaccine 8	\$100	90%	3 injections	Killed	No	55.5	32.7
Vaccine 4	\$100	90%	1 injection	Killed	Yes	55.8	33.6
Vaccine 7	Free	90%	1 injection	Live	No	56.1	34.4
Vaccine 5	\$50	90%	Oral	Synthetic	Yes	56.4	33.0
Vaccine 9	Free	90%	3 injections	Synthetic	Yes	60.0	33.4
Vaccine 8	Free	90%	Oral	Killed	No	61.8	33.7
Vaccine 16	Free	90%	Oral	Killed	Yes	64.6	33.4

Table 1. Hypothetical HIV vaccines: acceptability score means and standard deviations (SD) presented in order of increasing acceptability

\*Number refers to order of presentation

<sup>†</sup>Vaccines rated on a scale of 0 to 100, in increments of 10, reflecting probability of acceptance

reflected the relative values placed on the specific attributes within a dimension. For example, one would expect a free vaccine to be relatively more desirable than a \$100 vaccine. The free vaccine therefore would receive a positive part-worth utility score and the \$100 vaccine would receive a negative score. Part-worth utilities summed within a given dimension equal zero. The greater the range in partworth scores, the higher the importance score for a given characteristic.

For the choice-based CASI data, the CBC System calculated a series of proportions, each based on the number of times a vaccine with a particular attribute was chosen, divided by the number of times a vaccine with that attribute was presented. Chisquare analyses were computed indicating whether any particular set of attributes (e.g. efficacy) significantly contributed to vaccine choice. CBC also used Chi-square tests to evaluate every possible interaction between pairs of attribute dimensions.

## RESULTS

#### Sample description

Self-administered written questionnaires were completed by 318 adolescents. Ages of SAQ respondents ranged from 13 to 18 years (mean=15.9, SD=1.5) and 86% were female. Seventy-two per cent of the adolescents described themselves as African– American and 26% self-identified as non-Hispanic White. Eighty per cent of SAQ subjects were sexually experienced. Of these adolescents, 50% had used a condom at last intercourse, 31% indicated that condoms were used all of the time (over the prior 3 months), and 11% said that they never used condoms. Number of partners over the past year ranged from 0 to 20 (median=2).

Computer-aided self-administered interviews were completed by 343 adolescents. Ages of CASI

respondents ranged from 13 to 21 years (mean=16.1, SD=1.6) and 80% were female. Seventy-eight per cent described themselves as African-American and 17% self-identified as non-Hispanic white. Seventy-eight per cent of CASI subjects were sexually experienced. Of these adolescents, 48% had used a condom at last intercourse, 30% indicated that condoms were used all of the time (over the prior 3 months), and 12% said that they never used condoms. Number of partners over the past year ranged from 0 to 55 (median=2).

### HIV vaccine acceptability

On the SAQ the most acceptable vaccine of the 16 presented (killed virus vaccine, oral, free, 90% efficacious, with parental permission required) received a mean rating of 64.6 out of a possible 100 (SD=33.4). The least acceptable vaccine (synthetic vaccine, oral, \$100, 50% efficacious, no parental permission required) received a mean acceptability rating of 35.7 (SD=30.4). Across all 16 vaccines, the mean acceptability rating was 49.2 (SD=22.1). See Table 1 for a listing of the means and SD of acceptability scores for each of the 16 vaccines presented via SAQ.

Vaccine acceptability ratings were not significantly associated with age, academic achievement, gender, sexual experience, condom use, or number of sexual partners. African–American adolescents rated the vaccines as significantly less acceptable (mean=47.1, SD=21.9) than non-African–American adolescents (mean=54.2, SD=21.9; t=2.62, df=314, P < 0.01).

#### Vaccine characteristics

The ratings-based conjoint analysis results were based on the subsample of subjects completing the SAQ. As shown in Figure 1, the part-worth utility scores indicate that vaccine efficacy (importance score=31.3) had the strongest influence on vaccine acceptability. As might be expected, a 90% efficacious vaccine was highly desirable (partworth score=11.68), a 50% efficacious vaccine was relatively undesirable (part-worth score=-10.43), and a 70% efficacious vaccine received a score in between the 2 extremes (part-worth score=-1.25). Type of vaccine (important score=24.3) was also influential, with preferences for vaccines made synthetic or killed virus (part-worth from scores=2.31 and 2.25 respectively) and antipathy towards a live attenuated vaccine (part-worth score = -4.56). Vaccine cost (importance score = 19.4) was less of a factor, but indicated an understandable preference for a free vaccine (part-worth score=4.12). Mode (importance of delivery score=16.5) and parental permission requirements (importance score=8.5) did not strongly influence ratings of the hypothetical vaccines.

The choice-based conjoint analysis results were based on the subsample of subjects completing the CASI. Results were largely consistent with the ratings-based findings (see Figure 2). Vaccine efficacy had the strongest influence on vaccine choice, with the 90% efficacious vaccine being chosen more frequently (52% of the time) than 70% or 50% efficacious vaccines (chosen 33% and 19% of the time respectively;  $\chi^2 = 426.04$ , df=2, P < 0.01). Cost also influenced vaccine choice, with free vaccines chosen more often (39% of the time) than either \$50 or \$100 vaccines (chosen 33% and 32% of the time respectively;  $\chi^2 = 23.17$ , df=2, P < 0.01). Furthermore, type of vaccine affected vaccine choice, with preference for a killed virus vaccine (chosen 38% of the time) over a synthetic or live, attenuated vaccine (chosen 34% and 32% of the time respectively;  $\chi^2 = 14.20$ , df=2, P < 0.01). Mode of administration and parental permission requirements did not significantly influence vac-



Figure 1. Ratings-based conjoint analysis results showing the partworth utility scores for HIV vaccine attributes



Figure 2. Choice-based conjoint analysis results showing the influence of HIV vaccine attributes on vaccine preference.  $*\chi^2$  significant, P < 0.01

cine choice. In addition there were no significant 2-way interactions.

#### DISCUSSION

The purpose of this study was to evaluate acceptability of hypothetical HIV vaccines in a sample of urban adolescents and to examine the effects of vaccine characteristics (i.e. efficacy, cost, type of vaccine, mode of delivery, and requirement for parental permission) on acceptability.

#### Vaccine acceptability

Even the most highly rated vaccine on the written survey received a score of only 64.6 out of a possible 100, indicating relatively low levels of acceptability for HIV immunization. These findings are consistent with results of an HIV vaccine acceptability study done with a very different sample of university undergraduates<sup>8</sup>, suggesting that ambivalence about HIV immunization is not simply a function of the specific sample of adolescents who participated in the present study. Acceptability was not significantly associated with most demographic and behavioural measures used in this study, with the exception of race. African-American youth were less positively disposed toward HIV immunization than their non-African-American counterparts, perhaps reflecting the well-documented finding that many African-Americans are quite suspicious of public health policy as it relates to AIDS<sup>22-24</sup>.

#### Vaccine characteristics

The ratings-based and choice-based conjoint analysis procedures independently identified the same set of vaccine characteristics that substantially contributed to HIV vaccine acceptability. In both approaches, vaccine efficacy, type of vaccine, and vaccine cost were the 3 most important characteristics. Also in both analyses, mode of delivery and requirement for parental permission were not particularly influential domains. These findings are consistent with results of a prior study with university undergraduates (using ratings-based conjoint analysis), in which vaccine efficacy, type of vaccine, and cost also were the 3 most important factors<sup>8</sup>. Again, in this earlier study, mode of delivery had little effect on vaccine acceptability.

In the present study, vaccine efficacy appeared to have the strongest effect on vaccine acceptability. As the defined efficacy of the hypothetical vaccines dropped from 90% to 50%, acceptability dropped precipitously, suggesting that many people may be reluctant to accept a vaccine of limited efficacy. Diffusion theory, a theoretical model that has been used to understand factors associated with the acceptance of technological innovations, proposes that an innovation will only be accepted if it is seen as superior to existing, available technology<sup>25,26</sup>. Consistent with diffusion theory, we found during debriefing interviews with study participants that they would not accept a vaccine that worked only 50% of the time because they perceived it as having no advantages over condom use and felt that it would not provide sufficient reassurance that no HIV infection would occur. These results are particularly relevant given the concern that any HIV vaccine may be limited in efficacy<sup>27</sup> and therefore require very high immunization coverage (i.e. acceptance) in order to reduce rates of HIV infection  $2^{28-30}$ .

Type of vaccine also influenced HIV vaccine acceptability, with negative attitudes about a live, attenuated vaccine demonstrated across both the ratings-based conjoint and choice-based conjoint analyses. This issue is relevant because of the potential need for an HIV vaccine to confer mucosal immunity, which may best be attained with a live, attenuated vaccine<sup>31–33</sup>. Recognizing the importance of this issue, the World Health Organization has recommended that the possibility of developing such a vaccine should be intensively explored<sup>34</sup>. Our results, however, suggest that some people may be particularly reluctant to accept a live, attenuated vaccine.

Vaccine cost influenced vaccine acceptability, though, much less strongly than vaccine efficacy. The preference for free vaccines is not surprising. However, subjects did not distinguish between \$50 and \$100 vaccines in terms of their relative acceptability. The range of cost used to define vaccines in this study (i.e. free, \$50, \$100) may not have been sufficient to show a marked effect. However, the results do suggest that, for these adolescents, a vaccine cost of \$50 to \$100 represents only a minor barrier to acceptance.

Mode of vaccine delivery and requirement for parental permission were not substantial contributors to vaccine acceptability. The parental permission finding is consistent with research that suggests that parents and their adolescent children agree that parents should have the authority to decide about health-related issues<sup>35</sup>. In addition, a recent study found that the best predictor of hepatitis B vaccine acceptance among adolescents was their perception that parents believed hepatitis B vaccination was important<sup>36</sup>.

## Implications

A successful HIV immunization programme will require both an effective vaccine and acceptance of this vaccine by individuals at risk for infection. The results of the present study, along with prior research findings<sup>8–10</sup>, suggest that widespread acceptance of HIV immunization cannot be assumed and that the characteristics of the vaccine, as well as other psychosocial factors are likely to influence the acceptability of HIV immunization.

Intensive efforts to develop HIV vaccines continue. In conjunction with these vaccinedevelopment efforts, it is essential that we work intensively to understand the health education strategies that will enhance the acceptability of vaccination. Failure to address issues of HIV vaccine acceptance may lead to inadequate vaccine coverage, delays in immunization programme implementation, and unnecessary expenditure of substantial sums of money on ineffective vaccination efforts. It is essential, therefore, that health professionals begin now to understand issues relevant to HIV vaccine acceptability. This study indicates that some of the obstacles to HIV immunization that will need to be addressed in health education efforts include the belief that a relatively less efficacious HIV vaccine is not worth getting and negative attitudes toward a live, attenuated vaccine.

### Limitations and future directions

This study continues to lay the groundwork for understanding issues that may be predictive of HIV vaccine acceptance. However, there are several limitations that need to be addressed and that provide some indication of future directions for this area of research. One potential limitation is that the adolescent subjects in this study may not have had an accurate understanding of the different vaccine types presented, particularly regarding a live, attenuated vaccine. Although simply worded definitions were provided, it is still possible that some degree of misunderstanding led to the relatively negative attitudes about live, attenuated vaccines. However, such potential misunderstandings may, in fact, be key issues with respect to HIV vaccine acceptability. Moreover, the results regarding attitudes about live, attenuated vaccines were comparable to those obtained with university undergraduates8.

Another issue is that both conjoint analysis methods results in vaccine characteristic combinations that are not, in fact, possible (e.g. there will not be a live, attenuated vaccine delivered by injection). The decision was made to retain the technically unacceptable combinations of attributes for 2 reasons. First of all, the selective deletion of certain combinations weakens the balance of the fractional factorial design, thereby potentially undermining analyses based on a balanced model. In addition, we believed that it was extremely unlikely that the urban adolescents sampled in this study had sufficient knowledge about vaccination to make them aware that certain combinations were unlikely or impossible. The results themselves support this observation, given that mode of delivery was not an important factor in determining vaccine acceptability, either as a main effect or, in the choice-based conjoint analysis, as a 2-way interaction with type of vaccine.

A third important point is that it is very likely that parents will be required to provide consent for HIV immunization of adolescent children. As a result, in future research it will be essential to examine how parents perceive HIV immunization for their children. Many parents, for example, may feel uncomfortable acknowledging the risk of sexually transmitted infections for their adolescent and pre-adolescent children.

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