Willingness to Pay for Programs for the Human Papillomavirus Vaccine on a Rocky Mountain West College Campus

Chian Jones Ritten and Ian M. Breunig[1]

Introduction

Genital human papillomavirus (HPV) is the most prevalent sexually transmitted virus disease in the United States with more than 20 million Americans currently infected and another 6.2 million becoming infected each year (Weinstock et al., 2000). The lifetime likelihood of contracting HPV ranges between 80-85% (Fey et al., 2004). The highest rate of contraction is among adults ages 18-28, making college-age adults the most susceptible to infection (Koutsky, 1997). Although a majority of HPV infections resolve on their own with no health consequences, some strains cause genital warts and others are the cause of virtually all cervical cancers in women. Nearly all cervical cancer victims, 99.7%, are HPV-positive (Walboomers et al., 1999). Cervical cancer can be deadly, accounting for over 274,000 deaths a year worldwide (World Health Organization, 2007).

Although techniques such as cryosurgery of warty lesions and Imiquimod cream are used to treat genital warts, there is no cure for HPV. This makes prevention the key factor in the prevention of cervical cancer and genital warts. On June 8, 2006, the U.S. Food and Drug Administration (FDA) approved the use of a vaccine in women ages 10 to 26 to prevent infection (Bosch, 2003). Currently, two vaccines, quadrivalent and bivalent, are available for HPV prevention (each consist of three separate injections), with only quadrivalent approved for use in men (approved by the FDA in October 2009). The vaccines are nearly 100% effective in the prevention of the targeted HPV strains that may cause genital warts and precancerous cervical cell change (The Kaiser Family Foundation, 2011; Herrero, 2009).

Previous research pertaining to HPV vaccination focuses on general assessments of vaccine acceptability (Liau et al., 2012; Fazekas et al., 2008; Brewer et al., 2007), knowledge and awareness of the disease (Bynum et al., 2011; McCree et al., 2006; Dell et at., 2000; Denny-Smith et al., 2006; Yacobi et al., 1999; Dillard and Spear, 2010), and attitudes towards vaccine uptake (Friedman and Shepard, 2007). These studies suggest that general knowledge and awareness of HPV and its tie to genital warts and cervical cancer in women has drastically increased over the last couple of decades. General acceptability of the vaccine has also increased, although studies show that high costs of vaccination may prevent many that are at risk from receiving the vaccine (Liau et al., 2012; Dillard and Spear, 2010; Patel at al., 2012). The vast majority of these studies either focus on general trends for the entire U.S. or on regional aspects, specifically in the South, with little focus on the Rocky Mountain West. Regional differences are found in HPV vaccine uptake and cervical cancer rates (Jemal et al., 2013), limiting the effective extrapolation of these studies to this region.

[1] The authors are, respectively, Post-Doctoral Research Associate, Department of Agricultural and Applied Economics, University of Wyoming; Post-Doctoral Fellow, Pharmaceutical Health Services Research, University of Maryland School of Pharmacy. Jones Ritten is the corresponding author, cjonesri@uwyo.edu

Research suggests that vaccination of adolescents and the college-age community is critical to reducing the number and spread of HPV infections, which represents a community public health goal (Allen et al., 2009). Many college-age individuals may not have traditional health insurance. Paying out of pocket for the vaccine, which can total $390 (CDC, 2011), may reduce the likelihood of successfully vaccinating this high risk group (Liau et al., 2012; Allen et al., 2009; Hoover et al., 2000). The effect of the passage of the Affordable Care Act (August 2012) on vaccine uptake has yet to be determined. The act mandates all insurance providers to provide coverage for the HPV vaccine with no cost sharing. However, deductibles and copays for the doctor visits themselves can still make HPV vaccination prohibitively expensive (Gudeman, 2007). On the other hand, insurance coverage will increase service availability only if clinicians are willing to provide the service. For instance, some clinics choose not to stock or administer expensive vaccines, such as for HPV, due to high upfront costs of service.

Recent studies suggest that only a small minority of college age women have initiated the vaccine series (estimates between 10-30%) (Jain et al., 2009; Price et al., 2011; Dempsey et al., 2001; Marchland et al., 2012), leaving the vast majority of target populations unvaccinated. Providing HPV vaccination programs for college students may be a significant approach to reduce the overwhelming prevalence of HPV.

This study uses a survey on the Colorado State University (CSU) campus to address how likely college-age students in the Rocky Mountain West are to pay for vaccination programs Student's willingness to pay (WTP) or vote for a campus HPV vaccination program is elicited using the contingent valuation method. Contingent valuation is a survey-based methodology for eliciting values of services that ordinary markets may not be able to measure (Champ et al., 2003). This technique has been frequently used to measure values associated with vaccines (Prosser et al., 2004; Lee et al., 2002; Medlock and Galvani, 2009).

Because of the financial burden that can deter many college students from receiving the vaccine, this study introduced three different HPV vaccine programs in which the method of payment varied. Students were asked about WTP out-of-pocket for self-vaccination, WTP for an increase in student fees to fund the vaccine free of charge for all students, and WTP for a reallocation of existing student fees away from other funded university programs in order for all students to have access to the vaccine free of charge.

Methods

Survey sample

Survey instruments were developed and information was collected on a sample of 426 students enrolled in introductory level undergraduate economics courses[2] at CSU in March 2011. These courses are required for many majors across disciplines and fulfill general studies requirements. The courses are also open to all majors at CSU, with only a small fraction of those enrolled being declared Economics majors. Students were approached within a classroom setting, given information about the survey, and completed the survey on a voluntary basis. Prior to collecting the data for this study, two focus groups of 4-5 volunteers were conducted, from which the survey instruments were altered to ensure understanding amongst respondents. Pretests were then performed and the data were analyzed. The results supported the validity of the survey

[2] The courses included Principles of Microeconomics, Principles of Macroeconomics, and Gender in the Economy. Students enrolled in these courses are found to be highly representative of the CSU student body based on 2011 enrollment statistics with respect to demographic aspects.

instruments. They were then approved by Human Subjects at CSU and the implementation of the surveys was permitted.

After eliminating 4 surveys with missing information on gender or age, the effective population size was 422, of which 198 (47%) were female. In total, 362 (86%) respondents identified as White, 9 (2%) identified as Black or African American, 17 (4%) as Asian, 19 (5%) as Hispanic or Latino, 11(3%) as another race or ethnicity, and 2 not responding. The average age of the respondent was 20. Most have very low incomes with only 69 (16%) reporting an annual income of $10,000 or greater. Nearly half of the respondents (46%) resided in a campus dormitory and only 32 (8%) respondents reported as having a spouse of live-in partner.

A majority of the sample indicated that they were previously familiar with HPV and its link to cervical cancer. A majority of females (62%) and 10% of males reported prior vaccination for HPV, suggesting that CSU students have higher rates of vaccination than previous studies have found. One male and one female reported having been previously diagnosed with HPV[3], and 43 (10%) respondents reported knowing a friend or family member diagnosed.

Measures for contingent valuation

Three hypothetical programs were proposed to capture the effect of the different payment vehicles on valuation. Two dichotomous choice WTP treatment arms were established that were randomly assigned to respondents[4]. The first treatment arm (Treatment 1) pertained to Program 1 and the second arm (Treatment 2) pertained to Programs 2 and 3.

Treatment 1 respondents were asked whether they were willing to pay a random but preselected amount ranging from $10 to $400 to be vaccinated (Program 1). This range was based on a survey of actual costs of vaccination (given the actual cost of $390 without insurance). Respondents were directed that the cost would be a one-time out-of-pocket cost in order to assure that they assumed the proper opportunity cost. Since vaccination was only recently approved for males and it may not be commonly known to be available, only female respondents were asked to respond to this question.

Treatment 2 respondents (both male and female) were asked whether they were willing to vote for two proposed vaccination programs (Programs 2 and 3) that would make available a vaccination for all *willing* CSU students. Program 2 had an associated cost of increased student fees equal to a random but preselected amount, ranging between $10 and $400, for all CSU students. The associated cost of Program 3 was equal to that of Program 2, however the source of funding would be a reallocation of existing fees. Table I provides the exact questions posed to the students with the randomized value of the vaccination indicated as *X*.

[3] To determine if these observations should be dropped from the analysis, an indicator to control for these students was used, and no significant impact was seen. Therefore, these observations were retained in order to take advantage of their information regarding WTP for the vaccination programs.

[4] The treatment arm and the amount that respondents were asked if they would be willing to pay (ranging from $10 to $400) were randomized across (and within) the courses in which the survey was conducted.

Table I. Questions about willingness to pay posed to Treatment 1 (Program 1) and Treatment 2 respondents (Programs 2 and 3).

• Currently, CSU has 13,526 female students, making up 51.3% of all enrolled students. • The vaccine reduces the risk of being infected with HPV by 70% if previously uninfected. • If either proposal passes, the risk of cervical cancer will be reduced by 70% in women vaccinated.
Program 1: Would you pay an out-of-pocket price of $X to receive the vaccine yourself? (yes/no)
Program 2: An increase in all students' semester fees by $X to have the vaccine available for all female students. • The program will be funded by a new special student fee. • The costs of the program would have to be paid by you and other Colorado State University students. • Because you would be paying $X in additional student fees for the program, it would reduce the amount of available money for spending on your personal consumption. Would you vote for the proposed increase in your semester students fees of $X to have the vaccine available for all Colorado State University students? (yes/no)
Program 3: A reallocation of existing student fees, amounting to $X per student, away from other student services (rec center, classroom services, etc.) to fund availability of the vaccine free for all female Colorado State University students. • The program will not increase your student fees. • Payments for the program will be in the form of a reallocation of your student fees from other student services (for example, reallocation of fees from the Lory Student Center, Campus Recreation Center, University Facility Fee, Student Legal Services, Conflict and Resolution, Athletics, etc.). • Thus, paying for the program would reduce the amount of other student services that are currently available. Would you vote for this reallocation of student fees that would provide vaccinations for all students at the cost of other student services? (yes/no)

To ensure that respondents were aware of the opportunity cost for Treatment 2, the survey used the technique outlined by Bergstrom, Boyle and Yabe (2004). Prior to introducing the policy change, respondents were given a list of the programs that could have funding decreased if Proposal 2 (Program 3) were to pass. This was in order to have the respondent understand the true opportunity cost of a reallocation of resources. Although this assessment was not vital to the valuation for Treatment 1, respondents were asked to rank these programs in order to keep the treatments similar.

Preferences, especially social preferences, are important in individual decision-making (Jones Ritten, 2011). Researchers have shown that people deviate from assumptions of the self-interest (Henrich, et al., 2004). "Many behaviors are better explained by social preferences; in choosing to act, individuals commonly take account not only of the consequences of their actions for themselves but for others as well" (Bowles, 2006 p. 96). To measure their effect on valuation of vaccinations, respondents were asked the influence of self-interest and social

preferences, or "Attitudes," on their WTP decisions. Each preference motivation was given in a statement in which respondents were asked to rank their level of agreement to each statement from 1 (strongly disagree) to 5 (strongly agree). All statements are listed in Table II. Self-interest has been the primary motivation assumed within economics, and therefore was included in this study. Unlike pure self-interest, those acting out of altruistic motives, "take costly actions to increase the payoff of another actor, irrespective of the other actor's previous action" (Camerer and Fehr, 2002). Altruism has been indicated as another potential motivation in responses to WTP questions (e.g. Loomis et al., 2009). The specific altruism statement was chosen since it associates altruism with providing the vaccine for others, but makes the decision of vaccination up to the other individuals.

Table II: Variables measuring preferences, perceptions, and protests for HPV vaccination programs*

Preferences • I want to protect myself from HPV ('*Self-Interest'*) • I want others to be able to be protected against HPV ('*Altruism*') • It seems fair to me to contribute a fair share to help others be vaccinated ('*Fairness*')
Perceptions • Do you believe that the majority of Colorado State University students would be willing to vote in favor of [the proposal]'(yes/no*) ('Others' intentions')* • I believe that I am susceptible to contracting HPV *('Risk')* • I believe it is important for the CSU community to be vaccinated for HPV *('Community')*
Protest • I generally believe that vaccines are safe *('Safety')* • I believe the spread of HPV is primarily due to socially unacceptable sexual behavior *('Sex')*

*For each statement, respondents ranked their level of agreement from 1 (strongly disagree) to 5 (strongly agree) unless indicated otherwise.

Experimental economics shows the relevance of other types of social preferences into decision-making: specifically fairness and the motivation of others (Jones Ritten, 2011; Andreoni, 1998; Bowles and Gintis, 2000; Camerer and Fehr, 2002). In this context, fairness is associated with the respondent providing vaccinations for others in order to be fair to all. The belief of other's motivations and actions are also found to influence behavior. Only Programs 2 and 3 involve university-wide decisions. For these respondents, after the WTP questions, the belief of the motivations of others was captured by asking the respondents about their beliefs of how others would vote ('Others' intentions')[5].

To capture whether unwillingness to pay/vote for either program might be due to "protest", students were asked to rank their agreement with statements that vaccinations are unsafe ('Safety') or that socially unacceptable sexual behavior was the root cause of the spread of the disease ('Sex'). To assess whether WTP might be due to respondents' perception of their own HPV risk, they were asked to rank their level of susceptibility ('Risk'). Similarly, they were also asked to rank how important it is for the CSU community to be vaccinated ('Community').

[5] For greater discussion and more explicit models for the relationship between social preferences and WTP, the reader is referred to Jones Ritten (2011).

Lastly, knowing that many college students either rely on their parents, scholarships, or on other external sources of funding, respondents were asked about their parents' income and whether they pay for tuition, fees, and living expenses out of their own pockets (strongly disagree=0 / strongly agree=5)[6].

Logistic Model of WTP

The basic choice problem of respondents is to obtain the highest utility possible; either by paying/voting for a HPV vaccination program or not. An individual will accept to pay (vote in favor of) a fee for a program when the utility associated with a program is higher than that with no program (Hanemann, 1984), i.e.:

$$v(y, I - A; S) + \varepsilon_y \geq v(n, I; S) + \varepsilon_n \quad (1)$$

Where *v(.)* is the indirect utility function, *y* indicates the presence of a vaccination program, while *n* indicates no program, *I* is income, *A* is the stated price of the program, *S* is a vector of other socioeconomic variables affecting program preference, and ε_y and ε_n are identically, independently distributed random variables with means of zero. Therefore, an individual will pay/vote for a program (*y*) if the utility of doing so is greater than the utility of no program (*n*).

The utility difference (Δv) between with and without a program is:

$$\Delta v = v(y, I - A; S) - v(n, I; s) + (\varepsilon_y - \varepsilon_n) \quad (2)$$

The probability that an individual will be willing to pay/vote is:

$$P(y) = 1 - P(n) = \frac{1}{1 + e^{-\Delta v}} \quad (3)$$

$$= \frac{1}{1 + e^{-(\alpha + \beta \cdot A + \gamma \cdot I + \theta \cdot S)}} \quad (4)$$

where α, β, γ, and θ are estimated using a logit model by maximum likelihood estimation.

Statistical analysis

The analysis described below addressed two objectives. The first objective was to evaluate the unconditional probability that the sample will be willing to pay/vote for Programs 1, 2, and 3, as well as the probability adjusted for the beliefs and other personal characteristics of the respondents. The second objective was to explore the factors which contributed to the respondents' choices. First, descriptive statistics with respect to the WTP/vote for Program 1, 2, and 3, respectively are presented. The median value of all ranked responses are provided[7].

[6] During focus groups, participants indicated that a dichotomous, yes/no format for these questions was inadequate since in many cases students share, with varying degrees, these expenses with parents or scholarships.

[7] The Kruskal-Wallis equality of populations rank test was used to assess differences between respondents willing to pay/vote and unwilling to pay/vote for the respective programs. One-sided or two-sided Fisher's exact test was also used for all other categorical variables and a Wilcoxon-Mann-Whitney test was used for mean ages.

Multivariate logistic regression analysis was used to explore which factors significantly contributed to the respondents' choices to pay or vote for the respective programs, adjusting for other factors. Several ranked variables were operationalized by converting them to dichotomous or trichotomous variables due to infrequent responses among some extremes. These variables are noted in the tables with results. The average marginal effects of significant factors in the probability of WTP/vote were calculated. The overall (average) probabilities were then estimated to evaluate the popularity of the programs among the sampled students adjusted for significant factors.

Results

Sample characteristics

Table III presents the descriptive statistics for all of the questions on the surveys for Programs 1, 2, and 3. Just over half (52%) of women responding to Program 1 stated that they were willing to pay out of pocket for the HPV vaccine, unconditional on the stated price. Only 34% of students stated they were willing to vote for Program 2 – increasing total school fees paid by all students – but 45% stated they were willing to vote for Program 3 – reallocating the use of current fees in order to accommodate such a program.

The law of demand appears to hold among respondents to Program 1. Fewer proportions of women were willing to pay for the HPV vaccine as the stated price increased. There was no significant difference in "demographics" or "financial dependence" of those willing and unwilling to pay for the vaccine. However, there seems to be significant heterogeneity in respondents' "attitudes" as well as belief about the safety of vaccines ('Safety') and the relative importance of the HPV vaccination for the campus community ('Community').

For Program 2, smaller proportions of students were willing to vote for the program as the increase in student fees required grew larger (with the exception of $100). Intriguingly, no relationship between price and WTP/vote was discernible for Program 3, which may be due to the fact that no out-of-pocket payment is required. Over half of respondents were willing to vote for Program 3 at any implicit price level (besides the lowest price of $10). Among these same respondents, less than half were willing to vote/pay for Program 2 at any price level (besides the lowest price of $10). Thus, holding cost constant, it appears that students tend to prefer to reallocate funds away from existing school programs rather than incur higher fees.

For Programs 2 and 3, students who were willing to vote in favor of the program were substantially more likely to believe that a majority of other CSU students would also vote in favor of the program ('Others' intensions') ($p<0.001$ and $p=0.030$, respectively). Similar to respondents under Program 1, there appears to be significant heterogeneity in respondents' attitudes and belief in the relative importance of the HPV vaccination for the campus community ($p<=0.001$ for all). Compared to respondents not in favor of Program 2, those in favor of Program 2 were less likely to pay for their overall student fees out of their own pocket ('Fees') ($p<0.016$). Under Program 3, significant heterogeneity was exhibited in regard to beliefs of HPV as a consequence of socially unacceptable sexual behavior ('Sex') ($p=0.008$) and respondents' own susceptibility to contracting HPV ('Risk') ($p=0.029$).

Table III. Descriptive statistics of survey responses by willingness to pay/vote for Programs 1 (women only), 2, and 3.

	Frequencies†								
	Program 1			Program 2			Program 3		
Dichotomous Questions	yes	no	*p-value*	yes	no	*p-value*	yes	no	*p-value*
Total observations:	53	49		65	129		87	105	
Cost									
$10	12	3	*<0.001*	20	14	*0.002*	12	22	*0.114*
$25	14	3		14	22		22	14	
$50	15	12		7	22		19	8	
$100	4	5		12	17		16	13	
$200	4	12		7	25		16	16	
$400	4	14		5	29		20	14	
Demographics									
Age *(mean, s.d.)**	19.8 (2.3)	19.8 (1.7)	*0.309*	20.44 (5.3)	19.8 (2.3)	*0.647*	20.2 (4.3)	19.8 (2.2)	*0.934*
Male	--	--		32	68	*0.380*	56	38	*0.118*
Caucasion	48	44	*0.578*	59	107	*0.104*	92	72	*0.228*
Dormitory	25	24	*0.506*	31	55	*0.302*	46	40	*0.438*
Married	3	5	*0.476*	6	10	*0.459*	10	6	*0.350*
Financial dependence									
Own income >$10k	5	6	*0.444*	11	14	*0.167*	14	10	*0.437*
Parent's income <$50k	13	7	*0.307*	11	32	*0.300*	22	21	*0.443*
Parent's income $50k-$100k	19	24		26	55		41	39	
Parent's income >$100k	21	18		28	42		42	27	
History with HPV									
Diagnosed (dx)	1	0	*0.520*	0	0	*1.000*	0	0	*1.000*
Friend or family dx	12	7	*0.204*	2	12	*0.094*	7	7	*0.462*
Vaccinated	38	26	*0.041*	28	37	*0.033*	37	28	*0.386*
Prior knowledge	51	44	*0.187*	48	87	*0.228*	77	57	*0.155*
Attitudes									
Others' intentions	--	--		28	12	*<0.001*	27	12	*0.030*

	Medians‡								
	Program 1			**Program 2**			**Program 3**		
Ranked Questions [1,5]	**yes**	**no**	*p-value*	**yes**	**no**	*p-value*	**yes**	**no**	*p-value*
Financial dependence									
Tuition	2	2	*0.740*	2	3	*0.060*	3	3	*0.576*
Fees	2	3	*0.399*	2	4	*0.016*	3	3	*0.783*
Living expenses	2	4	*0.122*	4	4	*0.456*	4	4	*0.637*
Attitudes									
Self-interest	5	5	*0.008*	5	4	*0.001*	5	4	*<0.001*
Altruism	5	4	*0.084*	5	4	*<0.001*	5	4	*<0.001*
Fairness	4	3	*0.026*	4	3	*<0.001*	4	3	*<0.001*
Beliefs									
Safety	4	4	*0.001*	4	4	*0.173*	4	4	*0.516*
Sex	3	3	*0.350*	3	3	*0.872*	3	3	*0.008*
Risk	2	2	*0.178*	2	3	*0.469*	3	2	*0.029*
Community	4	3	*<0.001*	4	3	*<0.001*	4	3	*<0.001*

† P-values are calculated using the two-sided Fisher's exact test for multiple categorical variables and one-sided Fisher's exact test for dichotomous categories

‡ P-values calculated using Kruskal-Wallis equality of populations rank test to show significant heterogeneity in responses (despite Possibly similar median responses).

* P-value represents Prob>|z|,estimated using the Wilcoxen-Mann-Whitney test for different means

Multivariate analyses

Table IV presents the conditional probabilities (95% C.I.) for students' WTP for the vaccine (Program 1) or vote for Programs 2 and 3, adjusting for significant factors (i.e., $p<0.05$). Average marginal effects (ME) for the significant factors are also presented. Again, it was found that Program 3 (Pr=54.8%, 95%CI: 49.9%, 59.8%) is much more favorable than Program 2 (Pr=33.5%, 95%CI: 28.5%, 38.5%) among these respondents. The conditional probability that women under Program 1 would pay out of pocket for the vaccine was 52.7% (95%CI: 46.2%, 59.2%).

The law of demand seems to still hold for program 1 and the relationships between costs and the favorability of Programs 2 and 3 are similar to those discussed in the previous section[8]. A stronger belief in the importance of community vaccination leads to a greater probability of paying or voting for any of the programs. Students were much more likely to vote in favor of Program 2 or 3 if they believed that a majority of their campus-mates would vote similarly ('Others' intensions').

Under Program 1, females 20 to 22 years old were more likely to purchase the HPV vaccination when compared to all other ages (ME=0.21, p=0.015). Females who agreed that they tend to pay out-of-pocket for living expenses were less likely to pay than others (ME=-0.25, p=0.001). Interestingly, a woman was 26% *less* likely to pay for the vaccine if she stated that she agreed or strongly agreed with the altruistic notion that others should be able to be protected against HPV ('Altruism'). Since this program involves self-payment for self-vaccination, motivations beyond self-interest play no positive role. Those that are influenced by a motivation of altruism are less likely to pay out of pocket for the more self-oriented action of only self-vaccination. Therefore, not surprisingly, no other attitudes or beliefs were significant predictors of WTP by women under Program 1.

Regarding Program 2, men or women 23 years or older were more likely to vote in favor (ME=0.23, p=0.010), as were those who were neutral with regard to who pays for their living expenses (ME=0.173, p=0.044) and those who indicated that their parents' income was higher than others' (ME=0.25, p<0.001). Respondents who were neutral regarding their susceptibility to contracting HPV ('Risk') were less likely than others to vote for Program 2 (ME=-0.23, p<0.001). Unexpectedly, a person with a friend or family member who was previously diagnosed with HPV was 22% (p=0.001) *less* likely be in favor of the program[9]. None of these factors were significant in predicting favorability towards Program 3, however.

Given that the average cost for the HPV vaccine is approximately $390, the above results were used to calculate the probability that the responding students would purchase the vaccine under Program 1 or vote in favor of Programs 2 or 3 conditional on the price of the vaccine being $400. As expected at the highest price, the programs that require greater out-of-pocket expenses have reduced favorability when compared to those reported above. Approximately

[8] The negative marginal effects of cost on the WTP is 2 to 7 percentage points stronger when restricting models 2 and 3 to females, yet the relative magnitudes between price levels remain the same.

[9] Of 14 individuals who reported a friend or family member diagnosed with HPV, 12 indicated an unwillingness to pay for program 2 and half indicated an unwillingness to pay for program 3 (Table III). While perhaps a spurious result, further elucidation of this result would have required specific follow up within the questionnaire.

Table IV. Marginal effects from multivariate logistic regression models for the willingness to pay/vote for Programs 1, 2, and 3

	Program 1 (women only)		Program 2		Program 3	
	(*n*=102)		(*n*=194)		(*n*=191)	
Conditional Probability *(95% Confidence Interval)*	52.7% (46.2% , 59.2%)		33.5% (28.5% , 38.5%)		54.8% (49.9% , 59.8%)	
Significant predictors ‡	Marginal Effect	*p-value*	Marginal Effect	*p-value*	Marginal Effect	*p-value*
Cost = $10	*reference*					
Cost = $25	-0.073	*0.621*	-0.212	*<0.001*	0.219	*0.004*
Cost = $50	-0.229	*0.028*	-0.288	*<0.001*	0.259	*0.002*
Cost = $100	-0.319	*0.009*	-0.222	*<0.001*	0.147	*0.088*
Cost = $200	-0.491	*<0.001*	-0.283	*<0.001*	0.167	*0.035*
Cost = $400	-0.513	*<0.001*	-0.280	*<0.001*	0.199	*0.013*
Age [<20]	*reference*					
Age [20, 21, 22]	0.209	*0.015*	-0.074	*0.175*	--	
Age [23 +]	0.147	*0.366*	0.226	*0.010*	--	
Living expenses (disagree/strongly disagree)	*reference*					
Living expenses (neutral)	-0.124	*0.371*	0.173	*0.044*	--	
Living expenses (agree/strongly agree)	-0.252	*0.001*	0.029	*0.612*	--	
Parents' annual income [<$50,000]	*reference*					
Parents' annual income [$50,000 , $100,000)	--		0.129	*0.061*	--	
Parents' annual income [$100,000 +]	--		0.248	*<0.001*	--	
Friend or Family diagnosed with HPV (no)	*reference*					
Friend or Family diagnosed with HPV (yes)	--		-0.216	*0.001*	--	
Others' intentions (no)	*reference*					
Others' intentions (yes)	n/a		0.254	*<0.001*	0.471	*<0.001*
Community (neutral/disagree/strongly disagree)	*reference*					
Community (agree)	0.324	*<0.001*	0.136	*0.014*	0.131	*0.024*
Community (strongly agree)	0.371	*<0.001*	0.295	*<0.001*	0.219	*0.007*
Altruism (neutral/disagree/strongly disagree)	*reference*					
Altruism (agree/strongly agree)	-0.264	*0.027*	--		--	
Fairness (disagree/strongly disagree) †	*reference*					
Fairness (neutral)	--		0.151	*0.051*	0.135	*0.043*
Fairness (agree/strongly agree)	--		0.420	*<0.001*	0.282	*0.001*
Sex (disagree/strongly disagree)	*reference*					
Sex (neutral)	--		-0.128	*0.039*	-0.035	*0.614*
Sex (agree/Strongly agree)	--		-0.101	*0.107*	-0.147	*0.042*
Risk (disagree/strongly disagree)	*reference*					
Risk (neutral)	--		-0.227	*<0.001*	--	
Risk (agree/strongly agree)	--		-0.091	*0.101*	--	
Pseudo R-squared	0.380		0.511		0.418	

† Collinear with altruism, reciprocity, and commitment - estimates which substitute each in place of fairness reveal positive relationships similar to those on fairness, and expected probabilities remain nearly identical as reported above.

‡ All missing estimates or unlisted predictors from table 2 were estimated to have no significant impact (p>0.10) on predicting willingness to pay/vote.

21% (95%CI: 17%, 25%) of female students would be expected to purchase the HPV vaccination, and 25% (95%CI: 21%, 30%) of men and women would be expected to favor an equal increase in student fees. On the other hand, there is little response to stated price when students are asked their opinion about a reallocation of existing fees away from other campus-wide programs to fund the HPV vaccination; 58% (95%CI: 53%, 63%) would be expected to favor Program 3.

Conclusion

A successful HPV vaccination program on a university campus may hinge on subsidization by the University and taxpayers if it were to require an increase in out-of-pocket expenses for students who are already burdened by the cost of a college education. Results suggest that the high cost of the HPV vaccination series (around $390) may be a strong deterrent for self-vaccination if female students are encouraged to voluntarily pay out-of-pocket for the preventive measure (Program 1). Encouragingly though, it is also found that a similar student body may be more willing to sacrifice student funds previously allocated for existing campus programs (Program 3) than to increase obligatory student fees by the same amount (Program 2) to make the vaccine available to the entire student body. Even given an implicit cost of $400 per vaccine series, this survey shows that such a program would be favored by a majority of the student body, even knowing that the cost would be a reduction in funding for other programs. Hence, from a policy perspective, a reallocation of student fees seems to provide a potentially more successful HPV vaccination program. The costs of providing the vaccine would be paid entirely by the students themselves through already existing student fees.

These results suggest that Universities providing the HPV vaccine to students for the current out-of-pocket price of $390 may not be successful in achieving a high rate of vaccination response. Results predict that only approximately 21% of female students would purchase the vaccine at this cost. Combined with the fact that only 1% of males have received the vaccine to date (Harris, 2011), in order to have a greater participation rate in a student paid vaccination program, the university and taxpayers may have to highly subsidize the program.

Thus, from an administration's perspective, a program to promote the prevention of an HPV outbreak may be more feasible and incur less direct costs if implemented under the design of Program 3. Since funding for the program will come from already collected student fees, no new direct costs to the university or individual students will be incurred.

Another important contribution by this survey study is that it provides evidence suggesting that the likelihood of gaining a favorable response to a campus-wide HPV vaccination program not only depends upon economic considerations but also on the students' personal beliefs and attitudes towards the HPV vaccine. This study finds that, for all of the proposed vaccination programs, a personal belief that the community needs protection against HPV was associated with an increased probability of willingness to pay for the program. Therefore, in order to promote favorable attitudes toward such a program, efforts should be made to promote a sense of community within the student body. Although only found to influence Program 2, education about the safety of the vaccine may increase the probability of paying for a vaccination program. For programs that involve universal coverage (Programs 2 and 3), promotion should include a sense of fairness and the sense that others within the community are committed to campus safety and are willing to vote for such programs. Both of these motivations are found to increase the likelihood of respondents voting in favor of the vaccination programs. It should also be noted that students may also be more likely to support a vaccination program if it is successful in separating HPV with notions of unacceptable sexual behavior.

The recent passage of the Affordable Care Act, and the continuation of the mandate for HPV vaccine coverage by private insurance, may reduce the need for HPV vaccination programs on some college campuses. Yet, this study may provide insights into successful HPV vaccination programs for college-aged individuals within a broader community (i.e., not limited to students) who are not covered by health insurance. This study also gives insights into the motivations behind paying for other vaccination programs on a college campus. Particularly, for vaccines not mandated for coverage under current or future health care policies.

This study focused on student's support for HPV programs at CSU. The results show that the rate of vaccination of CSU students is higher than in previous studies that focused on other geographic regions or on the US as a whole. This is consistent with earlier evidence of geographic differences in HPV vaccine uptake. Heterogeneity in HPV vaccine uptake across geographic regions suggests further need for regional analyses and minimizing the use of general data to predict behavior in specific regions.

Given the varying demographic make-up of students at institutions in other regions, these results should be extrapolated with caution. The results of this survey study should also only be applied to the HPV vaccine, but the design of the survey may be applied to study the WTP for other vaccine programs. The sampling method used is derived solely from students enrolled in certain courses. However, this work represents a start in examining ways to help reduce payment barriers and encourage students to get vaccinated. In sum, this study provides results that give insight into an important health and community issue.

References

Allen JD, Mohllajee AP, Shelton RC, Othus MK, Fontenot HB, Hanna R. 2009. "Stage of adoption on the human papillomavirus vaccine among college women." *Preventive Medicine* 48: 420-425.

Andreoni J. 1998. "Why free ride? Strategies and learning in public goods experiments." *Journal of Public Economics* 37(3): 291-304.

Bergstrom J, Boyle K, Yabe M. 2004 "Trading taxes vs. paying taxes to value and finance public environmental goods." *Environmental and Resource Economics* 28(4): 533-549.

Bosch FX, de Sanjose S. 2003. "Human Papillomavirus and cervical cancer-burden and assessment of causality." *Journal of the National Cancer Institute Monographs* 31: 3-13.

Bowles S. 2006 "Microeconomics: Behavior, Institutions, and Evolution." New York, NY: Russell Sage Foundation.

Bowles S, Gintis H. 2000. "Walrasian economics in retrospect." *Quarterly Journal of Economics* 115(4): 1411-1439.

Brewer NT, Fazekas KI. 2007. "Predictors of HPV vaccine acceptability: A theory-informed, systematic review." *Preventive Med*icine 45: 107-114.

Bynum SA, Brandt, HM, Friedman DB, Annang L, Tanner A.. 2011. "Knowledge, beliefs, and behaviors: Examining Human Papillomavirus–related gender differences among African American college student." *Journal of American College Health* 59(4): 296-302.

Camerer C, Fehr E. 2002 “Measuring social norms and preferences using experimental games: A guide for social scientists.” *Institute for Empirical Research in Economics: University of Zurich* Working Paper No. 97.

“Cervical cancer, human papillomavirus (HPV), and HPV vaccines: Key points for policy-makers and health professionals.” World Health Organization (WHO). Geneva: WHO/RHR:08.14; 2007.

Champ P. Boyle K, Brown T. (eds.) 2003. *A Primer on Nonmarket Valuation*. Dordrecht/Boston/London: Kluwer Academic Publishers.

Dell DL, Chen H, Ahmad F, Stewart DE. 2000. “Knowledge about human papillomavirus among adolescents.” *Obstetrics and Gynecology* 96(5): 653-656.

Dempsey A, Cohn L, Dalton V, Ruffin M. 2011. “Worsening disparities in HPV utilization among 19-26 year old women.” *Vaccine* 29(3): 528-534.

Denny-Smith T, Bairan A, Page MC. 2006. “A Survey of female nursing students’ knowledge, health beliefs, perceptions of risk, and risk behaviors regarding human papillomavirus and cervical cancer.” *Journal of the American academy of nurse practitioners* 18: 62-69.

Dillard JP, Spear ME. 2010. “Knowledge of Human Papillomavirus and perceived barriers to vaccination in a sample of US female college students”. *Journal of American College Health* 59(3): 186-190.

Fazekas KI, Brewer NT, Smith JS. 2008. “HPV vaccine acceptability in a rural southern area”. *Journal of Womens Health* 17(4): 539-548.

Fey MC, Beal MW. 2004. “CEU Role of Human Papilloma virus testing in cervical cancer prevention.” *Journal of Midwifery & Women’s Health* 49: 4–13.

Friedman AL, Shepard H. 2007. “Exploring the knowledge, attitudes, beliefs, and communication preferences of the general public regarding HPV: Findings from CDC focus group research and implications for practice.” *Health Education and Behavior* 34: 471-485.

Gudeman R. 2007. “High cost of HPV vaccine limits use in surprising way.” *Youth Law News* 28(2): 1-6.

Hanemann WM. 1984. “Welfare evaluations in contingent valuation experiments with discrete responses.” *American Journal of Agricultural Economics* 66(3): 332-341.

Harris G. “Panel endorses HPV vaccine for boys of 11.” *The New York Times*. October 26, 2011:A1.

Henrich J, Boyd R, Bowles S, Camerer CI, Fehr E, Gintis H, McElreath R. 2004. “Overview and Synthesis.” In Henrich J, Boyd R, Bowles S, Camerer CI, Fehr E, Gintis H. (eds.) “Foundations of Human Sociality.” Oxford, UK: Oxford University Press.

Herrero R. 2009. “Human Papillomavirus (HPV) vaccines: Limited cross-protection against additional HPV types**.”** *Journal of Infectious Disease* 199(7): 919-922.

Hoover DH, Carfioli B, Moench EA. 2000. "Attitudes of adolescent/young adult women toward human papillomavirus vaccination and clinical trials." *Health Care for Women International* 21: 375-391.

"HPV vaccine information for young women – Fact sheet." Centers for Disease Control and Prevention Web Site." http://www.cdc.gov/std/hpv/stdfact-hpv-vaccine-young-women.htm. Page last updated September 15, 2011. Accessed April 20, 2012.

Jain N, Euler GL, Shefer A, Lu P, Yankey D, Markoaitz L. 2009. "Human papillomavirus (PHV) awareness and vaccination initiation among women in the United States, National Immunization Survey – Adult 2007." *Preventive Med*icine 48: 426-431.

Jemal A, Simard EP, Dorell C, Noone A, Markowitz LE, Kohler B, Eheman C, Saraiya M, Bando P, Saslow D, Cronin KA, Watson M, Schiffman M, Henley SJ, Schymura MJ, Anderson RN, Yankey D, Edwards BK. 2013. "Annual report to the nation on the status of cancer, 1975-2009, featuring the burden and trends in human papillomavirus (HPV) – Associated cancers and HPV vaccination coverage levels." *Journal of the National Cancer Institute* 105(3): 175-201.

Jones Ritten CJ. 2011. "Measuring values for environmental public goods: Incorporating gender and ethnic social effects into stated-preference value-elicitation methods*." Dissertation*. Colorado state University: Fort Collins, CO.

Koutsky L. 1997. "Epidemiology of genital Human Papillomavirus infection." *American Journal of Medicine* 102(5): 3-8.

Lee PY, Matchar DB, Clements DA, Huber J, Hamilton JD, Peterson ED. 2002. "Economic analysis of influenza vaccination and antiviral treatment for healthy working adults." *Annuals of Internal Medicine* 137(4); 225-231.

Liau A, Stupiansky NW, Rosenthal SL, Zimet GD. 2012. "Health beliefs and vaccine costs regarding human papillomavirus (HPV) vaccination among a U.S. national sample of adult women." *Preventive Med*icine 54(3-4): 277-279.

Loomis J, Bell P, Cooney H, Asmus C. 2009. "A comparison of actual and hypothetical willingness to pay of parents and non-parents for protecting infant health: The case of nitrates in drinking water." *Journal of Agricultural and Applied Economics* 41(3): 1-16.

Marchland E, Glenn BA, Bastani R. 2012. "Low HPV vaccine coverage among female community college students." *Journal of Community Health* DOI: 10.1007/s10900-012-9572-x.

McCree DH, Sharpe PA, Brandt HM, Robertson R. 2006. "Preferences for sources of information about abnormal Pap tests and HPV in women tested for HPV." *Preventive Medicine* 43(3): 165-170.

Medlock J, Galvani AP. 2009. "Optimizing Influenza Vaccine Distribution**."** *Science* 325(5948); 1705-1708.

Patel DA, Zochowski M, Peterman S, Dempsey AF, Ernst S, Dalton VK. 2012. "Human Papillomavirus vaccine intent and uptake among female college students." *Journal of American College Health* 60: 151-161.

Price RA, Tiro JA, Saraiya M, Meissner H, Breen N. 2011. "Use of Human Papillomavirus vaccines among young adult women in the United States: An analysis of the 2008 national health interview survey." *Cancer* 117(24): 5560-5568.

Prosser LA, Ray T, O'Brien M, Kleinman K, Santoli J, Lieu TA. 2004**. "**Preferences and willingness to pay for health states prevented by Pneumococcal Conjugate vaccine." *Pediatrics* 113(2); 283-290.

"The HPV vaccine: Access and use in the U.S." The Kaiser Family Foundation. http://www.kff.org/womenshealth/upload/7602-03.pdf. Published November, 2011. Accessed April 20, 2012.

Walboomers JM, Jacobs MV, Manos MM, Bosch FX, Kummer JA, Shah KV, Snijders PJF, Peto J, Meijer CJLM, Muñoz N. 1999. "Human papillomavirus is a necessary cause of invasive cervical cancer worldwide." *The Journal of Pathology* 189(1): 12-19.

Weinstock H, Berman S, Cates W. 2004. "Sexually transmitted diseases among American youth: Incidence and prevalence estimates, 2000" *Perspectives on Sexual and Reproductive Health* 36: 6–10.

Yacobi E, Tennant C, Ferrante J, Pal N, Roetzhaim R. 1999. "University students' knowledge and awareness of HPV." *Preventive Med*icine 28: 535-541.