

11-10-2020

Cost – Benefit Analysis of Austin Public Health’s Peer to Peer Adolescent Sexual Health Education Program

Kim Wilson

University of Texas Health Science Center at Houston, kimberly.j.wilson@uth.tmc.edu

Ujas Patel

University of Texas Health Science Center at Houston, ujas.j.patel@gmail.com

Shannon Sandrea

Austin Public Health, Shannon.Sandrea@austintexas.gov

Fernanda Santos

Austin Public Health, Fernanda.Santos@austintexas.gov

Henry Shelton Brown III

University of Texas Health Science Center at Houston, henry.s.brown@uth.tmc.edu

Follow this and additional works at: <https://digitalcommons.library.tmc.edu/jfs>

Recommended Citation

Wilson, Kim; Patel, Ujas; Sandrea, Shannon; Santos, Fernanda; and Brown, Henry Shelton III (2020) "Cost – Benefit Analysis of Austin Public Health’s Peer to Peer Adolescent Sexual Health Education Program," *Journal of Family Strengths*: Vol. 20 : Iss. 1 , Article 6.

Available at: <https://digitalcommons.library.tmc.edu/jfs/vol20/iss1/6>

The *Journal of Family Strengths* is brought to you for free and open access by CHILDREN AT RISK at DigitalCommons@The Texas Medical Center. It has a "cc by-nc-nd" Creative Commons license" (Attribution Non-Commercial No Derivatives) For more information, please contact digitalcommons@exch.library.tmc.edu

Cost – Benefit Analysis of Austin Public Health’s Peer to Peer Adolescent Sexual Health Education Program

Teen pregnancy results in poor long-term outcomes for both the mother and child. Teen mothers are 10-12% less likely to complete high school and have 14-20% lower odds of attending college (Basch, 2011). Children born to teen mothers face an increased risk of low birth weight, preterm birth, infant mortality, less preparedness for kindergarten, behavioral health issues and chronic medical conditions, incarceration, and lower educational and employment outcomes (Hoffman 2006; Jutte et al. 2010; Ventura, Hamilton, & Matthews, 2014). In addition to potentially contracting sexually transmitted diseases, children born to teen mothers are 2.4 times more likely to become teen mothers themselves (Martinez, Copen, & Abma, 2011). In order to address these issues, the Austin Public Health Department created Peer-to-Peer, a peer-led sexual health program serving approximately 750 teens annually. This paper presents their program and estimates its cost-benefit.

Background

Across the country in the past decade, teen pregnancy rates declined greatly – from a national average of 75 per 1,000 in 2009 to 24.2 in 2014 (Kost, Maddow-Zimet, & Arpaia, 2017; Ventura et al., 2014). This is cause for celebration and on the surface teen pregnancy rates in Travis County do not appear to be problematic. In 2014, the rate of teen pregnancy in Travis County was 26.9 per 1,000 females aged 13 to 19 compared to 37 per 1,000 in Texas as a whole (TXDSHS, 2017). However, disparities in teen birthrates remain as non-Hispanic Black and Hispanic female teens are two to 2.2 times more likely than their non-Hispanic White counterparts to give birth (Martin, Hamilton, Osterman, Driscoll, & Mathews, 2017). In Travis County, while teen pregnancy rates have declined since 2005 for all race and ethnic groups, Hispanic and Black teens remain approximately four times more likely to become pregnant than non-Hispanic White teens (41.7 and 38.4 vs. 9.6 per 1,000) (Ready by 21 Austin, 2017). For 15 to 19-year olds, the disparities are even more pronounced. In 2014, the pregnancy rate for Hispanic females ages 15 to 19 was 50.6 compared to 7.8 for White females; Blacks experienced 36.7 pregnancies per 1,000 females ages 15 to 19 years old (Ready by 21 Austin, 2017).

In addition, teen sexual activity results in high rates of sexually transmitted infection (STI). While 15 to 24-year olds make up 25% of the sexually active population, they account for about half of all new STI cases (incidence) in the U.S. (Weinstock, Berman, & Cates, 2004). By the time they are 24-year-olds, one-third of sexually active young people have contracted an STI (American Social Health Association, 1998). Specifically for U.S. teens aged 15 to 19, the rate of chlamydia is 2,028.2 per 100,000; for gonorrhea, the rate is 381.8. These rates are higher than all other age groups except for those aged 20 to 24 (Centers for Disease Control and Prevention, 2017).

High incidence rates of STIs and pregnancy among teens are due to adolescents having unprotected sex. The solution is either abstinence or use of condoms and other forms of birth control. Unfortunately, while most sexually active teens report using condoms “sometimes”, research shows that teens are more likely than adults to use them inconsistently or inappropriately (Kirby & Laris, 2009).

To address these issues, many schools and community organizations provide sexual health education aimed at reducing rates of unprotected sex among teenagers. High-quality reviews and meta-analyses of sexual health education interventions aimed at adolescents consistently find that comprehensive risk reduction programs, such as programs that aim to “prevent, stop or decrease sexual activity, but that also promote condom use and other safer-sex strategies for sexually active participants” (Underhill, Montgomery, & Operario, 2008), result in improvements in knowledge, attitudes, and skills. Findings related to behavior change are inconsistent with some reviews finding null effects, while others find improvements for behavioral outcomes (Chin et al., 2012; Denford, Abraham, Campbell, & Busse, 2017; Picot et al., 2012). The Austin Public Health Department’s Peer-to-Peer (P2P) program is one such comprehensive risk reduction program. Aims of the P2P program include improving knowledge, skills, and attitudes related to sexual activity, contraceptive use and the risks of sexual activity; reducing rates of reported pregnancy, birth and STI/HIV/AIDS rates among teenagers in Travis County; and empowering teens to improve their own health and the health of their communities. Because of the disparities in teen pregnancy rates between Hispanics and non-Hispanic White teens, the P2P program aims to be culturally relevant and to address concerns of Hispanic adolescents in particular.

P2P provides sexual health education to approximately 750 teens annually using 20 to 25 peer health educators (PHEs) and partnerships with community organizations. The program is made possible with Delivery System Reform Incentive Payment Program (DSRIP) funding provided by Texas Health & Human Services Commission (HHSC) through the Medicaid 1115 waiver program. In July 2017, APH contracted with the University of Texas Health Science Center School of Public Health (UTH SPH) to carry out a cost-benefit analysis of the P2P program to fulfill DSRIP economic evaluation requirements.

This paper details methods used to carry out the evaluation, the costs associated with the P2P program, its short-term health outcomes and long-term projected health outcomes, the financial value of said outcomes, the resultant costs versus benefits, and the results of a sensitivity analysis aimed at estimating the accuracy of projected results.

The Intervention

The P2P program uses an evidence-based curriculum called Making Proud Choices to provide sexual health education to approximately 750 to 800 teens per year, the majority of whom are low income and Hispanic. The program utilizes PHEs, who teach classes in tandem with an adult health educator. PHEs are representative of the target population (are primarily Hispanic from low-income families), some of whom are already teen parents themselves. Prospective PHEs go through a formal recruitment process including being

nominated, submitting an application, and going through an interview process. Once selected, they receive more than 30 hours of annual training. The P2P standard curriculum consists of 11 one-hour classes that include lectures, interactive exercises, and role-playing. In 2016-2017, the program was offered in five high schools at Austin Independent School District including: East Side Memorial, Lanier, Reagan, Austin, and Travis.

Methods

Baseline cost-benefit analyses were carried out in four steps, described in greater detail in the following sections: (1) estimation of program costs, (2) translation of estimated delays in initiation of sexual intercourse and increased condom usage into cases of STIs, HIV, and pregnancies averted, (3) assignment of medical and social costs averted to cases averted, and (4) calculation of the benefit to cost ratio for the program. We also carried out individual sensitivity analyses and Monte Carlo simulations to test the effects of changing the value of key variables on the cost-benefit results to arrive at a probabilistic range of the intervention's benefit-cost ratio.

Program costs were calculated under both the payer and societal perspectives. The former includes the direct costs to APH and its partner organization (Planned Parenthood of Greater Texas/PPGT) to deliver the programs and was provided by APH P2P program staff. The latter also includes the value of student time to participate in the program, which is standard in economic evaluation and is known as opportunity cost.

Program outcomes were evaluated using a sample of 2016-2017 school year participants ($n=172$, 21.6%) by researchers from Texas State University School of Social Work and the University of Texas at Austin's Steve Hicks School of Social Work using an uncontrolled pre/post study design. The current study calculated program effects using intent-to-treat analysis. Specifically, we removed students ($n=8$) who only completed post-test assessments and we carried forward pre-test responses for students (approximately 30%) who only completed pre-intervention assessments. Additionally, the initial instructions had a broad definition of sex, which could have included kissing, and so on. In the post-test, we could not be sure that students did not refer to sex in the narrower, traditionally understood definition. Therefore, condom use prevalence may have differed pre and post, not because of actual usage, but because of different prevalence of sexual activity due to definitions. To address these issues, we also ran models using data from two extensive, high-quality systematic reviews and meta-analyses as estimates of impact for the entire population of P2P program participants (Chin et al., 2012; Picot et al., 2012). Where data was not collected as part of the P2P evaluation, we incorporated data points from the Texas Department of State Health Services Vital Statistics program and the results from analyses of the 2006-2010 National Survey of Family Growth (Martinez et al., 2011; TXDSHS, 2017).

Assessing Intervention Effects on STD Transmission and Pregnancy Rates. We then used an adapted Bernoulli model of HIV transmission to translate program outcomes into cases of HIV and other STIs averted (Pinkerton & Abramson, 1993; Wang et al., 2000). In addition to HIV, the following STIs were included in the model: chlamydia, gonorrhea, genital

herpes, and human papillomavirus (HPV). Syphilis was removed from the original model for the sake of parsimony due to lack of program effects on incidence. This model is frequently used in economic evaluations of adolescent sexual health education programs and is cumulative probability equation $P = 1 - ((1 - \pi) + \pi(1 - \alpha)^n)$ that estimates probability of infection based on four components – number of sexual partners, number of sexual contacts with each partner, STI/HIV prevalence, and probability of STI/HIV transmission. π is the prevalence of STI/HIV infection in the population, α is the probability of transmission, and n is the total number of sexual acts with a single partner. We calculated intervention effects on both primary and secondary transmission. Primary transmission occurs when a P2P participant acquires an STI. Secondary transmission occurs when an infected P2P participant passes the STI on to another partner. Thus, the final equations used are as follows:

$$\begin{aligned} & \text{Primary Transmission} \\ P_c &= 1 - ((1 - \pi) + \pi(1 - \alpha(1 - ef_c))^n)^m \\ P_i &= 1 - ((1 - \pi) + \pi(1 - \alpha(1 - ef_i))^n)^m \\ X_p &= N_p((1 - P_i) - (1 - P_c)) \end{aligned}$$

$$\begin{aligned} & \text{Secondary Transmission} \\ P_c' &= 1 - (1 - \alpha(1 - ef_c))^n \\ P_i' &= 1 - (1 - \alpha(1 - ef_i))^n \\ X_s &= N_s((1 - P_i') - (1 - P_c')) \end{aligned}$$

Where e is the efficacy of condoms in preventing transmission of the STI, f is the frequency with which condoms are used (c in the control and i in the intervention); m is the number of sexual partners a participant has. X_p and X_s are the number of cases of primary and secondary transmission prevented. Secondary effects on pelvic inflammatory disease (PID) through reductions in chlamydia and gonorrhea cases were also included as an outcome. All outcomes were estimated using a one-year timeframe, thus effectively assuming that intervention effects “wear off” after one year, which is in line with the literature. Model parameters and their sources can be found in Appendix A.

Pregnancies averted were estimated based on changes in contraceptive use using equation $Y = N((g_c K + (1 - g_c)L) - (g_i K + (1 - g_i)L))$, where Y is the total number of pregnancies averted, N is the number of female P2P students plus the number of female sexual partners of male P2P participants, g is the portion of students using contraception in the control (c) and intervention (i) groups, and L is the probability of becoming pregnant within one year without contraception.

Estimates of STI incidence and prevalence for P2P participants and their peers were derived based on data from the Centers for Disease Control and Prevention, Texas Department of State Health Services, Austin/Travis County Health and Human Services Department and several national studies (Centers for Disease Control and Prevention, 2017; Owusu-Edusei, Chesson, & Gift 2011; Texas Department of State Health Services 2016;

Austin/Travis County Health and Human Services Department 2011; Centers for Disease Control and Prevention 2013; Belshe, Leone, Bernstein 2012; Bernstein, Bellamy, & Hook 2012; Roberts, Pfister, Spear 2003; Texas Department of State Health Services 2017; Markowitz, Liu, Hariri, Steinau, Dunne, Unger 2016). In general, the method used was to estimate a state rate of reported diagnoses for youth ages 14 to 19 years old from TX DSHS data for the 10 to 14 and 15 to 19 year old age groups, and then to adjust the rate for the race/ethnic make-up of the P2P cohort based on state-level differences between these groups. Finally, the reported rate was adjusted to account for national estimates of under-diagnosis of the STI. Where possible, range of estimated rates was calculated. As an example, Table 1 walks through the data and calculations used to derive the chlamydia case rate for the P2P and peer cohort.

Table 1: Example: P2P Chlamydia Rate Estimation (High)

Texas 2016, Diagnosis Rates		
10-14 year old	45.8	
15-19 year old	1,905.7	
14-19 year old (est)		1,750.7
Adjustment for race/ethnic composition of target population		2,365.2
Portion of cases that are diagnosed	20%	
Total Case Rate		
Per 100,000		11,825.74
Percent		11.8%

The *financial value of intervention effects* is the value of medical costs saved through averting STIs, PID, and pregnancies in teenage populations. Medical costs for treating STIs, HIV, and PID were multiplied by the number of cases of each condition averted. The number of pregnancies averted was segmented into number of abortions, miscarriages, preterm and full-term deliveries using estimates from the literature, and the number of cases of each multiplied by the relevant medical costs. These values and their source information are included in Appendix A.

Because our model uses a one-year time horizon, we did not incorporate any discount rates. In addition, because the relevant social benefits would be accrued over a longer time horizon, we did not include these in the base model.

Sensitivity Analyses. Using Monte Carlo methods ($k = 1,000$ iterations), we varied the estimates of current parameters to determine point estimates, lower and upper confidence intervals for individual outcomes of interest. We then estimated probable B/C ratio ranges based on these results. We used the model based on the Chin et al. estimates of program effects, since this was the scenario that most closely approached a B/C ratio of 1.0. The following parameters were included in sensitivity analyses: STD incidence, HIV prevalence,

probability of transmission, probability of condom use per act, number of partners per student in the past 12 months, contraceptive failure rates, and percentage of students using contraceptives. We assumed the triangular distribution for the parameters that varied, and we examined the number of cases of STIs and their sequela averted. We also examined averted pregnancies.

Results

Program Costs

Program costs are summarized in Table 2. The largest expense is staffing costs with 1.5 full-time equivalents (FTE) in program coordination and 1.4 FTE adult health educators required to run the program. Additionally, P2P recruited, trained and managed 22 teen peer health educators who were compensated with gift cards at a rate of \$12.50 per hour for time spent in training (32 hours) and teaching (48 hours). The total for peer health educators also includes a \$6.00 fee per gift card assessed by the vendor. Program materials include those used as part of the training, as well as those distributed at graduation and promotional materials at events and community trainings. Total program cost was \$220,584, which was \$277 per program participant (n=797).

Table 2. Program Cost Summary

Staffing	
Program Coordinators	\$115,921
Adult Health Educators	71,683
Peer Health Educators	25,040
Program Materials	3,700
Office Supplies	2,000
Mileage	2,140
Parking	100
Total Cost	\$220,584
Cost Per Participant	\$277

Program Evaluation Results

As noted, an evaluation of the program was carried out during the 2016-2017 school year using a subset of participants: 156 pre-intervention respondents and 121 post-intervention respondents. The students who responded to the pre-intervention assessment (n=156) were included in the ITT analyses. The majority (74.8%) was female, and 83.3% identified as Latino or Latina. Almost 40% reported ever having sex (38.7%), and 27.3% reported being sexually active in the past three months at pre-testing.

The original program evaluation, which did not include ITT analyses, included assessment of program effects on sexual health knowledge and attitudes. Statistically significant program effects were limited to increased knowledge about sexual health topics with mean knowledge increasing from a mean of 9.7 (SD 1.6) to 10.3 (SD 1.3) out of a

maximum possible score of 12.0 in the 103 students who participated in both pre and post-test assessments ($t = -4.79$, $p < .001$). Participants scored high at pre-test in terms of sexual health attitudes, with 78% reporting healthy attitudes on at least 11 of the 14 items; this increased to 86% at post-test. Only one attitudinal item (*If used correctly every time,*

Table 3. Impact on Number of HIV, STI and Pregnancy Cases

Model	Number of Cases Averted (Added)						
	HIV	Chlamydia	Gonorrhea	G.Herpes	HPV	PID	Pregnancies
P2P	(0.00)	(0.63)	(0.02)	(0.13)	-	(0.15)	(3.21)
Picot	0.00	0.81	0.04	0.17	-	0.19	1.75
Chin	0.00	4.12	0.89	1.10	3.10	1.01	10.75

condoms can prevent STDs and HIV) saw a statistically significant change between pre and post-test. There were no statistically significant effects on sexual health intentions or reported behaviors between pre and post-test.

Of particular interest for the current evaluation, the portion of sexually active participants who reported using a condom most or all of the time fell from 47.5% at pre-test to 45.9% at post-test using ITT analyses. Additionally, those who reported using any contraception most or every time fell from 60% to 56.5%.

Impact on Disease and Pregnancy Outcomes

As previously described, we projected program impact on cases of HIV, two STIs, and pregnancies using three sets of parameters: (1) The P2P program evaluation results, (2) Meta-analysis results from a systematic review carried out by Picot and colleagues as part of a health technology assessment for the United Kingdom's National Institute of Health Research (Picot et al., 2012; Shepherd et al., 2010), and (3) Meta-analysis results from a systematic review carried out by Chin and colleagues for the U.S. Centers for Disease Control and Prevention Guide to Community Preventive Services (Picot et al., 2012; Shepherd et al., 2010).

As Table 3 shows, using the P2P evaluation data, the program appears to have a negative effect on HIV, chlamydia, gonorrhea, and teen pregnancy, with an additional 3.21 pregnancies, 0.02 cases of gonorrhea, 0.63 cases of chlamydia, and approximately 0.15 cases of pelvic inflammatory disease (PID) occurring as a result of the program. Using the results from the Picot study's estimated effects, the projections improve to 1.75 pregnancies, 0.04 gonorrhea cases, 0.81 cases of chlamydia, 0.17 cases of genital herpes and 0.19 cases of PID averted. Finally, using the effects estimated by Chin et al. increase to 10.75 pregnancies, 0.89 gonorrhea cases, 4.12 cases of chlamydia, 1.1 cases of genital herpes, 3.1 cases of HPV, and 1.01 case of PID averted.

The Picot and Chin findings differ largely because Picot and colleagues restricted their search to randomized controlled trials ($n=12$), while Chin et al. included studies using a broader range of research design ($n=62$). The latter group's usage of a larger number of studies allowed the deduction of a greater number of statistically significant results across

sexual health behaviors. Thus, while Picot and colleagues found a non-significant trend on effects on condom usage (OR 1.07, CI: 0.88, 1.30) based on six studies (total sample n=8,138), Chin and colleagues' results, based on 33 studies, were statistically significant (OR 1.45 (CI: 1.2, 1.74). The latter study also identified positive effects on unprotected sexual activity and number of sexual partners, which were incorporated into the current analysis.

Benefits vs. Costs

Table 4 translates cases averted described in the prior section to short-term (one year) financial benefits and compares total benefits to the total program costs. In all three models, program costs are greater than the costs saved by not having to treat cases of HIV and STIs that would otherwise have occurred, or to pay for the expenses of various pregnancy outcomes. In cost-benefit analysis, one hopes to see a benefit-to-cost (B/C) ratio greater than 1.0, the higher the better. Using the current parameters, the model using data from the Chin meta-analysis performs best, but still has a benefit-cost ratio of less than 1.0 (B/C ratio = 0.98).

Table 4. Financial Benefits and Costs of the P2P Program: 3 Models

Model	Costs Saved (Added)							Total Benefits	Total Costs	B - C
	HIV	Chlamydia	Gonorrhea	G. Herpes	HPV	PID	Pregnancies			
P2P	(176)	(148)	(6)	(92)	-	(1,587)	(60,694)	\$(62,703)	\$220,584	\$(283,287)
Picot	229	192	9	119	-	2,065	33,072	\$35,688	\$220,584	\$(184,896)
Chin	264	976	210	762	528	10,885	203,158	\$216,782	\$220,584	\$(3,802)

Sensitivity Analyses

Table 5 shows the results of our Monte Carlo sensitivity analysis for the STDs and averted pregnancies using parameters from Chin et al. For each STD and for averted pregnancies, the parameters which are likely to vary, either due to the variation in effectiveness of an element of P2P, such as whether condoms are used or number of partners, or due to randomness in nature such as transmission rates, are listed. These ranges were modeled as triangular distributions, and as mentioned earlier, were run 1,000 times for each STD considered and for pregnancies. Triangular distributions are commonly used, and have the advantage of

As expected, the Monte Carlo results were similar to those based on Chin et al. Benefit-cost ratios ranged from 0.56 to 1.16. This indicates that P2P, were it implemented many times, would sometimes be cost-beneficial.

Table 5. Sensitivity Analysis Results: Cases Averted (Point Estimates and Confidence Intervals)

	<i>HIV</i>	<i>Chlamydia</i>	<i>Gonorrhea</i>	<i>GH</i>	<i>HPV</i>	<i>PID</i>	<i>Pregnancies</i>	<i>Benefits</i>	<i>B/C</i>
Point Est.	0.001	4.75	0.98	1.66	3.13	1.16	9.22	\$190,208.04	0.86
LCL	0.001	2.65	0.43	0.49	1.11	0.64	6.14	\$124,031.63	0.56
UCL	0.003	6.84	1.46	2.83	5.16	1.68	12.30	\$256,330.52	1.16

LCL – Lower Confidence Limit, UCL – Upper Confidence Limit, GH – Genital Herpes, HPV – Human Papillomavirus, PID – Pelvic Inflammatory Disease
B/C – Benefit-to-Cost Ratio.

Discussion

The present study assesses the extent to which the city of Austin’s PHE-led adolescent sexual health education intervention is cost-beneficial. Using the current parameters, the B/C results for the APH P2P program are not favorable, ranging from -0.28 to 0.98 depending on the set of program effects used. Sensitivity analyses, based on the Chin et al. parameters, revealed B/C ratios ranging from 0.56 to 1.16.

It is important to remember that the current analysis only includes short-term (one year) outcomes. It does not include the present value of lifetime costs of HIV treatment, nor the social costs related to teen pregnancy, such as the effects on teen moms’ education and income-earning potential, and on the children of teenage mothers. While including these additional parameters to costs averted would serve to improve the results, the present value of the effects is likely not to have much impact on the results.

The results of this economic evaluation are in-line with that of an economic evaluation performed by Shepherd and colleagues based on the meta-analysis results of their systematic review of behavioral interventions aimed at preventing STIs in young people ages 13 to 19. Based on data provided by relevant RCTs, the authors arrived at costs of teacher and peer-led interventions that were 4.30 GBP and 15 GBP per pupil. Using a simulation model of 1,000 boys and 1,000 girls who were 15 years old, the model estimated the intervention would avert three cases of STI and save 0.5 of a quality-adjusted life year (QALY). The cost per QALY gained was 20,223 GBP and 80,782 GBP for teacher and peer-led interventions, respectively. The teacher-led intervention was found to have between 46% and 54% probability of being cost-effective with results most sensitive to the effects of the interventions on condom use, the STI transmission probability, and the number of sexual partners in the base model. Due to the higher cost of providing annual training to a new cohort of PHEs, peer-led interventions would have a lower probability of being cost-effective (Shepherd, Kavanagh, Picot 2010).

This study has limitations. In addition to the small sample and high drop-off between pre and post-test data collection in the program evaluation data used for this study, the measures had some issues that impacted the reliability and validity of the evaluation findings. This evaluation pre-dates the current members of the P2P team who have already put plans in place to assess program effects with greater integrity. For one, they are adding a 20-item

Sexual Health Practices Self-Efficacy Scale (SHPSES) to the program evaluation protocol. The SHPSES assesses six factors: sexual relationships, sexual health care, sexual assault, safer sex, sexual equality/diversity, and abstinence. Items associated with each scale have demonstrated internal consistency with alphas ranging from 0.71 to 0.82 (Mirzaei, Ahmadi, Saadat, & Ramezani 2016). The program team is also in the process of negotiating an inter-local agreement with the Austin Independent School District to gain access to school-specific pregnancy and birth rates. Finally, the P2P team is changing to the Positive Prevention Plus (P3) curriculum starting in Fall 2018. P3 has been shown to be an effective teen pregnancy prevention curriculum in a similar population and comes with a standardized pre/post-test instrument. These new pieces of data, as well as other changes to the program evaluation protocol, give a more accurate representation of the program's impact, and should inform future economic evaluation work. For the current study, we used the results of two high-quality systematic reviews and meta-analyses to create alternate models of program effects on health outcomes and costs.

If the study had been an RCT, we may have found that in the RCT control, condom use fell more.

Should the new curriculum and updated evaluation protocol demonstrate efficacy in changing sexual health behavior in the targeted students, these analyses demonstrate that the net financial benefit of the program is influenced most meaningfully by the number of pregnancies prevented, which itself is dependent upon one or more behavioral changes being demonstrated (i.e. increased condom or other contraceptive usage and/or decreased frequency of sexual activity). It is likely not feasible to base an alternate payment method on assessed number of pregnancies prevented due to the lag time inherent in this outcome and the availability of related data. The current analyses demonstrate, however, that if the program is able to demonstrate a 10-15% increase in condom usage, a 20-25% increase in oral contraceptive use or a 25% reduction in unprotected sexual activity without a notable increase in intervention costs, it is likely to be a good investment from a short-term, solely financial perspective. Thus, reimbursements could be based on the number of participants completing most or all sessions. Funding under this model will likely come from public sources for which prevention of teen pregnancy and/or STI prevention are goals.

References

Althaus CL, Heijne JC, Low N (2012). Towards more robust estimates of the transmissibility of *Chlamydia trachomatis*. *Sexually transmitted diseases*; 39(5):402-404.

American Social Health Association. (1998). *Sexually transmitted diseases in America: how many cases and at what cost?*: Kaiser Family Foundation.

Austin/Travis County Health and Human Services Department (2013). *Sexually Transmitted Infections in Travis County in 2011*.

Basch, C. E. (2011). Teen pregnancy and the achievement gap among urban minority youth. *Journal of School Health, 81*(10), 614-618.

Belshe RB, Leone PA, Bernstein DI, et al (2012). Efficacy results of a trial of a herpes simplex vaccine. *New England Journal of Medicine, 366*(1):34-43.

Bernstein DI, Bellamy AR, Hook III EW, et al (2012). Epidemiology, clinical presentation, and antibody response to primary infection with herpes simplex virus type 1 and type 2 in young women. *Clinical infectious diseases, 56*(3):344-351.

Burchell AN, Richardson H, Mahmud SM, Trottier H, Tellier PP, Hanley J, et al. (2006). Modeling the Sexual Transmissibility of Human Papillomavirus Infection using Stochastic Computer Simulation and Empirical Data from a Cohort Study of Young Women in Montreal, Canada. *American Journal of Epidemiology, 163*(6):534-543.

Centers for Disease Control and Prevention. (2017). Sexually transmitted disease surveillance 2016. *Atlanta: US Department of Health and Human Services, 63-67*.

Centers for Disease Control and Prevention (2013a). Ready-to-Use STD Curriculum for Clinical Educators. In: CDC Division of STD Prevention Program and Training Branch.

Centers for Disease Control and Prevention (2013b). CDC Fact Sheet: Incidence, Prevalence, and Cost of Sexually Transmitted Infections in the United States.

Chin, H. B., Sipe, T. A., Elder, R., Mercer, S. L., Chattopadhyay, S. K., Jacob, V., Griffith, M. (2012). The effectiveness of group-based comprehensive risk-reduction and abstinence education interventions to prevent or reduce the risk of adolescent pregnancy, human immunodeficiency virus, and sexually transmitted infections: two systematic reviews for the Guide to Community Preventive Services. *American journal of preventive medicine, 42*(3), 272-294.

Cooper K, Shepherd J, Picot J, Jones J, Kavanagh J, Harden A, et al (2012). An economic model of school-based behavioral interventions to prevent sexually transmitted infections. *International Journal of Technology Assessment in Health Care, 28*(4):407-414.

Denford, S., Abraham, C., Campbell, R., & Busse, H. (2017). A comprehensive review of reviews of school-based interventions to improve sexual-health. *Health psychology review*, 11(1), 33-52.

Gebo KA, Fleishman JA, Conviser R, Hellinger J, Hellinger FJ, Josephs JS, Keiser P, Gaist P, Moore RD; HIV Research Network (2010). Contemporary costs of HIV healthcare in the HAART era. *AIDS*; 24(17): 2705-2715.

Hoffman, S. D. (2006). *By the numbers: The public costs of adolescent childbearing. Washington, DC: The National Campaign to Prevent Teen Pregnancy.*

Jutte, D. P., Roos, N. P., Brownell, M. D., Briggs, G., MacWilliam, L., & Roos, L. L. (2010). The ripples of adolescent motherhood: social, educational, and medical outcomes for children of teen and prior teen mothers. *Academic Pediatrics*, 10(5), 293-301.

Kirby, D., & Laris, B. (2009). Effective curriculum-based sex and STD/HIV education programs for adolescents. *Child Development Perspectives*, 3(1), 21-29.

Kost, K., Maddow-Zimet, I., & Arpaia, A. (2017). *Pregnancies, Births and Abortions Among Adolescents and Young Women In the United States, 2013: National and State Trends by Age, Race and Ethnicity*. Retrieved from

Martin, J. A., Hamilton, B. E., Osterman, M., Driscoll, A. K., & Mathews, T. (2017). Births: Final Data for 2015. *National vital statistics reports: from the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System*, 66(1), 1.

Martinez, G., Copen, C. E., & Abma, J. C. (2011). Teenagers in the United States: sexual activity, contraceptive use, and childbearing, 2006-2010 national survey of family growth. *Vital and Health Statistics. Series 23, Data from the National Survey of Family Growth*(31), 1-35.

Markowitz LE, Liu G, Hariri S, Steinau M, Dunne EF, Unger ER (2016). Prevalence of HPV after introduction of the vaccination program in the United States. *Pediatrics*, 37(2):e20151968.

Mirzaei M, Ahmadi K, Saadat S-H, Ramezani MA (2016). Instruments of high risk sexual behavior assessment: A systematic review. *Materia Socio-Medica*, 28(1):46.

Owusu-Edusei Jr K, Chesson HW, Gift TL, et al (2013). The estimated direct medical cost of selected sexually transmitted infections in the United States, 2008. *Sexually transmitted diseases*, 40(3):197-201.

Picot, J., Shepherd, J., Kavanagh, J., Cooper, K., Harden, A., Barnett-Page, E., . . . Frampton, G. K. (2012). Behavioural interventions for the prevention of sexually transmitted infections in young people aged 13–19 years: a systematic review. *Health Education Research*, 27(3), 495-512.

Pinkerton, S. D., & Abramson, P. R. (1993). Evaluating the risks: A Bernoulli process model of HIV infection and risk reduction. *Evaluation Review*, 17(5), 504-528.

Ready by 21 Austin. (2017). Pregnancies to Residents Ages 13 to 19 per 1,000 females ages 13 to 19. Retrieved from <http://readyby21dashboardatx.org/socially-and-emotionally-healthy-and-safe/pregnancy-and-births-among-teens.php>

Roberts CM, Pfister JR, Spear SJ (2003). Increasing proportion of herpes simplex virus type 1 as a cause of genital herpes infection in college students. *Sexually transmitted diseases*, 30(10):797-800.

Schiffer JT, Mayer BT, Fong Y, Swan DA, Wald A (2014). Herpes simplex virus-2 transmission probability estimates based on quantity of viral shedding. *Journal of The Royal Society Interface*; 11(95):20140160.

Shepherd, J., Kavanagh, J., Picot, J., Cooper, K., Harden, A., Barnett-Page, E., . . . Frampton, G. (2010). The effectiveness and cost-effectiveness of behavioural interventions for the prevention of sexually transmitted infections in young people aged 13-19: a systematic review and economic evaluation. *Health Technology Assessment*, 14(7), 1-230.

Smith MU, Dane FC, Archer ME, Devereaux RS, Katner HP (2000). Students together against negative decisions (STAND): Evaluation of a school-based sexual risk reduction intervention in the rural south. *AIDS Education and Prevention*; 12(1):49.

Texas Department of State Health Services (TX DSHS) (2017). Table 14B Reported Pregnancies, Births, Fetal Deaths, and Induced Terminations of Pregnancy by State, Public Health Regions, and County of Residence for Women Age 13-17 Texas, 2014 - Updated. Accessed at <http://www.dshs.texas.gov/chs/vstat/vs14/t14b.aspx>.

TXDSHS. (2017, October 6, 2017). Table 14B Reported Pregnancies, Births, Fetal Deaths, and Induced Terminations of Pregnancy by State, Public Health Regions, and County of

Residence for Women Age 13-17 Texas, 2014 - Updated. Retrieved from <http://www.dshs.texas.gov/chs/vstat/vs14/t14b.aspx>

Texas Department of State Health Services (2016). *Texas STD Surveillance Report, updated 3/26/2018*.

Texas Department of State Health Services (2017). *Texas HIV Surveillance Report, 2016*.

Underhill, K., Montgomery, P., & Operario, D. (2008). Abstinence-plus programs for HIV infection prevention in high-income countries. *The Cochrane Library*.

Ventura, S. J., Hamilton, B. E., & Matthews, T. (2014). National and state patterns of teen births in the United States, 1940-2013. *National vital statistics reports: From the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System*, 63(4), 1-34.

Wald A, Krantz E, Selke S, Lairson E, Morrow RA, Zeh J (2006). Knowledge of partners' genital herpes protects against herpes simplex virus type 2 acquisition. *The Journal of Infectious Diseases*; 194(1):42-52.

Wang, L. Y., Davis, M., Robin, L., Collins, J., Coyle, K., & Baumler, E. (2000). Economic evaluation of Safer Choices: a school-based human immunodeficiency virus, other sexually transmitted diseases, and pregnancy prevention program. *Archives of pediatrics & adolescent medicine*, 154(10), 1017-1024.

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(1), 6-10.

Appendix A: Summary of Model Parameters

Parameter	Point Estimate (Range)	Source
Demographics of P2P Participants		
Percent female, participants	75%	P2P evaluation data
Percent female, PHEs	95%	P2P staff report
Portion sexually active	39.1%	P2P evaluation data, post-intervention
Average number of acts w/ one partner, last 12 months	13.0	Calculations using data from Martinez, 2011 and Cooper, 2012
Number of sexual partners, last 12 months	1.57 (1.38-1.74)	Calculations using data from Martinez, 2011
Risk		
HIV prevalence: 13-18 years old	0.02%	TX DSHS, 2015
Probability of HIV transmission, single act	1.6% (0.1-3.0%)	Wang, 2000
Chlamydia incidence: 13-18 years old	11% (10-12%)	TX DSHS, 2015
Probability of chlamydia transmission, single act	4.5% (3.5-5.5%)	Althaus 2012
Gonorrhea incidence: 13-18 years old	1.0% (0.8-1.3%)	TX DSHS, 2015
Probability of gonorrhea transmission, single act	53% (35-70%)	Wang, 2000; CDC, 2013a
Genital herpes prevalence	7.1% (6.1-8.1%)	Calculations using data from Austin / Travis County HHSD (ATC HHSD), 2013; CDC, 2013b; Belshe, 2013; Bernstein, 2013; Roberts, 2003
Probability of genital herpes transmission, single act	1.7% (0.9-4.6%)	Schiffer, 2014; Wald, 2006
HPV prevalence	4.3% (2.3-6.3%)	Calculations using data from ATC HHSD, 2013; Markowitz, 2016.
Probability of HPV transmission, single act	40% (20-75%)	Burchell, 2006

Probability of becoming pregnant in one year without contraceptive use	44%	Wang, 2000
Contraceptive Utilization		
Condom use per act, control/pre-test	47.5%	P2P evaluation data
Any contraception use per act, control/pre-test	60.0%	P2P evaluation data
Condom use per act, intervention/post-test	46 – 53% (50-60%)	P2P evaluation data adjusted for RR in Picot, 2012 & Chin, 2012
Any contraception use per act, intervention/post-test	57 – 70% (65-72%)	P2P evaluation data adjusted for RR in Picot, 2012 & Chin, 2012
Condom use per act, PHEs	61%	Calculated based on Smith, 2000
Contraceptive Efficacy		
HIV transmission	95%	Wang, 2000
Chlamydia transmission	95%	
Gonorrhea transmission	95%	
Contraceptive failure rate, annual	9% (5-13%)	
Probability of Health State Given Adolescent Pregnancy		
Prenatal Care	50.6%	Wang, 2000
Abortion	22.6%	
Miscarriage	22.8%	
Live Birth	54.5%	
Treatment Costs		
Pregnancy: Prenatal Care	\$1,249.60	Wang, 2000 (adjusted to 2016\$)
Pregnancy: Live Birth	17,949.84	
Pregnancy: Miscarriage	689.95	
Pregnancy: Abortion	689.95	
HIV	27,463.00	Gebo, 2010 (adjusted to 2016\$)
Chlamydia	236.87	Wang, 2000 (adjusted to 2016\$)
Gonorrhea	236.87	
HPV	170.36	Owusu-Edusei, 2013 (2016\$)
PID	10,646.92	Wang, 2000 (adjusted to 2016\$)

References