Tailored Intervention for Parents to Promote their Adolescents' Vaccination against HPV

Angela Chia-Chen Chen
Arizina State University
College of Nursing & Health Innovation
Phoenix, United States
angela.ccchen@asu.edu

Michael Todd
Arizina State University
College of Nursing & Health Innovation
Phoenix, United States
mike.todd@asu.edu

Ashish Amresh
Embry Riddle Aeronautical University
College of Art and Sciences
Prescott, United States
amresha@erau.edu

Felipe González Castro
Arizina State University
College of Nursing & Health Innovation
Phoenix, United States
felipe.castro@asu.edu

***Abstract* — We conducted a pilot study to examine the feasibility, acceptability, and preliminary effects of a computer-tailored intervention for parents to promote their adolescents' HPV vaccination. Among 29 parents recruited from clinics (n = 24; 83%) and the community (21%) who completed intervention and pre- and post-intervention assessments, all (100%) intended to vaccinate their adolescents aged 11-17 after the intervention. Furthermore, all parents recruited from the clinics consented to their adolescents receiving the first HPV vaccine, except for one parent who wanted to wait until the child turned 13 years old. Regarding the theoretical mediators, results of Wilcoxon Signed Ranks test suggested significant positive changes in HPV-related knowledge and facilitators over time. Nearly all (97%) of the parents reported that the intervention helped them make a decision about their child's HPV vaccination and was a good way for the parents to learn about HPV and the vaccines. All parents stated that they would recommend this intervention to other parents who had unvaccinated adolescents.**

Keywords - adolescent health; computerized; tailored intervention; health promotion; HPV; vaccine

I. INTRODUCTION

Human papilloma virus (HPV) infection is the most common sexually transmitted infection in the United States and the primary cause of both cervical cancer and genital warts. Currently about 79 million Americans are infected with HPV, and this number is projected to increase by 14 million new cases each year [1]. In addition to the strong relationship between HPV Types 16 and 18 in female cervical cancer, HPV-associated oropharyngeal cancer has significantly increased in men over the past 20 years [2]. HPV vaccines have effectively reduced HPV-related cancers and diseases in the United States [1] and globally [3]. Thus, it is recommended that boys and girls at age 11 or 12 years in the United States should receive HPV vaccines [1, 4]. Since parents must consent for their adolescents under age 18 to receive HPV vaccines [5], it is important to engage them in decision-making about vaccinating their adolescents against HPV. Thus, our tailored intervention targeted parents with unvaccinated adolescents aged 11-17.

Empirical evidence [e.g., 6] suggests that multilevel factors are associated with the parents' decision to vaccinate their adolescents against HPV. These factors include: (a) individual (e.g., lack of knowledge and awareness of HPV and vaccines, perceived minimal risk of infection, worry that the vaccination encourages an adolescent's sexual behavior, concerns about vaccine safety and effectiveness); (b) interpersonal (e.g., provider recommendation); (c) community (e.g., community norms on parental responsibility to protect their adolescent child); and (d) systemic (e.g., HPV-related messages portrayed in social media, state policy, insurance coverage, limited access to healthcare) levels.

While an empirical understanding of the parents' decision-making about HPV vaccination for their adolescent child has increased during the last decade, efficacious interventions designed to promote HPV vaccination in both adolescent boys and girls remain limited. The rapid development of mobile technology has opened new and promising avenues for researchers and healthcare providers to develop innovative, personalized and tailored health education interventions, and to disseminate these to a wider population at relatively low cost, when compared with traditional interventions that are delivered using written materials or trained health educators [7]. Compared to non-tailored information/messages, research findings suggest that tailored information/messages developed to address individual knowledge, beliefs/attitudes, and situations are perceived by consumers as more relevant to their needs and preferences, thus more effective in prompting targeted behaviors [8]. Computer-tailored health education has shown promising results in promoting preventive behaviors, such as cancer screening [9, 10] and HPV vaccination [11, 12].

Through our previous and current collaborations with county vaccine clinics on health promotion projects [11, 13, 14], we have learned that among parents and adolescents who attend the clinics for school-mandated, non-HPV vaccines almost all parents and the majority of adolescents own

DOI: 10.5176/2345-7198_4.1.130

smartphones, and they are very experienced and comfortable with mobile technologies. Given that our intervention considers the competing demands of healthcare providers within clinical settings, and the popularity among parents and adolescents in the use of mobile technologies, our brief computer-tailored intervention provides an acceptable and feasible approach for parents and adolescents to learn about HPV and HPV vaccines, and to motivate vaccination behavior during the same visit.

In summary, our study aimed to (a) examine the feasibility and acceptability of this intervention, and (b) investigate the preliminary efficacy of this intervention on parental intentions to vaccinate their child, and action to obtain the first HPV vaccine.

II. METHODS

A. Design and sample

We used a one-group, pre- and post-test, quasi-experimental design. A parent was recruited if s/he (a) was 18 years old or older and (b) had one or more children aged 11-17 years old who had not been vaccinated for HPV. Only one parent from each family could participate in this study. If an eligible parent had more than one child ages 11-17 years old who had not received the HPV vaccination, we asked the parent to answer questions based on the oldest child. Our intervention and study materials were developed in both English and Spanish to meet the language needs of participants.

B. Procedures

We recruited participants by posting flyers in high-traffic areas in one vaccine clinic that serves a predominantly low-income population, advertising through local community organizations, and via word of mouth, approaches proven to be effective in recruiting our target population [11, 13, 14]. One bilingual (English/Spanish) interventionist was also available at the clinic and community organizations to advertise the study and screen potential participants. She also explained study purpose and procedures to eligible participants and obtained the informed consent from them. Our bilingual interventionist demonstrated how to access the intervention and online pretest and posttest surveys (T1 & T2) via a touchscreen tablet with a wireless data connection. The interventionist also answered participants' questions and noted all additional assistance given to them as part of the evaluation. The entire process, including consenting took approximately 30 minutes. Participants received $10 for their participation.

C. Ethical considerations

We received approval from the Arizona State University Institutional Review Board and Maricopa County Department of Public Health (MCDPH) prior to executing this project, and received informed consent from participants prior to their participation. We collected data via an anonymous survey, whereby each participant's survey was pre-assigned a unique numeric code, All data were stored on a HIPAA-compliant encrypted server with multilevel password protection, enterprise-level firewalls, and antivirus barriers.

We would also like to thank Institute for Social Science Research at Arizona State University for funding this research.

D. Theoretical framework

Our theoretical framework consisted of an integration of the Health Belief Model [15] and the Theory of Planned Behavior [16]. These models introduce specific psychosocial constructs that aid in modelling processes underlying HPV vaccination behaviors. Our intervention delivers messages designed to influence these relevant constructs (knowledge, perceived risks, perceived barriers, perceived facilitators).

E. Intervention

We developed tailored messages using information from multiple sources, including focus groups with key informants (parents) and healthcare providers. The design of the intervention software and the conversation tree for participant interaction have been presented elsewhere [13].

This tailored intervention, delivered via tablet computers, demonstrated feasibility, acceptability and preliminary effects in increasing parental intent and uptake of first HPV vaccines in Mexican American youth [11, 13]. Given the success of our original intervention that was designed for a Mexican American population, and per the request from the collaborating clinics and communities, we modified that original intervention towards a "multi-ethnic" intervention that can meet the needs of all parents with unvaccinated youth.

Our intervention included tailored messages that addressed (a) *knowledge* (HPV risk in adolescent boys and girls, HPV's link with different types of cancers and diseases, how to prevent HPV, HPV vaccine types, dose and safety issues); (b) *perceived risks* (child's acquisition of HPV infection based on child's age, sex, race/ethnicity, sexual behavior and orientation, family history of cancer, signs and symptoms, general health or other reasons); (c) *facilitators* for HPV vaccination (e.g., healthcare provider's suggestions, encouragement from religious leaders/pastors, beliefs that HPV vaccination will save a child's life); (d) *barriers* (e.g., lack of health insurance, worry about the safety of the vaccines); and (e) *cultural norms* (e.g., "Being healthy or sick is my child's destiny. I cannot do anything to change it.").

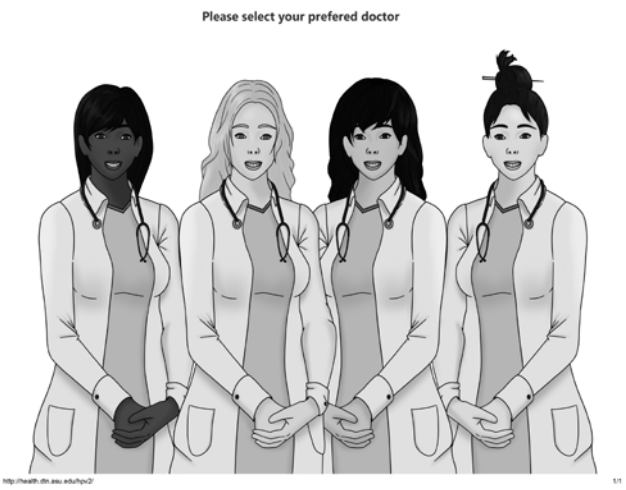

Figure 1. Screen of Provider Avatars

Using the tablet, each participant logged into an account with a pre-assigned code, chose a preferred language (English or Spanish) and an avatar to represent the provider (from 4 different avatars; Fig. 1). The provider avatar spoke, and the participant was presented with response options. After the participant responded, the provider avatar presented her answers via text and speech.

For example, for a mother with (a) a boy who (b) did not have any symptoms and (c) perceived zero risk because "My boy is very healthy and does not have any symptoms. He does not need the HPV vaccines," the provider avatar would provide a feedback message to address this misconception: "Many parents do not feel their children are at risk for human papillomavirus (also called HPV) infection because they do not see any symptoms. However, many adolescents who become infected with HPV do not even know they have it." Participants who did not endorse a particular risk factor would not receive a feedback message and would be led to the next "perceived risk" option. Figure 2 presents sample images of screens seen by participants.

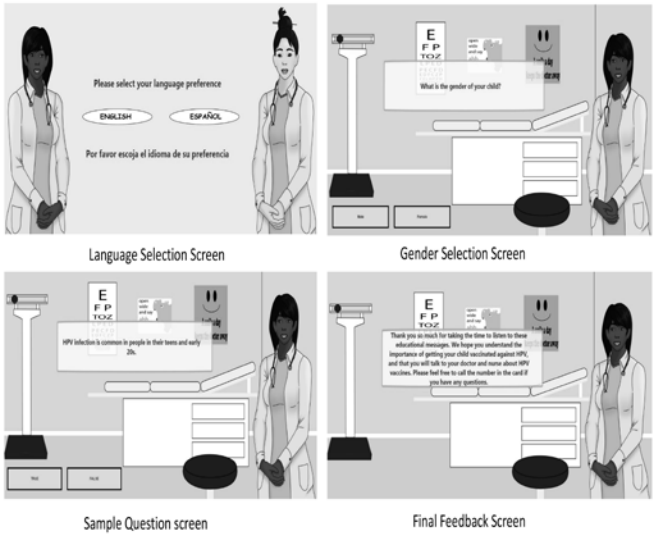

Figure 2. Example Screens of the Intervention

The final screen of the intervention presented a resource guide with current local and state-level information about vaccine clinics and health insurance coverage for participants who indicated a need (e.g., "I am not sure if my child is eligible for free or discount HPV vaccines.").

F. Measures

We adapted and modified survey questions from existing valid and reliable measures, including our prior work [11, 13]. *Feasibility*: assessed by parent-reported ease of use, response rate (percentage of eligible individuals agreeing to participate), and the number of completed assessments.

Acceptability: measured by a 12-item questionnaire developed and tested in our prior research [9, 11, 17, 18] to assess participants' ratings of the appropriateness of the content and wording, graphic design and color, clarity of directions, length of the program, and likelihood of recommending the program to other parents who share the same cultural background. All items used a 4-point Likert-type scale with response options ranging from strongly disagree (1) to strongly agree (4).

Sociodemographic characteristics: Participants answered 13 items regarding their own age, sex, race/ethnicity, education, employment, religion, and number of children; age(s) and sex(es) of their child(ren); whether the child(ren) received reduced or free lunch in school, and whether the participant received HPV education from other sources.

HPV-related knowledge: We included 12 true/false questions that addressed known risk factors for HPV infection, HPV-related diseases, and methods of detection from the literature [19], which were modified based on our prior work [11, 13].

Perceived risk: Eight true/false items (e.g., boys will not get HPV infection) were used to assess parents' perceived risks of their children being infected with HPV.

Facilitators: Nine yes/no items corresponding to a list of factors reported in prior research [20] to promote HPV vaccination behaviors (e.g., healthcare provider's recommendation, positive attitudes toward HPV vaccination) were used to assess parents' perceived facilitators.

Barriers: Twenty-one yes/no items corresponding to a list of perceived barriers reported in previous research [21, 22, 23], such as access to HPV vaccines (cost, insurance coverage, whether the parent has a regular primary care provider, availability of transportation), potential side effects of the vaccines, number of required vaccine shots, were used to assess parents' perceived barriers for vaccination.

Cultural norms: we adapted 3 items from the Cancer Screening Fatalism subscale of the Cultural Cancer Screening Scale (CCSS) [24] that had adequate reliability and predictive validity in women for breast and cervical cancer screening. All items used a 5-point Likert-type scale with response options ranging from strongly disagree (1) to strongly agree (5). The total score ranges from 3 to 15; lower scores indicate more favorable beliefs toward HPV vaccination.

Intention: Parental behavioral intention to vaccinate their children against HPV was assessed with one yes/no item.

Appointment: One yes/no item assessed whether or not the parent had made an appointment for their child's HPV vaccination. Parents who had not made appointments were asked why and probed regarding any factors that may have prevented them from doing so.

Vaccination: One yes/no item was used to assess whether or not the target child received the first dose of HPV vaccines.

F. Data analysis

Pretest and posttest data collected via online surveys were saved and managed using REDCap [25], a secure, web-based data collection platform and then imported into SPSS 24.0 [26] for analysis. Given the study's relatively small sample size, we conducted univariate analyses (e.g., means, frequencies, standard deviations) to describe distributions of

study variables and Wilcoxon matched-pairs test to examine pre-post changes in key variables.

III. RESULTS

A. Sample characteristics

Out of 31 parents enrolled in this study, 29 (93.5%; mean age 38.2 years, *SD* = 7.6) completed the intervention and both the T1 and T2 assessments. Of these 29 participants, 24 (82.8%) were recruited from and completed study activities in the clinic; the remainder (n = 5; 17.2%) completed the activities in a community setting. The median number of children in the household was 4 (range 1-8). Seven (24%) of the parents chose Spanish versions of the intervention and questionnaires. Detailed information about the sample is presented in Table 1.

TABLE 1. Sample Characteristics (N = 29)

Variables	n	%
Participant's biological sex		
Father	6	20.7
Mother	23	79.3
Race/Ethnicity		
Hispanic/Latino	14	48.4
White, non-Hispanic	12	41.4
Asian American	1	3.4
Black	1	3.4
Mixed	1	3.4
Education attainment		
High school/GED and above	19	65.5
Less than high school diploma	10	34.5
Employment status		
Full time (> = 36 hours per week)	10	34.5
Part-time (< 36 hours per week)	5	17.2
Not working	14	48.3
Target child's biological sex		
Boy	18	62.1
Girl	11	37.9
Child received free or reduced lunch		
Yes	19	65.5
No	10	34.5
[$]Source of learning HPV Information before Intervention		
Heard about HPV from family	0	0.0
Heard about HPV from friends & neighbors	0	0.0
Heard about HPV from healthcare providers	10	34.5
Heard about HPV from my or child's school	2	6.9
Heard about HPV from TV, radio or newspaper	2	6.9
Heard about HPV from religious leader	0	0.0
Never heard about HPV before intervention	17	58.6

Note. [$]Source of HPV Information before Intervention. The total percentage was over 100% as parents could choose more than one source of learning HIV information

B. Feasibility and acceptability

In this pilot study, feasibility was measured by response rate (percentage of eligible individuals agreeing to participate), number of participants who completed the intervention, and participant-reported ease of use. Of 35 eligible individuals, 31 (88.6%) agreed to participate in this study. Similar to our prior research [11], eligible parents declined to participate due to their prescheduled commitments (e.g., need to go back to work or pick up other children). Among 31 parents who consented to participate, 2 of them could not complete posttest (T2) due to the same reasons. Although these 2 parents could not complete posttest survey, they still consented their adolescent children to receive the first HPV vaccine at the clinic.

All participants reported that the computerized intervention was very easy (75.9%) or somewhat easy (24.1%) to use and understand; 93.1% said that the intervention was able to hold their attention, the content was relevant to their lives, and it provided the information they would like to know. About 97% of parents reported the tailored intervention helped them make a decision about child's HPV vaccination and was a good way for parents to learn about HPV and the vaccines. All parents stated that they would recommend this intervention to other parents with unvaccinated adolescents. Staff in the clinic also shared that the intervention was feasible to be implemented, given that it did not add any extra burden to their clinical activities.

Regarding the acceptability of the tailored intervention, the mean acceptability score was 3.65 (*SD* = 0.40, range 1-4).

C. Theoretical mediators

HPV-related knowledge: Findings from Wilcoxon Signed Ranks test suggested significant positive change from pre-intervention (Mdn = 5.5) to post-intervention (Mdn = 8.7); Z = - 3.3, $p = 0.001$.

Facilitators: parents perceived significantly more facilitators from pre-intervention (Mdn = 9.3) to post-intervention (Mdn = 10.1, Z = - 2.7, $p = 0.007$.)

Barriers, perceived risks and cultural norms: the difference from pre-intervention to post-intervention was not statistically significant in these 3 variables.

D. Vaccination intention and behavior

We measured the preliminary effect of the intervention in terms of parents' intention to vaccinate their adolescent children and whether or not the adolescent received the first dose of HPV vaccine.

Intention: After the intervention, 100% (n = 29) of parents, recruited from either the clinic or community setting intended to get their children vaccinated.

Behavior: Among the 24 parents who completed the intervention in the clinic, all of them consented to having their adolescents receive the first HPV vaccine, except for one parent who preferred to wait until the child is 13 years old. The 5 parents who completed the intervention in the community setting stated that they would make an appointment with pediatricians' offices for HPV vaccination; however, the actual behavior was unknown.

IV. DISCUSSION

Similar to our prior intervention that targeted only Mexican-heritage parents [11], this intervention that was designed for all parents regardless of racial/ethnic background, demonstrated promising effects. Parent reports indicated that the intervention was feasible and acceptable. The strong

intention (100%) and high vaccination rate immediately post-intervention (95.8%) in the clinical sample provided a preliminary demonstration of the efficacy of this intervention. The qualitative feedback from both parents and adolescents also suggested that adolescents were interested in learning about this important topic to help them make informed decisions about vaccination and their own health. This finding was also seen in our other study that targeted adolescents aged 11-17 [14].

As suggested by other researchers [e.g., 20], parents identified "prevents HPV," "saves my child's life," "knowing where to get the vaccine," "provider's recommendation," and "affordability" as five primary reasons to facilitate HPV vaccination behavior. The top five barriers reported by parents were: "safety concerns about vaccines," "lack of provider's recommendation," "my child is too young to get it," "I have no insurance and cannot afford it," and "I don't know if it works." These barriers are also consistent with other research findings [21, 27, 28, 29, 30]. Our tailored intervention addressed identified facilitators (e.g., provider's recommendation, knowing where to get the vaccine, affordability) and barriers (e.g., lack of provider's recommendation, cannot afford it) when it was implemented in the county walk-in, free clinics. Parents commented on how easy and convenient it was for them to learn HPV-related knowledge, and on how it motivated them to endorse the first HPV shot for their adolescent child while they were at the clinic for school-mandated, non-HPV vaccines. For parents who completed the intervention in the community setting, they appreciated the tailored intervention to help them learn about HPV and vaccines, and increase their intention to vaccinate their adolescent child. We provided a resource kit to the community sample, so under- and un-insured adolescents could locate clinics that provide free vaccines.

Similar to our prior research [11], parents did not identify any cultural norms (e.g., "Being healthy or sick is my child's destiny. I cannot do anything to change it.") related to parents' intention or behavior. Empirical studies [e.g., 31, 32] have shown mixed findings about parents' decision-making for HPV vaccination for their adolescent boys vs. girls. Our findings indicate that parents, regardless of their race/ethnicity, agreed that both adolescent boys and girls should be vaccinated against HPV. As indicated in the previous section, parents reported that they intended to vaccinate their adolescent child because these vaccines prevent HPV and can save his/her child's life. Healthcare provider's recommendation regarding the HPV vaccination also motivated parents, consistent with prior findings [11, 20].

Our tailored intervention provided a feasible and acceptable way for parents to learn about HPV and vaccines and to promote communication between parents and providers about HPV vaccines. Parents also learned about local and state resources for free vaccinations. These features showed promising effects in promoting vaccination intent and behavior. Furthermore, we developed avatars who represented different races/ethnicities based on appearance and skin colors. We found that Spanish-speaking Mexican-heritage parents tended to choose avatars with an appearance similar to their own, consistent with the Social Cognitive Theory principles of vicarious identification and learning [33]. While parents were completing these research activities, many of their adolescent children expressed their interests in learning more about HPV and the vaccines since they did not learn the information from any other sources. Parents also recommended the development of a similar intervention for their adolescents, so that adolescents can participate in the decision-making process to promote their own wellbeing.

There are several limitations to note in this study. The small sample size in this pilot study did not allow for comparative analysis between the clinic and community samples or a more detailed testing of the theoretical model. While we were able to track first dose of HPV vaccines for adolescents who received it in the clinics immediately after their parents completed the intervention, we were not able to estimate the actual rates of initiating or completing HPV vaccination for those who decided to vaccinate later. As a next step, a longitudinal, randomized clinical trial with an adequate sample size and a true control/comparison group is needed to evaluate the effectiveness of this intervention [34, 35] to promote initiation (first dose) and completion (both doses, for adolescents younger than 15) of HPV vaccination.

V. IMPLICATIONS AND CONCLUSION

The national goal for HPV vaccination is 80% (all doses) for boys and girls by age 15 [36]. However, only 43% of adolescents (49.5% for girls, 37.5% for boys) were up to date on the recommended HPV vaccine doses [37]. The Advisory Committee on Immunization Practices (ACIP) has recommended a universal HPV vaccination in boys and girls at 11-12 years to protect against HPV associated cancers. Our tailored intervention implemented in clinic and community settings show promising results in promoting parents' intention and behavior to vaccinate their adolescents against HPV. This intervention proved to be easy to deliver via tablet and highly acceptable to parents with limited health literacy. Parents who received the intervention at the clinics welcomed this brief intervention while waiting for their children to receive other school-mandated vaccines (e.g., meningococcal vaccine) and liked that they could have the first dose of HPV vaccine administered during the same visit rather than having to make another appointment. A successful intervention of this nature has the potential for broad-based scaling up for a significant public health [38] impact on HPV vaccination in other settings.

ACKNOWLEDGMENT

We would like to thank all of our study participants, the director and nurses of the Maricopa County Department of Public Health vaccine clinics for their invaluable contributions. We gratefully acknowledge Arizona State University's Institute for Social Science Research for funding this research. We also thank Nancy Moore and Casey Holland at Arizona State University's College of Nursing & Health Innovation for their editorial assistance.

REFERENCES

[1] Centers for Disease Control and Prevention. (2017). Genital HPV Infection-Fact Sheet. Available: http://www.cdc.gov/std/HPV/STDFact-HPV.htm#a5

[2] A. K. Chaturvedi, E. A. Engels, R. M. Pfeiffer, B. Y. Hernandez, W. Xiao, E. Kim, et al. “Human papillomavirus and rising oropharyngeal cancer incidence in the United States,” Journal of Clinical Oncology, vol. 29, pp. 4294-301, 2011.

.[3] S. M. Garland, S. K. Kjaer, N. Muñoz, S. L. Block, D. R. Brown, M. J. DiNubile, et al., “Impact and effectiveness of the quadrivalent human papillomavirus vaccine: A systematic review of 10 years of real-world experience,” Clinical Infectious Diseases, vol. 63, pp. 519–527, 2016.

[4] E. Petrosky, J. A. Bocchini, Jr., S. Hariri, H. Chesson, C. R. Curtis, M. Saraiya, et al., "Use of 9-valent human papillomavirus (HPV) vaccine: updated HPV vaccination recommendations of the advisory committee on immunization practices," Morbidity and Mortality Weekly Report, vol. 64, pp. 300-4, Mar 27 2015.

[5] National Conference of State Legislatures, “HPV vaccine: State legislation and statures,” 2016. http://www.ncsl.org/research/health/hpv-vaccine-state-legislation-and-statutes.aspx#

[6] A. Lacombe-Duncan, P. A. Newman, and P. Baiden, “Human papillomavirus vaccine acceptability and decision-making among adolescent boys and parents: A meta-ethnography of qualitative studies,” Vaccine, vol. 36, pp. 2545-2558, 2018.

[7] P. Klasnja and W. Pratt, “Managing health with mobile technology,” Interactions, vol. 21, pp.66-69.

[8] S. M. Noar, N. G. Harrington, S. K. Van Stee, and R. S. Aldrich, "Tailored health communication to change lifestyle behaviors," American Journal of Lifestyle Medicine, vol. 5, pp. 112-122, 2011.

[9] U. Menon, L. A. Szalacha, R. Belue, K. Rugen, K. R. Martin, and A. Y. Kinney, "Interactive, culturally sensitive education on colorectal cancer screening," Medical Care – Supplement; Monograph from the NCI, vol. 46, pp. S44-50, Sep 2008.

[10] K. M. Russell, V. L. Champion, P. O. Monahan, S. Millon-Underwood, Q. Zhao, N. Spacey, et al., "Randomized trial of a lay health advisor and computer intervention to increase mammography screening in African American women," Cancer Epidemiology, Biomarkers & Prevention, vol. 19, pp. 201-10, Jan 2010.

[11] Authors, “A pilot study of computerized, tailored intervention to promote HPV vaccination in Mexican-heritage adolescents,” GSTF Journal of Nursing and Health Care (JNHC), vol. 5, no.1, 2017.

[12] H. Y. Lee, J. S. Koopmeiners, J. McHugh, V. H. Raveis, and J. S. Ahluwalia “mHealth Pilot Study: Text Messaging Intervention to Promote HPV Vaccination,” American Journal of Health Behavior, vol. 40, pp. 67-72, 2016.

[13] Authors, “Developing a bilingual, computer-tailored, HPV vaccination promotion intervention for Latino parents.” ACM Digital Health Proceedings, 2015.

[14] Authors, “HPV and vaccination: Knowledge, attitudes, and intention in adolescents,” The 50th Annual Communicating Nursing Research Conference Proceedings, 2018.

[15] I. M. Rosenstock, V. J. Strecher, and M. H. Becker, "Social learning theory and the Health Belief Model," Health Education Quarterly, vol. 15, pp. 175-83, Summer 1988.

[16] I. Ajzen and B. L. Driver, "Prediction of leisure participation from behavioral, normative, and control beliefs: an application of the theory of planned behavior," Leisure Science, vol. 13, pp. 185-204, 1991.

[17] D. J. Wilkie, H. Y. Huang, D. L. Berry, A. Schwartz, Y. C. Lin, N. Y. Ko, et al., "Cancer symptom control: feasibility of a tailored, interactive computerized program for patients," Family & Community Health, vol. 24, pp. 48-62, Oct 2001.

[18] Authors, “A pilot, web-based HIV/STI prevention intervention targeting at-risk Mexican American adolescents: Feasibility, acceptability, and lessons learned,” GSTF Journal of Nursing and Health Care (JNHC), vol. 4, no. 2, 2017.

[19] J. D. Allen, M. K. Othus, R. C. Shelton, Y. Li, N. Norman, L. Tom, et al., "Parental decision making about the HPV vaccine," Cancer Epidemiology, Biomarkers & Prevention, vol. 19, pp. 2187-98, Sep 2010.

[20] L. Rambout, M. Tashkandi, L. Hopkins, and A. C. Tricco, "Self-reported barriers and facilitators to preventive human papillomavirus vaccination among adolescent girls and young women: a systematic review," Preventive Medicine, vol. 58, pp. 22-32, Jan 2014.

[21] I. C. Scarinci, F. A. Garcia, E. Kobetz, E. E. Partridge, H. M. Brandt, M. C. Bell, et al., "Cervical cancer prevention: new tools and old barriers," Cancer, vol. 116, pp. 2531-42, Jun 01 2010.

[22] J. Lechuga, G. R. Swain, and L. S. Weinhardt, "Impact of framing on intentions to vaccinate daughters against HPV: a cross-cultural perspective," Annals of Behavioral Medicine, vol. 42, pp. 221-6, Oct 2011.

[23] R. Podolsky, M. Cremer, J. Atrio, T. Hochman, and A. A. Arslan, "HPV vaccine acceptability by Latino parents: a comparison of U.S. and Salvadoran populations," Journal of Pediatric and Adolescent Gynecology, vol. 22, pp. 205-15, Aug 2009.

[24] H. Betancourt, P. M. Flynn, M. Riggs, and C. Garberoglio, "A cultural research approach to instrument development: the case of breast and cervical cancer screening among Latino and Anglo women," Health Education and Research, vol. 25, pp. 991-1007, Dec 2010.

[25] P. A. Harris, R. Taylor, R. Thielke, J. Payne, N. Gonzalez, and J. G. Conde, "Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support," Journal of Biomedical Informatics, vol. 42, pp. 377-81, Apr 2009.

[26] IBM Corp, "IBM SPSS Statistics for Windows," 22.0 ed. Armonk, NY: IBM Corp, 2013.

[27] R. Robitz, S. L. Gottlieb, C. J. De Rosa, S. L. Guerry, N. Liddon, A. Zaidi, et al., "Parent attitudes about school requirements for human papillomavirus vaccine in high-risk communities of Los Angeles, California," Cancer Epidemiology, Biomarkers & Prevention, vol. 20, pp. 1421-9, Jul 2011.

[28] N. Yeganeh, D. Curtis, and A. Kuo, "Factors influencing HPV vaccination status in a Latino population; and parental attitudes towards vaccine mandates," Vaccine, vol. 28, pp. 4186-91, Jun 07 2010.

[29] S. Chando, J. A. Tiro, T. R. Harris, S. Kobrin, and N. Breen, "Effects of socioeconomic status and health care access on low levels of human papillomavirus vaccination among Spanish-speaking Hispanics in California," American Journal of Public Health, vol. 103, pp. 270-2, Feb 2013.

[30] J. A. Bartlett and J. A. Peterson, "The uptake of Human Papillomavirus (HPV) vaccine among adolescent females in the United States: a review of the literature," The Journal of School Nursing, vol. 27, pp. 434-46, Dec 2011.

[31] M. B. Gilkey, J. L. Moss, A-L. McRee, and N. T. Brewer, “Do correlates of HPV vaccine initiation differ between adolescent boys and girls?” Vaccine, vol. 30, pp. 5928-5934, Sep 2012.

[32] R. B. Perkins, H. Tipton, E. Shu, C. Marquez, M. Belizaire, C. Porter, J. A. Clark, N. Pierre-Joseph, “Attitudes toward HPV vaccination among low-income and minority parents of sons: A Qualitative Analysis,” Clinical Pediatrics, vol. 52, pp. 231-240, 2013.

[33] A. Bandura, Social foundations of thought and action: A Social Cognitive Theory. Englewood Cliffs, NY: Prentice-Hall, 1986.

[34] B. R. Flay, A. Biglan, R. F. Boruch, F. G. Castro, D. Gottfredson, S. Kellam, et al., “Standards of Evidence: Criteria fo Efficacy, Effectiveness and Dissemination,” Prevention Science, vol. 6, pp. 151-175, 2005.

[35] D. C. Gottfredson, T. D. Cook, F. E. Gardner, D. Gorman-Smith, G. W. Howe, I. N. Sandler, et al., “Standards of Evidence for Efficacy, Effectiveness, and Scale-up Research in Prevention Science: Next Generation,” Prevention Science, vol. 16, pp. 893-926, 2015.

[36] National Vaccine Advisory Committee. “Overcoming Barriers to Low HPV Vaccine Uptake in the United States: Recommendations from the National Vaccine Advisory Committee: Approved by the

National Vaccine Advisory Committee on June 9, 2015," Public Health Reports, vol. 131, pp. 17-25, 2016.
[37] T. Y. Walker, L. D. Elam-Evans, J. A. Singleton, D. Yanket, L. E. Markowitz, B. Fredua, et al., "National, Regional, State, and Selected Local Area Vaccination Coverage Among Adolescents Aged 13–17 Years — United States, 2016," Morbility and Mortality Weekly Report, vol. 66, pp. 874–882, 2017.
[38] R. Spoth, L. A. Rohrbach, M. Greenberg, P. Leaf, C. H. Brown, A. Fagan, et al., "Addressing Core Challenges for the Next Generation of Type 2 Translation Research and Systems: The Translation Science to Population Impact (TSci Impact) Framework," Prevention Science, vol. 14, pp. 319-351, 2013.

AUTHORS' PROFILE

1. Angela Chia-Chen Chen PhD, RN, PMHNP is an Associate Professor of Arizona State University College of Nursing & Health Innovation and a Visiting professor at UCSF Center for AIDS Prevention Studies, United States. Her research focuses on developing and testing technology-based interventions aimed at promoting healthy behaviors and preventing diseases among vulnerable youth and young adults.

2. Michael Todd, PhD, is a Research Professor in the College of Nursing & Health Innovation at Arizona State University, Phoenix, AZ, United States. He is a senior research methodologist and statistician.

3. Ashish Amresh, PhD, is an Assistant Professor and the Program Chair for the Simulation Science, Games and Animation degree at Embry-Riddle Aeronautical University, United States. He has built several gaming programs at Arizona State University and worked as Graphics Software Engineer at Ronin Entertainment known for Star Wars: Force Commander and Bruce Lee: Quest of the Dragon games. His research interest is game-based learning and health behavior change via the design and development of serious games.

4. Felipe González Castro, PhD MSW, is a Professor and Southwest Borderlands Scholar at the Arizona State University College of Nursing and Health Innovation. He is a clinical psychologist, has over 35 years of experience in conducting federally-funded health psychology and health promotion research, and the design, adaptation and evaluation of preventive interventions for implementation with diverse health disparity populations.