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Research article

An Intergenerational Human Papillomavirus Vaccine and Cervical Cancer Screening Promotion Model, a Pilot Study

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Abstract

Objective: The purpose of this pilot study is to investigate the feasibility of integrating a Brief-Negotiated Interview (BNI) and mobile phone health education program Wheel of Wellness (Wow) in a primary care setting to improve both Human Papillomavirus (HPV) vaccine completion rates of adolescent females (AFs) and intent of their adult female guardian (AFG) to schedule a timely Cervical Cancer Screening (CCS) appointment. **Design/Methods:** A one-armed proof of concept pilot study was conducted among 50 AFG and their AF daughters, aged 9-17, who had no or incomplete HPV vaccination series. Both AFGs and their AFs completed pre and post-surveys on HPV vaccination and CCS knowledge, behavior, attitudes, and confidence. A BNI was completed among vaccine-hesitant AFGs and follow-up educational and reminder text messages were sent to all participants for nine months. **Results:** A total of 50 dyad participants were enrolled into the study and 45 dyads completed the study. The mean age of the AFG was 39 years and the mean age of the AF was 11 years. Over 50% of the sample were African American (37%) and/or Haitian/West Indies (29%). Only 21% of AFs had heard of HPV and 28% knew that HPV can cause cervical cancer. Over two-thirds (86%) of AF participants had receipt of ≥ 1 -dose HPV vaccines at the end of study and half were HPV up-to-date (HPV UTD) with the vaccination series. Follow-up surveys showed overall acceptability to the model. **Conclusions:** This pilot study expanded the understanding of motivational interviewing and mobile health education to overcome barriers of HPV vaccination and adherence to CCS guidelines.

Keywords: human papillomavirus, human papillomavirus vaccine, cervical cancer, pap test, mobile health education, text messaging, educational text messages, reminder text messages

Introduction

Human papillomavirus (HPV) is the most common of the sexually transmitted infections in the United States today. Although most HPV infections disappear on their own, those which persist can lead to cancer of the cervix, vagina, and vulva in women and cancers of the anus and oropharynx in both men and women [1]. The U.S. Centers for Disease Control and Prevention (CDC) estimated that from 2011-2015, HPV caused approximately 33,700 HPV-associated cancers per year, with cervical cancer (10,800 per year) and oropharyngeal cancer (10,700 cases per year) among the most prevalent [2].

HPV vaccination, a primary prevention method for HPV infection and HPV-related disease, has been proven effective against the majority of cervical, anal and other genital cancers [3].

Routine HPV vaccine initiation, has been recommended by the CDC between ages 11-12 years, but may start as early as 9 years [4-6]. Catch-up vaccination is also recommended for all 13- to 26-year-olds who were not vaccinated [4-6]. Despite the vaccine's proven efficacy, only 68.1% of 13-17 year-olds initiated and 51.1% completed the vaccine series in 2018 [7]. Only 39.9% of adolescents completed the series on time: prior to their 13th birthday [7]. HPV vaccine rates remain well below the rates for other childhood vaccines, such as meningococcal (87 %) and Tdap (89%), which have surpassed the HPV2020 80% vaccination objective [7,8].

To date, no U.S. state has attained the 80% HPV vaccination rate. Secondary prevention in the form of cervical cancer screening (CCS), has been shown to reduce the morbidity and

mortality of cervical cancer by identifying abnormal cells before they become malignant [4]. According to the 2015 U.S. National Health Interview Survey (NHIS), the most recent data available, only 77% of young adult women ages 21-29 and 83% of adult women ages 30-65 received a pap test, CCS, in the last three years [9]. Unfortunately, these screening rates still remain below the HP-2020 CCS objective to have 93% women ages 21-65 screened for cervical cancer, within past three years [10]. In 2012, the CDC reported that about 8 million women ages 21-65 were not screened for cervical cancer in the last 5 years [11].

Innovative mobile health strategies are needed in primary health care setting to help unveil and address barriers to HPV vaccination and CCS. According to a recent Pew Study, over 89% of Americans between the ages 19-49 own a smartphone and about 81% of those who own cell phones, send or receive text messages [12,13].

This pilot study took place during pediatric and adolescent well-child visits at Boston Medical Center AFS to address prevention needs for both the AFG and the AF. It employed a motivational intervention in discussion HPV, followed by a mobile health educational text message program. It was hypothesized that educational and reminder text messages following a BNI would significantly increase the rate of HPV vaccine series completion among AFs, and improve AFG adherence to CCS guidelines.

Methods

Objectives and study design

An one-armed proof of concept pilot trial among 50 AFG-AF dyads. The objective of the study was to evaluate the feasibility of delivering a motivational and educational intervention, the BNI. The BNI was followed by a series of automated educational and reminder text messages aimed at increasing HPV vaccination uptake and completion rates among adolescents. An additional goal was to enhance intent for guardians to schedule appointments for a CCS.

Intervention BNI and Wheel of Wellness mobile phone texting and website

The BNI employs a client-centered style of motivational counseling that helps clients explore their decision-making

strategies and resolve ambivalence about adopting new healthy behaviors [14] - this was measured by the AFs completion of HPV vaccine series and intent of the AFG to schedule a CCS appointment. The mobile health information technology (HIT) system that was used during follow-up, the WoW, is an automated texting program that provides English language low health literacy education (short text essays with evidenced based links to the WOW website) and reminder text messaged (appointments). WoW is a HIPAA compliant mobile health education website and texting system. Mobile health education and reminders may offer cost-effective and easily replicable methods for providing caregivers' and their children's knowledge about HPV, HPV vaccine, and CCS. It may also increase motivation for vaccine initiation and completion and CCS adherence.

Together, the BNI and WoW constitute an integrated intergenerational model that draws from the Health Belief Model (perceived susceptibility and severity), the Transtheoretical Model (readiness to change), and the Theory of Planned Behavior and Reasoned Action (linking attitudes, norms and intentions to behavioral change activities) [15-23]. Each of these theoretical paradigms have been applied to vaccine-related behaviors as shown in Figure 1.

Setting

This pilot proof of concept was conducted at Boston Medical Center (BMC), a large urban academic hospital and the largest safety-net facility in its region. Participants were recruited from clinics operated by the Departments of Pediatrics and Adolescent Medicine at BMC. BMC serves a predominantly low-income, minority population with 57% of patients coming from under-served groups. The Pediatric Clinic sees approximately 2,033 females patients ages 9-17 annually, a population that is racially and ethnically diverse (62% Black, 15% White, 13% Latino, and 10% other), but largely socioeconomically disadvantaged (70% publicly insured, 30% privately insured).

Participants

All participants were enrolled between May 2017 and September 2017. In order to be eligible for the study, AFG had to: 1) be between 26-65 years old, 2) receive primary care at BMC, 3) own a cellular phone capable of receiving text messages 4) have

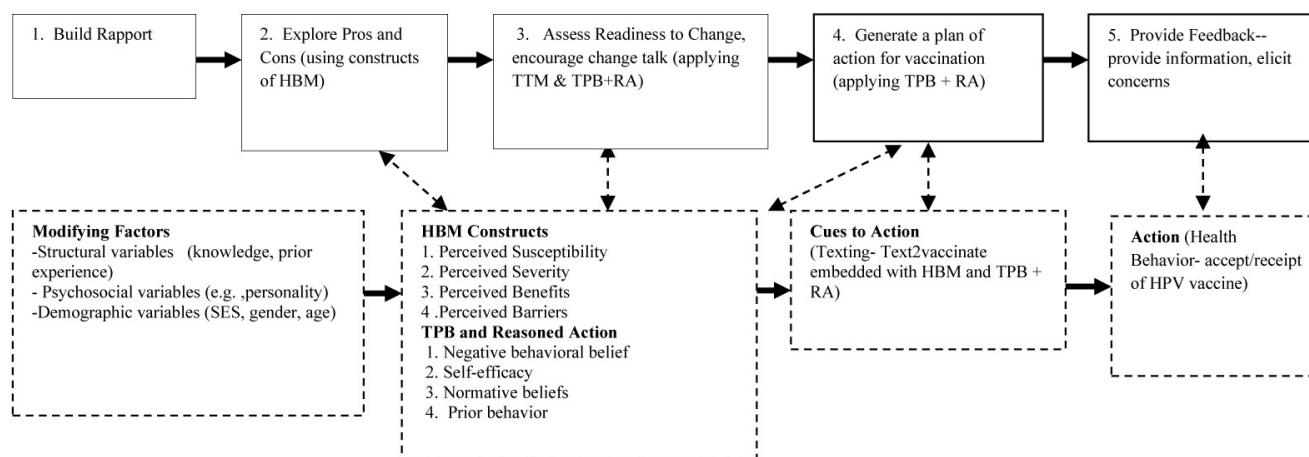


Figure 1. Brief Negotiated Interviewing applied to vaccination: Health Belief Model (HBM) [9], Transtheoretical Model (TTM) [8], and Theory of Planned Behavior and Reasoned Action (TPB+RA) [19].

a daughter between 9-17 years old who had not completed or initiated the recommended HPV vaccination series, and 5) read and write in English. The AFG and her AF daughter were approached by a research assistant before scheduled appointments in the clinic. If both indicated a willingness to participate written consent was obtained from the AFG and assent from the AF. Upon completion of their survey, each received a \$20 gift card.

Research assistants administered a screening questionnaire to collect demographic information, thoughts, knowledge, attitudes, and concerns about HPV vaccination and CCS. Information about HPV vaccine administration and CCS history was obtained from the AFG and the adolescent female daughters during the baseline questionnaire and verified using the hospital's electronic medical record system. The research assistant then entered this information into an online secure data collection application, REDCap. Data was also entered into the Wheel of Wellness (WoW), a HIPAA compliant mobile health education website and texting system that was developed by an external contractor with help and guidance from study team. On the AFG profile, WoW included demographics, contact information, HPV vaccine concerns, CCS concerns, AF's HPV vaccine history and future appointment, and finally their own CCS history and future appointment(s). On the AF profile, WoW included demographics, contact information, HPV vaccine concerns, and their HPV vaccine history and future appointment(s).

At nine months post-intervention, participants received a WoW exit survey via text message. Those who did not respond to the text message were contacted by phone to answer the follow-up questionnaire, WoW Exit Survey, as administered by the research assistant. The WoW Exit Survey was designed to assess: 1) whether or not the website and text messages were user friendly, 2) how helpful the text messages and WoW were in helping the participants to schedule and attend HPV vaccination and CCS appointments, and 3) how helpful WoW was in increasing the confidence of the participants in their knowledge about HPV screening and vaccination.

AFGs who were due for their CCS during the study were measured for CCS completion, whereas those AFGs who were not due yet for their CCS during the study period were measured for intent. CCS intent was measured using the WoW Exit Survey, which asked guardians about their intent to: 1) schedule an appointment for their CCS and 2) show up to their appointment and get the CCS.

BNI administration procedures

Prior to study initiation, research assistants were trained to deliver a 10-20 minute BNI, which followed an algorithm with separate components for the AFGs and AFs, while they were waiting in the exam room (Table 1). In order to assure fidelity to the algorithms and competence in motivational interviewing techniques, a guided curriculum, role plays, and scoring systems were used in training. The dyad was separated during the BNI in order to promote disclosure by AFGs of their concerns about their daughters' sexuality and perceived barriers to CCS, and to allow daughters the privacy to ask questions about HPV and protect their confidentiality.

Text messages

WoW automatically generated and sent personalized text messages to the participants based on their individual profile once a month. The message history of each participant was recorded by the system in a texting log which included the date, time, and the content of each message. The AFG received scheduling reminders, appointment reminders, and educational text messages tailored to their selected concerns about the HPV vaccine, as well as information about their CCS concerns. Of note, AFs received educational, scheduling, and appointment reminder text messages that pertained to their own declared HPV vaccine history and their specific concerns, not those of their parents/guardians.

The educational text messages were designed to address concerns that were identified in the initial questionnaire. These texts included a few brief, informational sentences alongside a link to reliable and accurate websites with additional in-depth information. Examples of such sites were the Centers for Disease Control and Prevention (CDC) and American Academy of Pediatrics (AAP) for HPV and CCS recommendations from American College of Obstetrics and Gynecology (ACOG). Once a month for twelve months, or until completion of the vaccination series by the AF, the AF and the AFG each received individual educational text messages regarding the HPV vaccine and Pap text respectively. Once all concerns were addressed, the AFG received alternative text messages containing general information about the benefits of receiving the HPV vaccine and CCS. The AFGs who had not expressed HPV vaccine or CCS concerns received text messages pertaining to the benefit, rather than concern, of HPV vaccine or CCS every month.

The scheduling text messages were designed to help both the AFG and their AF to remember the AF's HPV vaccine due date and to make the appointment for the HPV vaccine. Three months prior to the HPV vaccine due date, the AFG and AF were sent scheduling reminders and follow up calls bi-monthly from one of the research assistants attempting to assist them in scheduling the appointment. Once the appointment was scheduled, all participants were sent two appointment reminder text messages at two weeks and one day prior to the appointment. If the AF missed the appointment, the AFG would receive a text acknowledging the missed appointment three days later, as well as a reminder to schedule a new appointment five days later. An identical mechanism was put into place for AFGs in regards to the CCS.

BNI plus text messaging

Building upon preliminary data from an earlier study, we utilized BNI in combination with text messages (Figure 2). Educational, scheduling, and reminder text messages were sent to all participants regardless of BNI eligibility. Educational text messages were used post-BNI to address concerns and reinforce benefits of the HPV vaccine completion and adherence of CCS guidelines. The scheduling and appointment reminder text messages were used to improve recall among AFGs and their AFs to: 1) return for the 2nd and 3rd doses of HPV vaccine for daughters and 2) comply with routine CCS for AFGs.

Data analyses

The data collected from the participants was entered into an online data collection tool, REDcap. In addition to WoW recording participant demographics, contact information, HPV vaccine

Table 1. Cervical Cancer BNI Algorithm.

BNI principle	Sample script
Build rapport Needed if conversation is initiated by staff who is not the patient's primary care provider	My name is _____. I am working with child's doctor to help answer parent's questions about vaccines.
<i>If no objections to HPV vaccine, skip to Pap smear discussion below; if initial refusal of HPV vaccine, negotiate as follows, then take up Pap smear with mother.</i>	
Ask permission, then elicit HPV knowledge	I understand that you have some concerns about the HPV vaccination. Do you mind if we talk a little bit about it? To start, what do you already know about the HPV virus? <i>Provide information using CDC materials "Tips and timesavers" sheet: http://www.cdc.gov/vaccines/who/teens/for-hcp-tipsheet-hpv.html</i>
Elicit concerns and benefits	Now that we talked a little about the HPV infection, what are your concerns regarding the vaccine? What possible benefits if any do you see in getting your child vaccinated? SUMMARIZE: On the one hand you have some concerns about _____ and at the same time you feel the benefits would be _____.
Provide information	Ask permission to give feedback (<i>May I share some more information about the vaccine with you?</i>), then provide factual response to parents' concerns based on CDC tips and timesavers. REINFORCE POSITIVES: It sounds like your child's health is very important to you. It is to me too. I know the vaccine is safe, and it can prevent cancer, which is why I strongly recommend it to all my patients.
ASSESS READINESS	Where does this leave you in thinking about this vaccine?
If ready to vaccinate today, proceed	
If not ready to vaccinate, provide menu of options	There's a few different things we can do from here: -I can give you some information to review at home -I/ the nurse can give you a call back in a week or two to answer any more questions that might come up. What sounds best to you?
PAP Smear Discussion	
Ask permission	I wonder if we might also talk about why it's important for mothers to take care of their own health by getting a Pap smear? Have you ever had a Pap smear? If you are 21 years old or more, have you had one in the last 3 years?
Elicit what mother knows	Can you share with me what you understand about Pap smears?
Provide feedback	A pap smear looks for the changes in cells in the cervix (the opening of the womb) that might become cervical cancer if left to grow. There are simple treatments that can be done to remove abnormal cells before they become cancer, but they have to be discovered when they are just starting to grow for the treatment to be effective. That's why we recommend a test every 3 years.
Elicit reaction	What do you think about that?

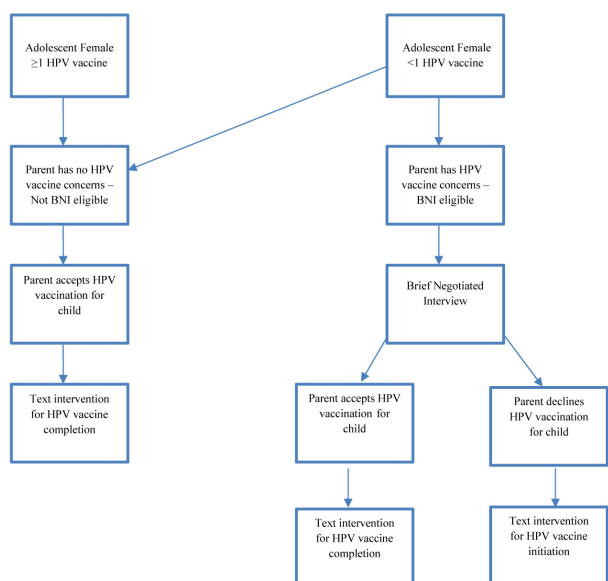


Figure 2. Intervention Flowchart.

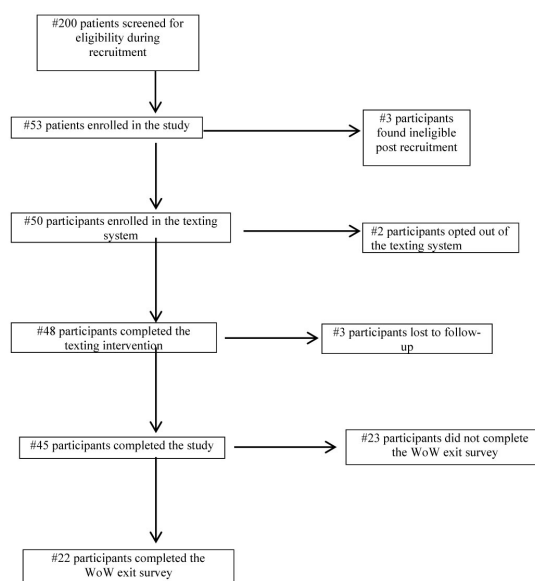


Figure 3. Consort Diagram.

and cervical cancer screening information, there was a texting log that recorded all of the text messages sent to participants. Following nine months of intervention, the participants were sent a follow-up questionnaire about the WoW system via text message. The follow-up questionnaire was designed to assess: 1) whether or not the website and text messages were user-friendly, 2) how helpful the text messages and the WoW system were in helping the participants to schedule and attend HPV vaccination and pap test appointments, 3) how helpful the WoW system was in increasing the confidence of the participants in their knowledge about HPV screening and vaccination.

During the data collection phase, AF participants were divided by age group and vaccine status. Participants were divided into age groups 9-14 and 15-17. Vaccine status was categorized: ≥ 1 dose HPV vaccine, ≥ 2 dose HPV vaccine, ≥ 3 dose HPV vaccine, and HPV vaccine up-to-date (UTD). HPV UTD includes those who received ≥ 3 doses, or those who received 2 doses when the first HPV vaccine dose was initiated before age 15 years and the time between the first and second dose was at least 5 months minus 4 days.

AFGs who were due for CCS during the study were measured for Pap test or HPV test completion, whereas those adult female guardians who were not due yet for their CCS during the study period were measured for intent. CCS intent was measured using the follow-up questionnaire, which asked AFGs about their intent to: 1) schedule an appointment for their CCS and 2) show up to their appointment and get CCS.

Results

Participant characteristics

Two hundred and fifty patients (adult female guardian-adolescent female dyads) were screened. A total of 50 dyads (100 participants) met inclusion criteria and were enrolled, and 45 dyads completed the study (Figure 3). The mean age of the adult female caregiver (AFG) was 38.5 ± 6.7 years and the adolescent female's (AFs) mean age was 11.0 ± 1.8 . Over 50% of the sam-

Table 2. Parent Demographics

Age (Years)	Mean	Standard deviation	
	Mother 39 Daughter 11	6.365698	2.359609
Race (n=47)	African American	n 18	% 37
	Hispanic/Latina	2	4
	Haitian/Caribbean/ West Indies	14 13	29 27
	Other		
Monthly Household Income (n=39)	\$0-20,000	14	29
	\$20,001-40,000	1	2
	\$40,001-60,000	2	4
	\$60,001-80,000	6	12
	\$100,001 or higher	2	4
	Prefer not to answer	14	29
Education (n=48)	Primary middle school	3	6
	Secondary-high school	24	50
	GED	4	8
	Tertiary	17	35
Pap test due date (n=50)			
Due for pap test during study period		Due for pap test after study period	
n	%	n	%
8	16	42	84

ples were African American (36.7%) and/or Haitian/West Indies (28.6%) (Table 2).

HPV knowledge and attitudes

Knowledge of HPV and its effects on the body was high among AFGs but knowledge about how HPV is contracted was lower (Table 3). The majority of participants (78%) had heard of HPV and knew that HPV can cause cervical cancer, but only 59% knew HPV could be passed on by genital skin-to-skin contact. Of the total participants, only 65% knew that HPV can be passed on during sexual intercourse. While most AFGs had heard about the HPV vaccine (80%), only about half (49%) knew that HPV vaccines offer protection against most cervical cancers. Knowledge of HPV among adolescent females (Afs) was overall low compared to that of AFGs. Only 21% of Afs had heard of HPV and 28% knew that HPV can cause cervical cancer. A low percentage of Afs (21%) knew that HPV can be passed on by genital skin-to-skin contact and only 9% knew that having sex at an early age increases the risk of getting HPV.

When Afs were asked about their AFGs' attitudes, whether they would approve of giving them the HPV vaccine, more than half (70%) of AFs thought their adult female guardian (AFG) had intended to give them the vaccine, and most of them (88%) had subsequent HPV initiation (receipt of ≥ 1 HPV vaccine dose). Among those who answered no/don't know (30%), a little more than half (57%) had HPV initiation. There was a significant association between the adolescent female's (Afs) perception of the AFGs intention to HPV vaccinate the adolescent female and the actual HPV initiation. If the AFG had the intention of giving their AF the vaccine, the daughters were more likely to receive the vaccine ($p=0.00392$).

HPV vaccine uptake

The majority of AFGs (80%) gave permission for their Afs to receive the HPV vaccine (Table 4). The mean age among girls who received the first HPV vaccination was 10.7 ± 1.75 years, while adolescents who had not yet initiated HPV vaccination had a mean age of 11.4 ± 2.30 . Over three-fourths (86%) of participants aged 9-17 received one or more doses of HPV vaccine by the end of study, and half of AF participants aged 9-17 were UTD with their scheduled doses. HPV UTD rates were higher (60%) among AF participants aged 15-17 compared to rates among AF participants ages 9-14 (40%). At the end of the study, 7/50 14% of daughters had no documentation in the electronic medical record (EMR) of HPV vaccine initiation.

Cervical cancer and CCS attitudes and knowledge

A large majority (90%) of the adult female caregivers (AFGs) had heard of cervical cancer, while only one-third (33%) knew someone who had cervical cancer (Table 3). Most of our adult female caregivers (82%) reported having been screened for cervical cancer previously. A large majority (80%) reported having heard of a vaccine that can help prevent HPV infection and HPV-related cancer. Only eight (16%) of the AFGs in the study were due for their CCS during the study period. Seven of the eight AFGs who were due for their screening received a test. About half (48%) of AFGs whose due date fell outside the study period provided information about their intent to sched-

Table 3. Attitudes and Knowledge: HPV, HPV vaccine, Cervical Cancer, Pap test.

	Yes/True n %	No/False n %	Don't know n %
Parent HPV Knowledge			
Before today, have you ever heard of HPV?	38 78	10 20	1 2
Have you ever heard of HPV testing	34 69	11 22	4 8
HPV can cause cervical cancer	38 78	0 0	11 22
HPV can be passed on by genital skin-to-skin contact	29 59	4 8	16 33
There are many types of HPV	25 51	6 12	18 37
There are many types of HPV HPV can be passed on during sexual intercourse	32 65	2 4	15 31
Having many sexual partners increases risk of getting HPV	36 74	2 4	11 22
Most sexually active people will get HPV at some point in their lives	19 39	11 22	19 39
Having sex at an early age increases the risk of getting HPV	26 53	6 12	17 35
Parent HPV Vaccine Knowledge and Attitudes			
Have you heard of a vaccine to help prevent HPV infection cervical cancer?	39 80	10 20	N/A
HPV vaccines offer protection against most cervical cancers	24 49	5 10	20 41
Boys can get the HPV vaccine	30 61	5 10	14 27
If the HPV vaccine became available in this clinic for your daughter, would you give permission for your daughter to receive it?	39 80	3 6	7 14
Parent Cervical Cancer Knowledge and Attitudes			
Have you heard of cervical cancer?	44 90	5 10	N/A
Do you know how women are checked for cervical cancer?	29 60	11 23	8 17
Do you think you are at risk for cervical cancer?	7 14	24 49	18 37
Have you ever been checked for cervical cancer?	40 82	5 10	4 8
Do you think your daughter is at risk for getting cervical cancer?	7 14	28 57	14 29
Adolescent HPV Knowledge			
Before today, had you ever head of Human Papillomavirus (HPV)	10 21	26 55	11 23
Have you ever heard of HPV testing	7 15	30 64	10 21
HPV can cause cervical cancer	13 28	6 13	28 58
HPV can be passed on by genital skin-to-skin contact	10 21	5 11	32 68
There are many types of HPV	16 34	1 2	30 64
HPV can be passed on during sexual intercourse	11 23	1 2	35 72
Having many sexual partners increases the risk of getting HPV	11 23	2 4	34 72
Most sexually active people will get HPV at some point in their lives	6 13	3 6	38 81
Having sex at an early age increases the risk of getting HPV	4 9	0 0	43 92
Adolescent HPV Vaccine Knowledge and Attitudes			
Have you heard of a vaccine to help prevent HPV infection/related cancer?	14 30	33 70	N/A
HPV vaccine is for boys and girls	31 66	2 4	14 30
If the HPV vaccine is available here for you, would you like to receive it?	31 66	3 6	13 28
Do you think your mother/father will approve of giving you the vaccine?	33 70	4 9	10 21

ule through the WoW exit survey. Among them, 65% reported screening intent.

WoW feedback

Overall, participants who participated in the WoW Exit Survey (18) reported a positive experience with WoW. Questions regarding WoW included changes in knowledge, attitudes, and behavior as well as their confidence about scheduling and showing up to their appointments for the HPV vaccine and CCS (Table 5). The majority (89%) either strongly agreed or agreed that the WoW text messages were easy to understand. More than half (67%) reported that they strongly agreed or agreed that the WoW text messages helped them learn more about HPV and cervical cancer. Most participants positively responded by strong-

ly agreeing or agreeing that the WoW text messages helped remind them to schedule (72%) and show up to their appointments (78%).

Discussion

This is the first study to look at the combination of a primary and secondary prevention strategy in a primary care setting for increasing vaccination and CCS rates. The findings support our hypothesis of adding text messaging and educational messages following a BNI is a feasible model to increase rates of initiation and completion of the HPV vaccine series in adolescent females (AFs), and improve adult female guardians’(AFG) adherence to CCS guidelines. Based on the WoW feedback collected from the follow-up survey, the mobile health education system was wide-

Table 4. Intervention population vaccine coverage by age group and pre-/post-intervention (n=50).

Pre-Intervention (n=50)				Post-Intervention (n=50)								
Dose	Ages 9-14 (n=45)		Ages 15-17 (n=5)		Ages 9-14 (n=45)		Ages 15-17 (n=5)		Total (n=50)			
	n	%	n	%	n	%	n	%	n	%		
≥1	8	18	2	40	10	20	38	84	5	100	43	86
≥2	0	0	1	20	1	2	18	40	4	80	22	44
≥3	0	0	0	0	0	0	0	0	3	60	3	6
HPV UTD*	0	0	0	0	0	0	18	40	3	60	25	50

*HPV UTD includes those who received ≥3 doses, and those who received 2 doses when the first HPV vaccine dose was initiated before age 15 years and the time between the first and second dose was at least 5 months minus 4 days.

Table 5. WoW Exit Survey Results.

	n	%
The WoW Text Messages Helped Me Learn More about HPV and Cervical Cancer (n=18)		
Strongly Agree	6	33
Agree	6	33
Neutral	3	17
Disagree/Strongly Disagree	3	17
The links in the text messages helped me learn more about HPV and cervical cancer (n=8)		
Strongly Agree	3	38
Agree	4	50
Neutral	1	12
Disagree/Strongly Disagree	0	0
The WoW text messages helped remind me to schedule my doctor appointments. (n=18)		
Strongly Agree	5	28
Agree	8	44
Neutral	4	22
Disagree/Strongly Disagree	1	6
The WoW text messages helped remind me to show up to my doctor appointments. (n=18)		
Strongly Agree	4	22
Agree	10	57
Neutral	3	17
Disagree/Strongly Disagree	1	6
After using the WoW system, I am more likely to schedule my child’s appointment for the HPV vaccine. (n=22)		
Strongly Agree	8	36
Agree	8	36
Neutral	4	18
Disagree/Strongly Disagree	2	9
After using the WoW system, I am more likely to schedule my own doctor’s appointment for my pap smear. (n=22)		
Strongly Agree	7	32
Agree	10	45
Neutral	3	14
Disagree/Strongly Disagree	2	9
After using the WoW system, my child and I are more likely to show up to the appointment for HPV vaccine. (n=22)		
Strongly Agree	8	36
Agree	9	41
Neutral	3	14
Disagree	2	9
After using the WoW system, I am more likely to show up to my doctor’s appointment for my pap smear. (n=22)		
Strongly Agree	5	23
Agree	13	59
Neutral	2	9
Disagree/Strongly Disagree	2	9
After using the WoW system, I am more confident in making my child’s appointment for the HPV vaccine. (n=22)		
Strongly Agree	4	18

Agree	13	59
Neutral	3	14
Disagree/Strongly Disagree	2	9
After using the WoW system, I am more confident in making my doctor's appointment for a pap smear. (n=22)		
Strongly Agree	6	27
Agree	11	50
Neutral	4	18
Disagree/Strongly Disagree	1	5
After using the WoW system, I am more confident about getting the HPV vaccine for my child. (n=22)		
Strongly Agree	6	27
Agree	10	45
Neutral	4	18
Disagree/Strongly Disagree	2	9
After using the WoW system, I am more confident about getting a pap smear. (n=22)		
Strongly Agree	8	36
Agree	10	45
Neutral	4	18
Disagree/Strongly Disagree	0	0

ly acceptable and improved motivation and education about the HPV vaccine and CCS.

Our study is among the first to utilize a BNI to address guardian concerns related to HPV and HPV vaccination, to empower guardians to make health-promoting decisions, and to promote shared-decision making between patients and clinicians. Recent studies have demonstrated BNI to significantly increase knowledge of HPV vaccine and increase the initiation rate for HPV vaccine, but failed to ensure a higher HPV vaccine completion rate [24]. This pilot study tested if the addition of a text-messaging follow-up to the BNI would improve HPV vaccine completion rates.

At baseline, 17 AFGs who identified no concerns about barriers during the BNI later reported having concerns on the WoW checklist. In order to accurately identify AFG concerns, it may be best to have them first complete a checklist of concerns before proceeding with the BNI. Further research is needed to explore what might make the BNI more effective at identifying and addressing health concerns, improving and reinforcing knowledge related to HPV, and facilitating adoption of prevention measures.

Limitations

One limitation of the study is how the EMR reminded clinicians about immunizations due dates. Although participants may have intended to vaccinate during the study period, the providers were not prompted by the electronic medical records system to do so. These wrong due dates may have been a possible confounder in the study. This highlights the importance of prompting providers to vaccinate and follow HPV vaccine guidelines. Further studies should explore innovative ways of empowering patients to communicate with providers about their intentions, as well as improving existing technology to enhance provider recommendation of HPV vaccine and promote an increase in HPV vaccine completion.

This is a one-arm pilot study with a small sample size and no control or comparison group. Although the size of the sample is sufficient to assess study logistics and achieve the primary outcome, it does not permit adjusted analyses; the results are pre-

liminary in nature.

The study was also conducted only in English with adult female guardians who had to have phone – both of which lend to bias in the sample for a more educated or higher-income population.

Half of participants from ages 9-17 were HPV UTD at the end of the study. Due to a limited study timeline, this rate does not take into account possible vaccination or CCS completion post-study. Future studies should measure vaccine and CCS completion rates over a longer period of time in order to accurately represent HPV UTD and accurate CCS screening rates. Follow-up attrition also posed several challenges during the course of the study and limited the generalizability of WoW Exit Survey results.

Conclusions

This pilot research study tested whether a motivational interview followed by educational and reminder text messages were able to improve cervical cancer prevention in a high-risk population. This was done by increasing participants' motivation to seek preventative measures, such as HPV vaccine initiation and timely completion of CCS, and reinforcing short term decisions to overcome barriers. High HPV vaccine initiation and completion rates, along with high satisfaction of the WoW component, from our small sample, one-armed pilot study suggest that the dyad approach and the intervention protocols deserve further exploration in a randomized, controlled trial. The logistics and process measures reported in this pilot provide a sound basis for a larger, appropriately powered trial of this integrated, intergenerational intervention.

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