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LINKING HEALTH BEHAVIOR THEORY AND INTERVENTIONS TO INCREASE
HUMAN PAPILLOMAVIRUS VACCINE UPTAKE

By

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Professional Paper

presented in partial fulfillment of the requirements
for the degree of

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Linking Health Behavior Theory and Interventions to Increase Human Papillomavirus Vaccine Uptake

Chairperson: Dr. Sophia Newcomer

Human papillomavirus (HPV) is the most common sexually transmitted disease in adults in the United States (US). Persistent HPV infection can cause several cancers, including cervical, oropharyngeal, and anal cancer. To prevent these cancers, the U.S. Advisory Committee on Immunization Practices recommends that all adolescents start the HPV vaccine series at ages 11-12 years. Despite the safety and efficacy of available HPV vaccines, vaccine uptake rates remain lower than public health goals. In the US, only 51.1% of eligible adolescents have completed the vaccine series, a rate lower than the Healthy People 2020 goal of 80% coverage for series completion. In Montana, only 53% of females and 43.9% of males have completed the series. Suboptimal HPV vaccine uptake rates and existent disparities must be addressed to decrease HPV-attributable cancer risk. This paper describes which interventions may be effective in increasing HPV vaccination rates in Montana through a review of the literature on HPV vaccination interventions and their use of health behavior theories, and an analysis of local parent and adolescent feedback about HPV vaccination. The literature review focused on education interventions, provider communication interventions, and health systems interventions to increase HPV vaccine uptake. I found that the use of health behavior theories to inform HPV vaccination interventions was inconsistently reported in published studies of interventions; however, several health behavior theories did support the potential for effectiveness of certain interventions. For example, stage behavior theories may provide tools to move a parent from hesitancy to willingness to vaccinate. The behavior theory constructs of subjective norms and cues to action support provider recommendation and reminder/recall interventions. Most HPV vaccination interventions that I identified were conducted in urban populations, which limits their generalizability to rural populations like those in Montana. However, local parents emphasized the importance of reminders to complete the HPV vaccine series. Provider recommendations were also highly valued. This literature review and analysis of local parent and adolescent feedback provides valuable information for stakeholders seeking to increase HPV vaccine uptake in adolescents.

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Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection (STI) and HPV infection can cause a variety of cancers (Centers for Disease Control, 2019a). Vaccination against HPV can prevent these cancers (Centers for Disease Control, 2019e), and the U.S. Advisory Committee on Immunization Practices (2020) recommend that adolescents start the HPV vaccine series at age 11-12 years. Despite the availability of an effective vaccine, uptake rates remain below the Healthy People 2020 goal of 80% series completion coverage (Office of Disease Prevention and Health Promotion, 2019). As of 2018, rates in Montana are also below the goal at 51.2% (Centers for Disease Control, 2019b). To protect Montanans against HPV and HPV-attributable cancers, identification of interventions that may be effective to increase HPV vaccination in Montana is needed.

The goal of this professional paper is to describe which interventions may be effective in increasing HPV vaccination rates among adolescents in Montana. This goal will be achieved by reviewing the literature on interventions to increase HPV vaccine uptake and identifying their use of health behavior theories, and through analysis of local parent and adolescent feedback about HPV vaccination.

The literature review focused on three types of intervention: (a) provider communication strategies, (b) education directed to the parent and/or adolescent, (c) health systems interventions. Discussion of each type of intervention includes a description of any health behavior theories used, and an analysis of how the theories were used by researchers.

Most of the interventions to increase HPV vaccination rates have been tested in urban populations, limiting their generalizability to rural populations like those in Montana. Given this limited generalizability, and given that tailoring interventions to a specific population is more effective than standardized interventions, I sought to identify local parents' and adolescents' perceptions, attitudes, and beliefs regarding HPV vaccination and HPV interventions. Using the transcripts from the first Adolescent Health Patient and Family Advisory Council (AHAC) meeting held at Community Medical Center (CMC), I conducted a qualitative analysis of the main themes discussed about HPV vaccination and HPV interventions from parents and adolescents at that meeting.

The findings from the literature review and the AHAC meeting data provide helpful information and first steps towards identifying strategies that will be effective at increasing HPV vaccine uptake in Montana.

The table below contains definitions for terms used throughout this paper.

Important Definitions	
Intervention	“An intervention is a combination of program elements or strategies designed to produce behavior changes or improve health status among individuals or an entire population. Interventions may include educational programs, new or stronger policies, improvements in the environment, or a health promotion campaign” (Missouri Department of Health and Human Services, n.d.)
Health behavior	“All of the things we do that influence our physical, mental, emotional, psychological, and spiritual selves” (Hayden, 2014, p. 5), or more simply, “actions taken by individuals that affect health or mortality” (Short & Mollborn, 2015, p. 79)
Health behavior theory	“An interrelated set of propositions that serve to explain health behavior or provide a systematic method of guiding health promotion practice” (DiClemente, Crosby, & Kegler, 2002, p. 8)
HPV vaccine series initiation	When an individual who has not yet received any dose of the HPV vaccination receives the first dose in the vaccine series
HPV vaccine series completion	When an individual receives the final dose of the HPV vaccine series and is thus completed vaccinated. Depending on the age of the patient, a complete series of the HPV vaccine is either two or three doses. If the patient initiates the series between ages 9-14, two doses make a complete vaccine. After age 15, or for those patients with weakened immune systems, three doses are necessary for a complete vaccine (Centers for Disease Control, 2019d)

Background

Human Papillomavirus

HPV is the most common STI in the United States (US): over 80% of adults will contract HPV in their lifetime (Centers for Disease Control, 2019c). The Centers for Disease Control estimate that 79 million people in the US are currently infected, and they estimate 14 million new infections annually (Centers for Disease Control, 2019e). Of those new infections, about half are in people ages 15-24 years (Centers for Disease Control, 2019e). HPV is a non-enveloped, double-stranded DNA virus in the Papillomaviridae family (Steben & Duarte-Franco, 2007). There are over 120 identified HPV genotypes (or types), and about 40 of these types

infect the mucosal epithelial lining of the anogenital tract and other areas (Centers for Disease Control, 2019e).

HPV strains can be classified by their risk of causing cancer into low-risk and high-risk types (Steben & Duarte-Franco, 2007). HPV-6 and -11 are associated with low-risk lesions, including anogenital warts and low-grade squamous intraepithelial lesions on the cervix and vulva (Steben & Duarte-Franco, 2007). High-risk types, like HPV-16 and -18, are associated with cancers and recurrent respiratory papillomatosis (Steben & Duarte-Franco, 2007). Infection with high-risk HPV types can cause cervical, vulvar, vaginal, penile, anal, and/or oropharyngeal (throat) cancer. (Centers for Disease Control, 2019a). Most HPV infections are asymptomatic and transitory, but if the immune system is unable to clear the infection, persistent infection can lead to cell abnormalities (Centers for Disease Control, 2019e). High-risk HPV types are detected in 99% of cervical cancers worldwide (Centers for Disease Control, 2019e).

HPV Transmission and Risk

HPV is spread through vaginal, anal, or oral sex (Centers for Disease Control, 2019a). Anyone who is sexually active can contract HPV, and 50% of people who contract HPV will be infected by their first sexual partner (Centers for Disease Control, 2019a).

Factors that increase risk for HPV infection include number of lifetime and recent sexual partners; there is less conclusive evidence for other risk factors like genetics, number of pregnancies, young age of sexual initiation, smoking, and having an uncircumcised male partner (Centers for Disease Control, 2019e). Correct and consistent condom use can reduce the risk of transmission, but cannot eliminate the risk. The Centers for Disease Control and Prevention states that “abstaining from sexual activity (i.e., refraining from any genital contact with another individual) is the surest way to prevent genital HPV infection. For those who choose to be sexually active, a monogamous relationship with an uninfected partner is the strategy most likely to prevent future genital HPV infections” (2019e).

Public Health Cost

Globally, 4.5% of all cancers are attributable to HPV (probably caused by HPV), which is about 630,000 new cases annually (de Martel, Plummer, Vignat, & Francheschi, 2017). The Centers for Disease Control (CDC) estimates that HPV causes about 35,000 new cancer cases per year in US men and women (2019c). A 2018 estimate put the cost of screening, treating, and preventing HPV

related cancers in the US at approximately \$8 billion annually (Vogel, Appel, & Winkler, 2018).

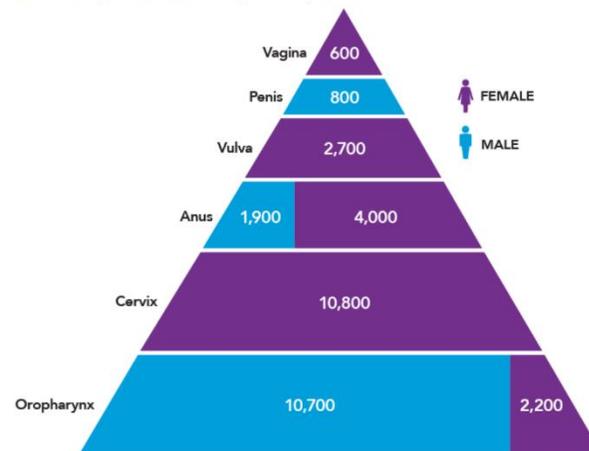
In addition to cancer, HPV infection is associated with psychosocial impacts and complications from the surgical treatment of lesions. Genital warts can lead to shame and decreased self-esteem (Jeynes, Chung, & Challenor, 2009). Additionally, the “surgical treatment of precursor lesions is associated with an increased risk of perinatal mortality and extreme premature delivery for subsequent pregnancies” (Petry, Wormann, & Schneider, 2014, p. 50).

Prevention

HPV-attributable cancers, genital warts, and precursor lesions can be prevented with vaccination (Centers for Disease Control, 2019a; de Martel, Plummer, Vignat, & Francheschi, 2017). A recent Centers for Disease Control estimate states that 92% of new HPV-attributable cancers could be prevented in the US if 80% of the eligible population was vaccinated (2019f).

Three HPV vaccines are currently licensed in the US: Gardasil-4, Gardasil-9, and Cervarix (Centers for Disease Control, 2019e). Gardasil-4 is a quadrivalent HPV vaccine that protects against HPV-6, -11, -16, and -18. Gardasil-9 is a nine-valent HPV vaccine that protects against HPV-6, -11, -16, -18, -31, -33, -45, -52, and -58. Cervarix is a bivalent HPV vaccine that protects against HPV-16 and -18 (Centers for Disease Control, 2019e). Gardasil-4 was the first vaccine to be approved by the Food and Drug Administration in 2006. The Gardasil vaccines are approved for females and males. The Cervarix vaccine is only approved for females.

Numbers of U.S. Cancers Caused by HPV



President's Cancer Panel (2018)

HPV vaccines are delivered in a series, and it is important to vaccinate as early as possible. Adolescents aged 11-12 years should receive 2 doses, 6-12 months apart. If adolescents start the series at 15 years or older, then 3 doses are recommended to achieve optimal immunity, with the second dose 1-2 months after the first, and the third dose 6 months after the first. A complete series of the vaccine improves protection, as compared to an incomplete series, i.e., only getting one dose (Centers for Disease Control, 2019a). Gardasil is approved starting at age 9, and Cervarix at age 10, and earlier vaccination is preferred as HPV vaccines only protect against HPV types to which someone has not yet been exposed (Centers for Disease Control, 2019e).

The HPV vaccines are clinically efficacious and the safety of these vaccines has been thoroughly studied. They been found to have high efficacy at preventing HPV infection, precancerous epithelial lesions, and malignant epithelial tumors (Centers for Disease Control, 2019e). Within the first 6 years after the quadrivalent vaccine was introduced, the prevalence of 4 types of HPV covered by the vaccine decreased by 64% in the US (Soon, Sung, De La Cruz, Chen, & Hiraoka, 2017). Common side effects are mild, and include pain, redness, and swelling at site of injection and fever (Centers for Disease Control, 2019e). Both the Centers for Disease Control and Prevention and the Food and Drug Administration monitor vaccine side effects, and no significant adverse effects have been reported from HPV vaccines (Centers for Disease Control, 2019e).

HPV Vaccination Rates

Despite the safety and efficacy of the available HPV vaccines, vaccine uptake rates remain lower than public health goals. Current data show that vaccination rates for US adolescents 13-17 years of age are lower than the Healthy People 2020 goal of 80% series completion (Office of Disease Prevention and Health Promotion, 2019). Within the already lower than desirable vaccine

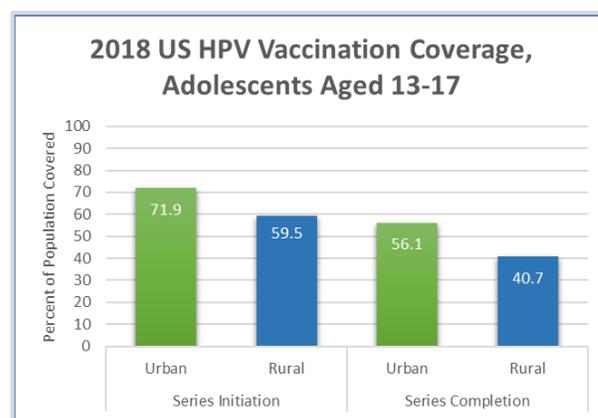


Figure 1. 2018 US HPV Vaccination Coverage
Data from NIS-Teen (Centers for Disease Control, 2019b)

uptake, disparities exist between vaccine series initiation and completion and between urban and rural populations, among others.

Figure 1 and 2 illustrate these disparities nationwide, and in Montana.

The urban/rural disparity might seem to indicate that access to health care could be contributing to lower rates in rural areas, but other adolescent vaccinations like Tdap

(tetanus, diphtheria, pertussis) don't share that disparity (Centers for Disease Control,

2019b). For example, nationally, 86% of rural adolescents age 13-17 and 88.6% of urban adolescents have received at least one Tdap vaccine (Centers for Disease Control, 2019b). Tdap vaccination rates demonstrate that adolescents are getting vaccinated, they just are not getting all of the recommended vaccines. Other factors besides access to care likely contribute to the disparity. For example, Tdap is required for school attendance in Montana and in most other states (Immunization Action Coalition, 2020).

Interventions to Increase HPV Vaccine Uptake

Suboptimal HPV vaccine uptake rates and existent disparities must be addressed to decrease HPV-attributable cancer risk. Efforts to increase uptake will necessarily involve efforts to change vaccination behavior. When Public and Community Health workers engage in promotion efforts to change a health behavior (in this case HPV vaccine uptake), they use some sort of intervention.

An intervention is a combination of program elements or strategies designed to produce behavior changes or improve health status among individuals or an entire population.

Interventions may include educational programs, new or stronger policies, improvements in the environment, or a health promotion campaign (Missouri Department of Health and Human Services, n.d.).

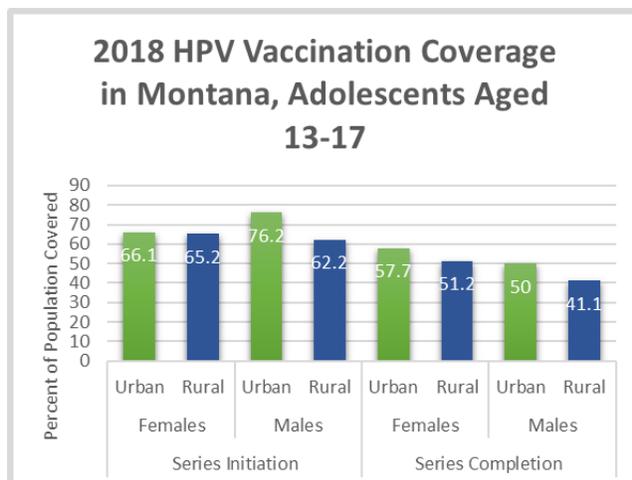


Figure 2. 2018 HPV Vaccination Coverage in Montana
Data from NIS-Teen (Centers for Disease Control, 2019b)

Public and Community Health research attempts to determine which interventions are most effective, acceptable, and feasible.

When designing a health behavior intervention, it is important to know why people *are not* engaging in the desired behavior. Knowing the ‘why’ can be the difference between an effective and an ineffective intervention. Three tools exist to help determine that why: theory, prior research, and direct feedback from a target population, and those tools are used in HPV vaccination intervention research.

Health Behavior Theory: Health behavior theories provide a conceptual framework to explain why people do or do not engage in health behavior like HPV vaccination. A health behavior theory is “an interrelated set of propositions that serve to explain health behavior or provide a systematic method of guiding health promotion practice” (DiClemente, Crosby, & Kegler, 2002, p. 8). These theories can guide researchers in identifying determinants of health behavior and provide frameworks for intervention development (Simons-Morton, McLeroy, & Wendel, 2012). Constructs from those theories, like ‘perceived barriers,’ can help health professionals and researchers design interventions that address specific reasons that a population isn’t engaging in the desired health behavior. Future interventions to increase HPV vaccination in Montana will likely include use of these theories, so it will be important to know which health behavior theories support HPV vaccination interventions that increase uptake.

Prior research: In addition to using health behavior theory as a guide, prior research can help intervention designers determine why people aren’t engaging in a specific health behavior. Much research has been done to identify reasons why people do not get vaccinated. Some reasons include vaccine availability and cost, health beliefs, healthcare utilization, and patient-caregiver relationship (Katz, et al., 2010), as well as strength of provider recommendation and the style of recommendation (Malo, Hall, Brewer, Lathren, & Gilkey, 2018). One major finding from prior research on HPV is that tailoring an intervention to a target population may result in higher rates of vaccine series initiation and completion (Dempsey & Zimet, 2015; Fu, Bonhomme, Cooper, Joseph, & Zimet, 2014; Walling, et al., 2016).

Population-specific primary data: To tailor an intervention is to address population-specific cultural factors, barriers and facilitators to vaccine uptake, and/or other characteristics. Knowing general reasons why people don’t get vaccinated is important and helpful, but tailoring

an intervention requires more than just general knowledge of other populations' reasons for not vaccinating. We also need a direct understanding of the population for which we wish to increase uptake. For HPV vaccination, we need to know why people aren't initiating and/or completing the vaccine series.

Aim 1: Literature Review of HPV Vaccine Uptake Interventions

Methods:

The focus of this review is on recent articles that summarize the outcomes of HPV vaccination interventions. Primary attention is given to interventions that measured vaccine series initiation and/or completion as the outcome and showed an increase in vaccine uptake in the priority population. However, for comparison, some articles are included that did not show effectiveness or measured other outcomes, such as vaccine awareness or knowledge.

To conduct this literature review, I followed the steps listed by Creswell and Creswell in *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (2018). These steps include:

1. Identifying key words (e.g. HPV, HPV vaccination, HPV vaccination intervention, health behavior theory)
2. Searching databases for relevant materials (OneSearch, PubMed, Web of Science, Google Scholar, etc.)
3. Locating about 50 reports of research with a priority on peer-reviewed journal articles
4. Skimming articles for relevance
5. Summarizing the articles and assembling the literature thematically or by important concepts

This literature review is organized thematically by type of intervention, specifically focusing on these types: (a) provider communication strategies, (b) education directed to the parent and/or adolescent, and (c) health systems interventions (e.g., automated prompts in electronic health systems). An initial review of the literature suggests that interventions of these types are the most commonly studied with regard to increasing HPV vaccine uptake in adolescent populations (Smulian, Mitchell, & Stokley, 2016; Walling, et al., 2016).

Throughout the literature review, the health behavior theory or theories that either support or oppose the ability of the intervention to affect vaccine uptake were identified and described. For example, the Health Belief Model and the Theory of Planned Behavior were explicitly referenced in recent intervention studies (Malo, Hall, Brewer, Lathren, & Gilkey, 2018; Sundstrom, Brandt, Gray, & Pierce, 2018).

In recent years, several systematic reviews have compared HPV vaccination interventions and their outcomes (Fu, Bonhomme, Cooper, Joseph, & Zimet, 2014; Niccolai & Hansen, 2015; Gilkey & McRee, 2016; Smulian, Mitchell, & Stokley, 2016; Walling, et al., 2016; Francis, et al., 2017). Similar search strategies as described in these systematic reviews were used to identify articles this review. However, the focus of this review is on articles published from January 2015 to March 2020, to avoid reviewing research that has already been covered in the systematic reviews mentioned. The table below lists the total number of systematic and literature reviews discussed, and the number of original intervention research articles reviewed in this paper.

Number of Articles Reviewed by Intervention Type

	Systematic and Literature Reviews	Educational Interventions	Provider Communication Interventions	Health Systems Interventions
Number of Articles Reviewed	8	6	5	7

Findings

Educational Interventions

Educational HPV vaccination interventions are designed to increase vaccine uptake are common in the literature. Within the context of health promotion, education can be defined as any combination of planned learning experiences designed to increase awareness, knowledge, change attitudes, or build skills with the goal of producing behavior change or improving health status (McKenzie, Neiger, & Thackeray, 2017). For the purposes of this literature review, the behavior change I am concerned with is HPV vaccine uptake, and I am interested in educational interventions aimed at parents, adolescents, or adult patients still within the window for recommended vaccination.

Educational Intervention Examples
A flyer with HPV information given to parents or hanging on a clinic wall
An informational video or website designed to provide information about HPV and HPV vaccination
A workshop for parents providing information on HPV and HPV vaccination
A letter to parents with HPV and HPV vaccine facts

This review specifically focuses on educational interventions that measure the outcome of vaccine uptake, because while awareness, knowledge, attitude, and skill are necessary for behavior change, they are often not sufficient (Simons-Morton, McLeroy, & Wendel, 2012). Therefore, if the goal is to create a behavior change, to increase HPV vaccine uptake, simply increasing awareness, etc., may not be enough to actually bring about uptake. Because awareness is not necessarily sufficient to generate behavior change, it is unclear if educational interventions can be recommended as a strategy to increase HPV vaccine uptake.

Recent systematic reviews have found educational interventions to have mixed effectiveness. Fu and colleagues (2014) conducted a systematic review of 33 educational interventions “designed to improve patient or parental knowledge or attitudes, and which measured ... (1) receipt of HPV vaccine (any dose or completion of the 3-dose series), (2) intention to receive HPV vaccine, or (3) attitude toward HPV vaccine.” (Fu, Bonhomme, Cooper, Joseph, & Zimet, 2014, p. 1902). They found that these educational interventions were largely unsuccessful and observed that intent to vaccinate was the measured outcome for most of the interventions, rather than vaccine initiation and/or series completion (Fu et al., 2014). The authors state that “even among adolescents and young adults, there is no evidence that the positive intentions and attitudes achieved by HPV educational interventions are durable or that they impact vaccine uptake” (Fu et al., 2014, pg. 1907). Other authors have echoed this observation (Niccolai & Hansen, 2015; Walling, et al., 2016). However, Fu and colleagues (2014) did note that most of the studies they reviewed were not well-designed or adequately powered. Most of the interventions reviewed consisted of a single educational session, which may not be enough to affect vaccination behavior (Fu et al. 2014).

Walling and colleagues (2016) conducted a broader systematic review of HPV vaccination intervention studies and also found mixed outcomes and variability in study quality. The authors used a different classification system for interventions than used in this paper: informational, behavioral, and environmental. Their ‘informational’ interventions fit the definition of educational intervention I am using, as did some of the interventions they classified as ‘behavioral.’ Because of the concern that awareness, etc., is not sufficient for behavior change, Walling and colleagues (2014) chose to only review studies that used HPV vaccine uptake as an outcome measure. The informational interventions had mixed results: one study

showed increased vaccine uptake and one did not. Interventions testing the way educational messages were framed also had mixed results (Walling, et al., 2016). Echoing Fu and colleagues (2014), Walling and colleagues (2016) observed that many of the studies were poorly designed: lacking control groups and introducing the possibility of bias through self-reported outcomes.

In contrast, Smulian and colleagues (2016) found the educational interventions they reviewed to be effective. Using yet another slightly different classification system, Smulian and colleagues (2016) conducted a broad systematic review of HPV vaccination interventions. These authors chose to include two educational interventions under the wider category of ‘increasing community demand for HPV vaccination’ (Smulian, Mitchell, & Stokley, 2016). This category also included other, non-educational interventions like vaccination requirement for school attendance (Smulian, Mitchell, & Stokley, 2016). The authors note that while patient education alone is not recommended to increase vaccine coverage “due to insufficient evidence...the two patient education studies reviewed here demonstrate some potential promise of this type of intervention as it relates to HPV vaccination” (Smulian, Mitchell, & Stokley, 2016, p. 1584). However, they caution that both studies were of 18-26-year-olds, not the recommended age range for vaccination, and both had moderate sample sizes.

Recent Studies

Since the publication of these systematic reviews, additional studies with mixed findings and varying quality have been conducted on educational interventions that measure increase in HPV vaccine uptake. For example, Joseph and colleagues (2016) conducted a pilot randomized controlled trial using a single 10-20 minute negotiated interviewing session to educate African American and Hatian mothers (n=200) about the HPV vaccine. This trial increased knowledge, but did not increase vaccine intitation or completion (Joseph, et al., 2016). This could be due to the single education session: Fu and colleagues (2014) noted in their review that a single education session may not be enough to change behavior.

Lee and colleagues (2016), in a community-based participatory research study, used a quasi-experimental design to test the impact of a mobile health educational intervention on vaccine uptake in Korean immigrant women (aged 18-26). This was a small study, n=30, without a control group that did see a clinically significant impact on HPV vaccine initiation, as well as increased knowledge and intent to vaccinate. Thirty percent of the participants initiated the

vaccine after the study was complete. For this intervention, the participants received culturally and personally tailored education delivered to them through their mobile phones, and the education sessions lasted 20-30 minutes each day for 7 days. The authors suggested that the personalization of the education sessions was an important contributor to vaccine initiation in participants.

In Sweden, Grandahl and colleagues (2016) conducted a much larger cluster-randomized controlled trial and found a statistically significant increase in HPV vaccine uptake. The authors also found an increase in favorable beliefs about primary HPV prevention (Grandahl, et al., 2016). However, about half of the females in the intervention group were already vaccinated against HPV when the trial began (male vaccination rate prior to the intervention was not measured). At the conclusion of the trial, 15 females and 1 male in the intervention group reported receiving the vaccine before the follow-up questionnaire was given (16 students out of 394 in intervention group) (Grandahl, et al., 2016).

Last year, Dixon and colleagues (2019) published a study of a single-session educational video intervention delivered to parents of adolescents and saw an increase in HPV vaccine uptake in adolescents whose parents viewed the video. This cluster-randomized controlled trial took place during clinic visits, and used a program that electronically transferred medical records so that the clinic knew the patient was due for a dose of the HPV vaccine, and could target parents accordingly. Adolescent children of parents who received the intervention (n=537) were three times as likely to receive a dose of the vaccine (Dixon, et al., 2019). Unlike Lee and colleagues (2016) and Grandahl and colleagues (2016), Dixon and colleagues (2019) used the electronic record of receipt of immunization to measure uptake, rather than relying on self-report of participants.

Although awareness and knowledge are necessary but often not sufficient for behavior change, some published educational interventions studies have focused on these outcomes, independent of actual HPV vaccine uptake. For example, Sweeney and colleagues (2015) conducted a randomized trial to evaluate increase in knowledge and intent to vaccinate in sexually active undergraduate women. The authors used a single, one-hour education session and found that it was effective at increasing knowledge and intent to vaccinate, even at follow up.

However, without measuring vaccine uptake, it is unclear whether this intervention could be effective at increasing HPV vaccination in this population.

Use of Health Behavior Theory in Educational Interventions

The very idea of an educational intervention implies that lack of awareness or knowledge is a reason why people haven't initiated or completed HPV vaccination. Because health behavior theories are commonly used to explain the 'why' behind behavior, researchers may be using health behavior theories to guide intervention development. However, there is not much mention of the use of health behavior theories in the systematic reviews I looked at. The only mention of a health behavior theory was in Walling and colleagues' paper (2016), where the authors claim that there is mounting evidence to suggest that health belief models may impact intent but do not have long-term impact on behavior (pg. 6). While that may be the case, health belief models are only one "style" of health behavior theory, and the Health Belief Model itself *has* been used in effective educational interventions (Grandahl, et al., 2016).

Health Behavior Theory Definitions	
Knowledge	Objectively verifiable truth
Perception	An individual's interpretation of information
Belief	What an individual considers to be true
Attitude	Evaluation about the goodness or badness of an object or thing
Value	Evaluation of the relative importance of various factors, concepts, and actions
Social Norm	The prevalence of a behavior within a society or group
Subjective Norm	The perception that an important person or group will approve of a behavior

Simons-Morton, McLeroy, & Wendel, 2012

Many health behavior theories exist, but in the original research articles of educational intervention that I reviewed, three theories are primarily used: the Fogg Behavior Model (FBM), the Health Belief Model (HBM), and the Theory of Planned Behavior (TPB). I am going to provide a brief description of each of these theories, and then discuss how the theories are used and how their use is reported by researchers. To the right is a table with terms and definitions relevant to health behavior theories.

Fogg Behavior Model: Like many behavior theories used in health promotion, the FBM was not originally designed to explain health behavior. The FBM was not designed to change health behavior, it was designed to inform persuasive technology (Fogg, 2009). Persuasive technology aims to change attitudes or behavior through apps or websites. Examples include Amazon's 'one-click' shopping, or the way Facebook continually

updates users' newsfeeds to encourage continued scrolling (Larson, 2017). However, health behavior interventions that use persuasive technology have used this theory to guide intervention development (Lee, Koopmeiners, McHugh, Raveis, & Ahluwalia, 2016).

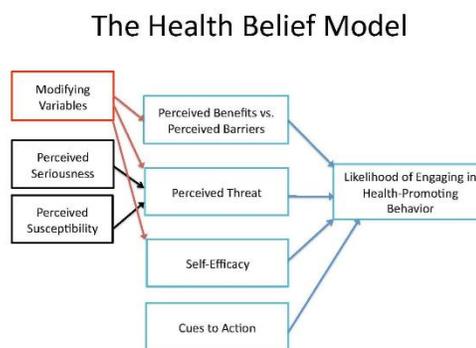
Motivation, ability, and trigger are the three constructs that explain behavior in the FBM. "For a person to perform a target behavior, he or she must (1) be sufficiently motivated, (2) have the ability to perform the behavior, and (3) be triggered to perform the behavior. These three factors must occur at the same moment, else the behavior will not happen." (Fogg, A behavior model for persuasive design, 2009, p. 1).

The motivation construct has "three 'Core Motivators': sensation, anticipation, and belonging. Each of these has two sides: pleasure/pain, hope/fear, acceptance/rejection" (Fogg, 2020). The FBM states that there are three ways to increase ability to do a behavior: train people, give them a tool or resource, or make target behavior easier to do (Fogg, 2020). Last, there are three types of triggers: facilitator (high motivation, low ability), signal (high motivation, high ability), and spark (low motivation, high ability). The intervention designer chooses which trigger to use based on where the target population is at in terms of their motivation and ability (Fogg, 2020).

Health Belief Model: "The premise of the HBM is that beliefs about susceptibility and severity of health concern and beliefs about the utility of possible preventive action predict the likelihood of action" (Simons-Morton, McLeroy, & Wendel, 2012, p. 113). In other words, people's readiness to engage in a health behavior is based on 1) their

desire to get well, avoid getting sick, or improve health, and 2) the belief that a specific behavior will help them fulfill that desire (Simons-Morton, McLeroy, & Wendel, 2012).

A description of the constructs of the HBM follow.



Ulrich, n.d.

In the HBM, individual action mostly follows from how that individual perceives different threats to their health. The perceived threat is a combination of how serious the individual thinks a health issue would be for them (perceived seriousness) and how likely it is that that health issue will actually happen to them (perceived susceptibility).

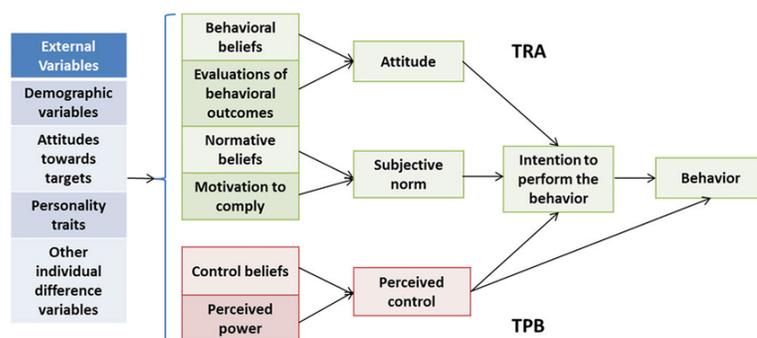
Generally, perceived seriousness will only contribute to the likelihood of a behavior if the individual thinks they are susceptible to the health threat (Simons-Morton, McLeroy, & Wendel, 2012).

Additionally, the perceived benefits of engaging in a health behavior must outweigh the perceived barriers. For example, a parent must believe that vaccinating their child against HPV has benefits that outweigh perceived barriers that might include cost or lack of transportation. The HBM also states that an individual must have self-efficacy (confidence in their ability to take action) around a behavior, and there must be a cue to action (new information that relates to a perceived threat) (Simons-Morton, McLeroy, & Wendel, 2012). To continue the HPV vaccination example, the parent must feel confident in their ability to get their child vaccinated, and they may need a cue to action, like a provider recommendation, to engage in vaccination behavior.

If an individual perceives that a health issue is a threat, they perceive that the benefits of engaging in a behavior to mitigate that threat outweigh the barriers, they feel confident they can engage in that behavior, and they experience a cue to action, they are then more likely to engage in the health-promoting behavior. It is important to note that the HBM doesn't explain how to cross the gulf from likely to engage to actually engaging in the behavior.

Theory of Planned

Behavior: The TPB is an expansion of the Theory of Reasoned Action (TRA), and its basic premise is that behavior is the product of three main constructs – attitude toward the



Rai, Goodwin, Meyerowitz, & Kabanga, n.d.

behavior, subjective norms, and perceived behavioral control (Simons-Morton, McLeroy, & Wendel, 2012). Like the FBM, the TPB is not a health behavior theory. The TRA/TPB is very popular psychological theory intended to explain behavior more generally, but has been widely used in health promotion (Simons-Morton, McLeroy, & Wendel, 2012).

According to the TPB, an individual with a positive attitude about a behavior is more likely to perform the behavior. Here, attitude is defined as subjective evaluation of the behavior, positive or negative evaluation of self-performance of the behavior, and is influenced by behavioral beliefs and expected outcomes (Simons-Morton, McLeroy, & Wendel, 2012).

The second construct of the TPB is subjective norms. The perception of social approval is at the heart of the subjective norms construct (Simons-Morton, McLeroy, & Wendel, 2012). An individual who perceives a behavior to be prevalent (especially among their peers) and socially normal is more likely to engage in the behavior.

Last, an individual's intent to perform a behavior is impacted by their perceived behavioral control. This is their evaluation of their ability to do the behavior, how easy or difficult they think it will be, if they are confident that they can do it (self-efficacy) and if they think the behavior is within their power (Simons-Morton, McLeroy, & Wendel, 2012).

Like the HBM, the constructs of the TPB - attitude, subjective norms, and perceived behavioral control - are necessary but not necessarily sufficient for an individual to actually engage in a behavior. While the TPB appears to cross the gap from intent to behavior, critics argue that behavior is also influenced by environmental factors outside of an individual's control (Simons-Morton, McLeroy, & Wendel, 2012)

Both the TPB and the HBM are expectancy value theories. This means that they are based on the idea that behavior is at least partly based on "rational calculation of the benefits of the action, considering the available options" (Simons-Morton, McLeroy, & Wendel, 2012, p. 98). When a person thinks about a behavior, they develop beliefs about the behavior, and those beliefs evolve into attitudes about engaging in the behavior. "Expectancy value theories were developed to explain how individuals' behaviors are influenced by beliefs and attitudes toward

objects and actions” (Simons-Morton, McLeroy, & Wendel, 2012, p. 99). These theories assume that people behave according to the personal benefit they expect to derive from the action. If we know what sorts of beliefs and attitudes predict behavior, we can use that information to design effective behavior change interventions, theoretically. Beliefs and attitudes are based on information, so new information could alter them (Simons-Morton, McLeroy, & Wendel, 2012).

Heterogenous reporting and lack of consistency in the use of health behavior theories in educational interventions makes it impossible to determine which health behavior theories might be the best to use to increase HPV vaccine uptake. Researchers use a variety of health behavior theories to inform educational interventions for HPV vaccination, but there are wide discrepancies in how authors report that use of theory, and this lack of consistency makes comparing interventions-by-theory impossible. Additionally, lack of consistency complicates matters for future researchers attempting to test and/or adapt the intervention for use in a different population.

One of the key discrepancies is the level of detail with which authors describe their use of theory. For example, Lee and colleagues (2016) explain that they used a single model, the Fogg Behavior Model (FBM) to guide intervention development, along with feedback from the priority population and other key community stakeholders. The authors provide a conceptual framework for the study that illustrates how they used FBM in the intervention. The intervention “identifies barriers, develops motivators, and provides a trigger to initiate a health behavior action, such as receiving the HPV vaccine” (Lee, Koopmeiners, McHugh, Raveis, & Ahluwalia, 2016, p. 68). Some detail is provided to explain how the constructs guided intervention design, but it is unclear if the FBM influenced the instrument that measured outcomes.

Grandahl and colleagues (2016) used the Health Belief Model (HBM) both to guide intervention development, and to measure some of their primary outcomes. School nurses provided a 30-minute face-to-face education session about HPV risks and prevention which addressed susceptibility, severity, barriers, and benefits. As a result of the intervention, students did perceive themselves to be at increased risk, considered HPV a severe threat, and perceived fewer barriers to vaccination as a result of intervention (Grandahl, et al., 2016). The authors of this study explained in great detail how the HBM was used both in the intervention and the measurement of outcomes.

In contrast, Dixon and colleagues (2019) only mention in passing that they used a health behavior theory: in this case, the Theory of Planned Behavior (TPB). Their explanation is limited to one sentence: “although not assessed in this article, the scripts and questions used by participants were guided by the theory of planned behavior, which has been used in previous HPV vaccine uptake research” (Dixon, et al., 2019, p. 4). The only further description of the content of the scripts explains that they included discussion of HPV risks and benefits of the vaccine, along with reinforcing messages (Dixon, et al., 2019).

Sweeney and colleagues (2015) also used the TPB to guide the development of their intervention. The authors noted that the TPB has been used successfully as a framework for interventions addressing sexual risk behaviors and STIs (Sweeney, McAnulty, Reeve, & Cann, 2015). However, not only did Sweeney and colleagues (2015) not measure HPV vaccine uptake as an outcome of their intervention, they found only a change in knowledge about HPV and intent to vaccinate, and no change in self-reported risk behavior. Without measuring vaccine uptake, this study cannot add information about what behavior theories are effective guides for interventions that increase uptake.

The problem of lack of consistency for comparing interventions by theory also arises in how researchers use theory. Some researchers do not adhere to one theory all the way through their intervention, instead combining different theories for different parts of their intervention. Others adhere one theory all the way through. Additionally, sometimes researchers report using a behavior theory to guide the intervention development, sometimes they only report using a behavior theory to measure intervention outcomes, and sometimes they do both. Again, these issues make comparing interventions by theory impossible.

For example, Joseph and colleagues (2016) did not report using the HBM as a framework for their intervention, but they did report measuring intervention outcomes using an instrument that measured changes in HBM constructs. Lee and colleagues (2016) used the FBM to guide intervention development, but used the Transtheoretical Model (Stages of Change) to measure intent to vaccinate post-intervention.

Other interventions use more than one health behavior theory to guide intervention development: a proposed intervention developed by Cooper and colleagues (2016) used constructs from a variety of health behavior theories: HBM, TPB, and Social Cognitive Theory.

The authors provided a helpful table outlining the theories used, including constructs and definitions, and clearly delineate how the strategies the intervention uses align with the different constructs. While the authors are only describing a proposed intervention, and not results of a trial, the table they provide would be ideal in all studies using health behavior theories.

The examples given thus far illustrate studies that clearly state their use health behavior theories, but not all studies make this clear. Without contacting the authors of every study that doesn't mention their use of theory, it is impossible to know if these studies did not use a theoretical framework or simply don't mention it.

While many authors do mention the use of health behavior theories, others do not, and it is unclear if that means that no theory was used or if the theory simply was not mentioned. This lack of explicitly connecting interventions to theory makes it more difficult to model future interventions on these studies. For example, Winer and colleagues (2016) studied the use of an educational presentation to Hopi mothers at a mother/daughter dinner, and found that the intervention increased HPV vaccine initiation for those who were unvaccinated or had unknown vaccine status at the time of the intervention. The authors do not detail the process of intervention development, noting that a description of the process was forthcoming in another manuscript (Winer, Gonzales, Noonan, & Buchwald, 2016). (I was unable to find this forthcoming manuscript.) They do mention that focus groups were used with Hopi parents to design the intervention, and those focus groups assessed knowledge, attitudes, and beliefs about HPV vaccination. It is possible to speculate that the authors asked questions in those focus groups that were guided by a health behavior theory or theories, but it is impossible to determine from the article as published.

Heterogenous reporting and lack of consistency in the use of health behavior theories in educational interventions makes it impossible to determine which health behavior theories might be the best to use to increase HPV vaccine uptake. Lee and colleagues (2016) used the FBM, and saw a clinically significant increase in uptake. Dixon and colleagues (2019) used the TPB, and also saw increased vaccine uptake. Using yet another model, the HBM, Grandahl and colleagues (2016) saw a small increase in vaccine uptake. Thus, it does appear that educational interventions that use some health behavior theory to guide intervention development (not just to measure outcomes) are effective.

Provider Communication Interventions

Provider communication interventions are those interventions that specifically focus on the method the provider uses to communicate with parents and adolescents about the HPV vaccine. The provider is the physician, physician's assistant, or nurse providing healthcare to the patient. Providers have also been described as the clinician prescribing the HPV vaccine (Brewer, et al., 2017). Communication is less easily defined, as there is disagreement on this definition within the field. For the purposes of this review, communication is defined as “a process by which information is exchanged between individuals through a common system of symbols, signs, or behavior” (Merriam Webster Dictionary, 2020). Provider communication here is defined as in-person dialog about HPV and the HPV vaccine between parents, patients, and providers in a clinical setting.

Inevitable overlap occurs between communication interventions and other intervention types; however, categorization is still useful. This overlap exists partly because almost every intervention involves some type of communication (McKenzie, Neiger, & Thackeray, 2017). For example, educational interventions and communication interventions are not mutually exclusive: an intervention to improve provider communication may include education sessions to train providers. In fact, Gilkey and McRee (2016) chose to include the use of educational materials provided in a clinical setting as part of their systematic review of provider communication interventions. However, Gilkey and McRee (2016) defined provider communication more broadly than the definition I use here. For purposes of this paper, “the use of educational materials” is an educational intervention, though it is certainly true that information is being communicated in such an intervention. For this paper, provider communication interventions focus on the impact of the provider's communication style on HPV vaccine uptake, where educational interventions focus on the impact of a planned learning experience on HPV vaccine uptake.

Between 2014 and 2016, a flurry of research was published on provider communication as it relates to HPV vaccine uptake. Generally this research focused on surveying parents to determine if the presence and quality of provider recommendation had an impact on HPV vaccine uptake (Rahman, Laz, McGrath, & Berenson, 2015; Dempsey, et al., 2016; Gilkey, et al.,

2016), surveying providers to determine how often and how strongly they recommended the vaccine (McRee, Gilkey, & Dempsey, 2014; Gilkey, Malo, Shah, Hall, & Brewer, 2015), and exploring reasons why providers might not regularly communicate with caregivers and patients about HPV vaccination (Bynum, et al., 2014; Gilkey, et al., 2015).

Research suggests that receipt of provider's recommendation to vaccinate is an effective way of driving HPV vaccine uptake. Gilkey and McRee (2016) conducted a systematic review of provider communication interventions and found that provider communication can increase HPV vaccine uptake. The authors noted that "adolescents who receive a provider's recommendation have substantially higher odds of initiating HPV vaccination compared to those who do not" (Gilkey & McRee, 2016, p. 1454). Moss and colleagues (2016) analyzed parental interview data from the 2010 National Immunization Survey (NIS-Teen) and found that adolescent vaccine uptake rates were higher when parents reported they received a recommendation from their adolescent's provider. Additionally, parents report that *lack* of any provider recommendation is a main reason they have not vaccinated their adolescent for HPV (Gilkey & O'Leary, 2018). These findings reflect the broader vaccination literature: a provider recommendation is a strong and consistent correlate with vaccine uptake (Moss, Reiter, Rimer, & Brewer, 2016).

A recommendation is important, but the *strength* of the recommendation also matters for vaccine initiation. Dempsey and colleagues (2016) conducted a cross-sectional survey of parents of 9-14-year-olds and found that "a very strong [provider] recommendation for HPV vaccines was associated with a higher likelihood of vaccine receipt" (p. 1469). Additionally, those parents who recalled a very strong recommendation for HPV vaccines also had more positive attitudes about HPV vaccine safety, efficacy, and necessity (Dempsey, et al., 2016). In their systematic review, Gilkey and McRee (2016) also reported that the strength and quality of the recommendation is positively correlated with vaccine acceptance. A strong recommendation emphasizes the importance of the vaccine, the vaccine's role in cancer prevention, and the importance of getting the vaccine at that time rather than waiting (National HPV Vaccination Roundtable, 2019).

The style of provider communication can also positively impact HPV vaccine series initiation. Brewer and colleagues (2017) and Dempsey and colleagues (2018) tested provider communication interventions and found that 'announcement' (or 'presumptive') training for

providers resulted in a clinically significant increase in HPV vaccine initiation. Brewer and colleagues (2017) conducted a randomized trial to determine if the style of communication used by providers had an impact on vaccine uptake. The styles of communication they tested were ‘announcement’ and ‘conversation.’ A provider using the announcement approach would announce to the parent or caregiver that their child was due for the HPV vaccine and that it would be given during that visit. The announcement approach assumes the parent is ready to vaccinate (Brewer, et al., 2017). Using the conversation approach, the provider would start a conversation, using an open-ended discussion to hopefully build rapport and increase parent openness to vaccination (Brewer, et al., 2017). The clinics randomized to receive the provider training in the announcement approach saw an increase in HPV vaccine initiation, where the control and conversation clinics did not.

There are several different names for the announcement approach but these approaches all work similarly. The announcement approach is called ‘presumptive’ by Dempsey and colleagues (2018), but the different name still produced similar increased HPV vaccine initiation rates. Their multi-component intervention included a training for providers that taught the use of the presumptive approach, to be followed by brief motivational interviewing for hesitant parents. Intervention clinics saw a clinically significant increase in HPV vaccine initiation. Moss and colleagues (2016) called the announcement/presumptive approach “efficient” communication, or provider-driven, and also noted that adolescent vaccination rates were higher when reported experiencing the efficient communication style.

Provider communication style has a clear impact on HPV vaccine initiation, but not on series completion. While Brewer and colleagues (2017) did see a significant increase in HPV series initiation in practices where providers were trained in the announcement style of recommending the HPV vaccine, they did not see an increase in series completion rates as a result of their intervention. They did note, however, that their intervention was not focused on completion, and that they only used a 6-month follow-up period. Many of the intervention participants might go on to complete vaccination outside of the follow-up window. Additionally, older adolescents tend to see their providers less often, and the intervention did not aim to increase clinic visits (Brewer, et al., 2017). Dempsey and colleagues (2018) also saw no increase in completion rates.

The length of the follow-up period may make the impact of provider communication interventions on series completion opaque, but it is likely that there are different barriers for series completion as compared to series initiation (Katz, et al., 2010; Walling, et al., 2016). HPV series initiation can be done in a single visit, whereas completion requires one or two return trips to the clinic. Provider communication interventions are often focused around vaccine hesitancy in caregivers, which impacts series initiation. If a caregiver is willing to initiate, bringing them back to the clinic may require different tactics other than convincing them to return, thus, a different type of intervention might be needed. Getting patients to return for series completion is often a focus of reminder/recall interventions, which will be discussed below in the Health Systems interventions section.

Provider communication clearly has a positive impact on HPV vaccine initiation, but it is important to note that in the two above mentioned trials that tested communication style, the increase in initiation did not reach the Healthy People 2020 goal of 80% coverage for eligible adolescents (Brewer, et al., 2017; Dempsey, et al., 2018). Initiation rates did not even come near the 80% coverage goal. Several possible explanations for this exist. First, while both providers in the intervention arm of both trials received training in the announcement approach, no one was in appointments monitoring that all providers executed the intervention training correctly. Inconsistent execution might impact parents' decisions about initiation. Additionally, the providers were asked to report on their use of the announcement approach after time had passed, potentially giving them time to forget how and how often they used it. For example, providers were asked to think back over the previous weeks (Malo, Hall, Brewer, Lathren, & Gilkey, 2018) or quarters (Dempsey, et al., 2018) and report how often they used a given announcement style.

Second, Dempsey and colleagues (2018) noted that there was variability in provider use of intervention components across clinics and contexts. While a follow-up analysis of secondary outcomes did determine that the use of the presumptive approach followed by motivational interviewing and an HPV fact sheet with hesitant parents was the main mechanism in the intervention that improved vaccine uptake (Reno, et al., 2019), the variability in provider use of intervention components could have negatively impacted HPV vaccine initiation.

Third, provider communication style has been studied in the context of vaccine hesitancy, not refusal (Brewer, et al., 2017; Dempsey, et al., 2018). Gilkey and O'Leary (2018)

observed that while communication style can impact HPV vaccine uptake in hesitant parents, parents with a strong degree of hesitancy or outright refusal may need a different approach. Strong hesitancy or refusal may indicate that those parents have different internal barriers to vaccination. A higher level of strong hesitancy or refusal may exist for parents around HPV vaccination than for other types of vaccines, impacting the ability of provider communication interventions to achieve 80% vaccination in the trial population. A different type intervention could be needed to address those concerns.

Use of Health Behavior Theory in Provider Communication Interventions

Provider communication interventions to increase HPV vaccine uptake also use health behavior theories to guide intervention development, and to test intervention outcomes. Two different sets of behavior may be addressed with health behavior theories in these interventions: the providers' communication behavior recommending vaccination and whether the parent or patient obtains the vaccination based on that recommendation. Research indicates that providers do not consistently or strongly recommend the HPV vaccine, and so changing that behavior is important to increase HPV vaccine uptake (Bynum, et al., 2014; Gilkey, et al., 2015; Dempsey, et al., 2016; Gilkey & O'Leary, 2018). As noted above, provider recommendation to parents is linked to increased HPV vaccine initiation, as is style of communication. Provider communication interventions may use health behavior theories related to provider behavior, parent/patient behavior, or both.

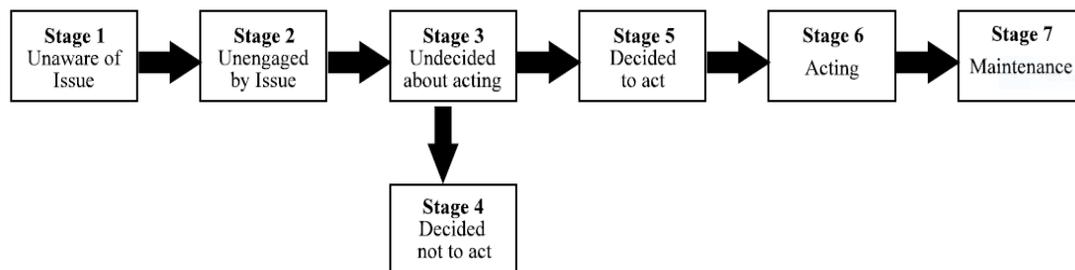
Both Brewer et al. (2017) and Dempsey et al. (2018) used health behavior theories to guide provider communication intervention development. The TPB guided the development of the intervention for Brewer et al. (2017), and the Precaution Adoption Process Model (PAPM) guided Dempsey et al. (2018). The TPB is described above in the educational interventions section. A brief description of the PAPM follows.

Precaution Adoption Process Model: The PAPM is a stage theory of behavior intended to explain how people decide among possible options, and the term 'precaution-adoption' highlights the focus on "the psychological processes within the individual that translate to action to reduce a particular threat" (Simons-Morton, McLeroy, & Wendel, 2012, p. 267). Based on decision theory, the PAPM is most applicable toward behavior change when the behavior is the adoption of a new behavior that reduces risk (McKenzie, Neiger, &

Thackeray, 2017). These are behaviors that the individual engages in deliberately after carefully considering their options.

The stage construct is essential to the PAPM, and can be defined as “categories of change (stages) along a continuum of motivational readiness to change a problem behavior” (McKenzie, Neiger, & Thackeray, 2017, p. 169). Stages are critical to the behavior change progression, and the PAPM assumes that individuals will pass through each stage on their way to that change. Barriers exist within each stage and between stages, and are similar no matter what the behavior change is or the population within which change is desired (Simons-Morton, McLeroy, & Wendel, 2012).

In the PAPM, a person starts out unaware of the health issue (Stage 1). At some point in time, they learn something about the issue, but remain unengaged (Stage 2). When the person reaches Stage 3, they have become engaged and are thinking about what to do about the issue. At this point, the person can do one of three things. They can decide to remain undecided, remaining in Stage 3. They may decide not to act, moving to Stage 4. Or, the person may decide to act, thus moving to Stage 5. Once the person has decided to act, the next step is actually enacting a behavior to address the health issue (Stage 6). Finally, depending on the behavior, they may need to maintain the behavior change over time (Stage 7) (Weinstein, Sandman, & Blalock, 2008). The figure below illustrates the stages in the PAPM.



Weinstein, Sandman, & Blalock, 2008

A person’s transition from stage to stage is influenced by a variety of different possible factors (Weinstein, Sandman, & Blalock, 2008). Using HPV vaccination as an example, educational messaging about HPV from the media and from a provider could move

someone from Stage 2 to Stage 3. The transition from Stage 3 to Stage 4 or 5 could be influenced by beliefs about severity of HPV and susceptibility to HPV, by fears about safety, by recommendations from others, or by the perception that HPV vaccination is a social norm.

The use of health behavior theories in provider communication interventions is inconsistently reported, making it impossible to determine which theories might be the most effective to use in provider communication interventions to increase HPV vaccine uptake. Inconsistent reporting appears in two key areas: author mention of use of health behavior theory and varied level of detail provided regarding the use of health behavior theory.

Not all authors mention the use of health behavior theory in intervention developments, and this makes deciding which theory might best inform a future intervention difficult. For example, Brewer and colleagues (2017) did not mention their use of TPB. That information is, however, present in a paper (Malo, Hall, Brewer, Lathren, & Gilkey, 2018) examining intermediate outcomes and process measures from the Brewer et al. (2017) intervention. Malo et al. (2018) clearly stated that the intervention was guided in part by the TPB, and gave some explanation as to how TPB constructs were used. The fact that Brewer et al. (2017) used TPB to guide their intervention development and did not mention it suggests that other interventions (of any kind) may use a theoretical framework, even if the authors do not mention it.

Malo and colleagues (2018) provide an example of health behavior theory use that was easily analyzed and could be used to guide future research. The authors noted that the intervention was designed to operationalize TPB constructs to increase providers' positive attitudes toward recommending the HPV vaccine, to change their perceived subjective norms about the vaccine, and to increase their perceived behavioral control to recommend the vaccine (Malo, Hall, Brewer, Lathren, & Gilkey, 2018). The reason stated for using this approach should be familiar. Basically, in order to increase the frequency and quality of provider recommendation, it is necessary to know why providers aren't engaging in that behavior, to know the barriers and facilitators for their communication (Malo, Hall, Brewer, Lathren, & Gilkey, 2018). Malo and colleagues (2018) noted that TPB constructs were used pre- and post-intervention to assess provider attitudes, subjective norms, and behavioral control around recommending the HPV vaccine. Here we see a health behavior theory being used to change

provider behavior, with patient vaccine uptake as a subsequent outcome. In the future, the example provided by Malo et al. (2018) could easily be used to adapt this intervention to another population, or as a framework for designing another provider communication intervention based on TPB.

The clear detail provided by Malo et al. (2018) allowed the authors to determine that the TPB was not the variable that impacted vaccine uptake. The TPB constructs improved in providers in both the announcement and conversation arms, but vaccine uptake did not increase in the conversation arm of the trial. Because the authors measured these constructs specifically, they were able to determine that the constructs do not explain why the announcement training was more effective than the conversation training (Malo, Hall, Brewer, Lathren, & Gilkey, 2018).

In contrast, Dempsey and colleagues (2018) did not provide details regarding how they used the PAPM in their intervention design. It is unclear whether PAPM constructs were used to develop the training for providers, as an overarching framework suggesting communication style would impact vaccine uptake, or something else. Neither the paper analyzing secondary outcomes from the Dempsey et al. (2019) trial (Reno, et al., 2019), nor the paper examining the Motivational Interviewing component of that same trial (Reno, et al., 2018) give any further mention of the use of the PAPM. Therefore, determining if PAPM constructs had any mediating effect on either the providers' behavior change or patient vaccine uptake is difficult.

Health behavior theories are being used in provider communication interventions, but not with the level of consistency that would allow a determination of which health behavior theory is most effective in guiding intervention design or increasing HPV vaccine uptake. As with educational interventions, it appears that a theoretical framework is helpful, but there is not enough evidence to suggest that any one particular theory is 'better' than another for guiding interventions that aim to change provider behavior.

Health Systems Interventions

Health systems interventions that have been tested for increasing HPV vaccination rates include reminder/recall interventions for parents and clients, and electronic health record-based provider prompt interventions. A reminder/recall intervention reminds parents or patients that they are due for a dose of the HPV vaccine and could use letters, phone calls, text messages, emails, postcards, or other method to remind parents or patient (Dempsey & Zimet, 2015). While the terms are sometimes used interchangeably, reminders are messages notifying the parent or patient of a dose of the HPV vaccine that is *due*, while recalls are messages notifying the parent or patient of a dose that is *overdue* (Oliver, Frawley, & Garland, 2016). Reminders/recalls can be initiated by the patient's provider, or by a centralized source such as a managed care organization, public health department, or insurance program, and could be generated through EHR or other methods. (Francis, et al., 2017).

While reminder/recalls are aimed at parents or patients, provider prompts are reminders *for providers* that a patient is due or overdue for a vaccine. These prompts are typically generated at the point of care. The prompt could be generated by EHR, it could be a note on the patient's chart, it could be a list of due/overdue patients given to the provider at the start of each day, or the prompt could take some other form (Oliver, Frawley, & Garland, 2016).

Both of these health systems interventions aim to change health behavior through environmental cues (Francis, et al., 2017). In the literature, these interventions are sometimes classified as clinic-level, practice-based, or electronic health record (EHR) interventions. However, centralized reminder/recall interventions or non-electronic reminder/recall and provider prompt interventions are also included here. Francis, et al. (2017) categorized these types of interventions as communication technology interventions, but also included educational, interactive computer videos. Because the main aim of those videos was education, I chose to use a different name to more clearly differentiate between intervention types.

Several systematic and literature reviews have found reminder/recall interventions effective for increasing HPV vaccine uptake. In their 2015 systematic review of practice- and community-based interventions, Niccolai and Hansen reported that all evaluated reminder/recall interventions saw an increase in at least one HPV vaccine outcome. Dempsey and Zimet (2015) reviewed interventions for HPV vaccine uptake and noted that text messaging and centralized

reminder/recall interventions seemed effective at increasing HPV vaccination, particularly for completion rates. A literature review by Oliver and colleagues (2016) had similar findings, as did a systematic review by Francis and colleagues (2017).

Reminder/recall interventions may be more effective at increasing HPV vaccine series completion than series initiation. Dempsey and Zimet (2015) and Oliver et al. (2016) both state that reminder/recall interventions seem to have a greater impact on completion rates than initiation rates. Francis et al. (2017) note that reminder/recall interventions are effective at increasing initiation and completion, but EHR interventions are especially effective for completion. Niccolai and Hansen (2015) do not make a comparison, only observing increases in receipt of one dose of the HPV vaccine. All of these authors state that the barriers for series initiation and series completion are different. Due to this, different interventions are likely to be effective with parents and patients with differing barriers. Reminders/recalls are likely effective for parents and patients who have already decided to vaccinate, but that system might be less effective for parents/patients who are hesitant to vaccinate in the first place.

Unlike many other types of intervention, reminder/recall interventions have been shown to be effective across different demographics (Francis, et al., 2017). Francis et al. (2017) noted that reviewed interventions showed effectiveness in males and females, across minority and majority populations, and in urban and rural areas. The broad applicability is promising for populations where HPV vaccination rates lag behind, like in rural areas (Francis, et al., 2017).

While some results of reminder/recall interventions have been statistically significant, the question of clinical significance remains. Niccolai and Hansen (2015) observed that, in the studies they reviewed, “some effects sizes were modest, some increases were not sustained over time, and some HPV vaccination outcomes did not improve. Therefore, although change is possible, the clinical relevance of some of these results may be less certain” (pg. 691).

Provider prompt interventions have been shown to be effective in increasing uptake rates of other vaccines (Dempsey & Zimet, 2015). However, in the identified systematic reviews that assessed provider prompt interventions for HPV vaccine uptake, authors found mixed results. Niccolai and Hansen (2015) observed increased HPV vaccination in provider prompt interventions. Dempsey and Zimet (2015) noted that provider prompts (also called practice alerts) were effective in some cases but not in others. Oliver et al. (2016) argued that provider

prompts do not increase HPV vaccine uptake, however, they only reviewed one such study. Francis et al. (2017) reported that provider prompt interventions had a positive effect on series initiation and completion.

Recent Reminder/Recall Interventions

In more recent years, additional evidence has emerged that text message reminder interventions may be effective at increasing HPV vaccine uptake. For example, Rand et al. (2015) reported that a centralized text message reminder to parents had a positive impact on HPV vaccine initiation. In this study, up to 4 simple text message reminders were sent to parents of publicly insured adolescents in upstate New York. The managed care organization running the public insurance program generated the messages and send them to all parents whose adolescents had no record of receipt of the HPV vaccine. The text messages had a small but statistically significant impact and increased rates of HPV vaccine initiation among the subjects: 16% of the intervention group receiving the text messages initiated the vaccine compared to 13% in the control group who did not receive the messages (Rand, et al., 2015).

In a 2017 study by Rand et al., text message reminders resulted in higher HPV vaccine completion rates and shortened the time from first or second dose to completion of the series. Parents in this parallel randomized controlled trial were given the option to receive either text message or phone call reminders at the time of enrollment. Their adolescent children were enrolled in the study at the time of receipt of the first or second dose of the HPV vaccine series. Text message reminders were more effective than phone call reminders. When the study was complete, 49% of text message adolescents had completed the series compared to 30% of the text message control, and 48% of phone message adolescents had completed the series compared to 40% of the phone message control. Additionally, text message reminders were more effective at decreasing the amount of time from receipt of the first or second dose to completion of the series (Rand, Vincelli, Goldstein, Blumkin, & Szilagyi, 2017).

Tull et al. (2019) also found that text message reminders were effective at increasing HPV vaccine uptake. In this trial, the authors sent one text message to parents of adolescents enrolled in a secondary school vaccine program in Australia. These parents had already consented to have their children vaccinated through the centralized school program, and reminders were sent through this program rather than through any primary care providers or

insurance company. The authors aimed to test the impact of the reminder on uptake of any dose of the vaccine, and they also aimed to test the impact of two types of theory-based content in the text messages. The reminder resulted in a small but statistically significant increase in uptake and series completion. Interestingly, the content of the tested text messages did not have a significant impact on uptake rates and both types of message were effective (Tull, et al., 2019).

In two recent studies of reminder/recall interventions, issues reaching all parents by phone were identified as a potential limitation of the effectiveness of the intervention. Rand et al. (2015) noted that about half of the parents eligible to receive reminders never did, due to phones that were out of service or unable to receive text messages. Other parents opted out after the first message (Rand, et al., 2015). Tull et al. (2019) reported difficulty acquiring phone numbers for parents and problems with the quality of the parental data, including phone numbers, that they were able to acquire.

The clinical barriers to implementation of reminder/recall interventions have implications for their effectiveness outside of a research setting. Private clinics may not implement reminder/recalls due to cost, issues with staff availability or turnover, other priorities, and/or time constraints (Rand, Vincelli, Goldstein, Blumkin, & Szilagyi, 2017). Rand et al. (2017) observed that they were able to implement their intervention using research staff, and the necessary staff and time for the intervention might not be available within private clinics.

One possible way to address these barriers is through the use of centralized reminders like those used by Rand et al. (2015). Centralized reminders from managed care organizations have the advantage of resources and economies of scale to which smaller clinics may not have access (Rand, et al., 2015). Tull et al. (2019) were also able to utilize a centralized secondary school immunization program to generate reminders. However, similar programs to the school immunization program they used do not exist in many places. Those authors also recognized that they were operating within an environment that already places heavy regulatory importance on childhood vaccination, which could have impacted their results (Tull, et al., 2019).

Despite these recent statistically significant findings of the efficacy of reminder/recall interventions, the concerns about clinical relevance remain (Niccolai & Hansen, 2015). Both Rand et al. (2015) and Tull et al. (2019) saw relatively small but statistically significant increases in uptake. Rand et al. (2017) saw a larger impact. All of these authors point out that

reminder/recall interventions are likely not sufficient alone to increase HPV vaccine uptake to the Healthy People 2020 80% coverage goal. For example, Rand et al. (2017) pointed out that provider recommendation may have more impact on initiation, and reminder/recall may be more important for receipt of dose 2 and 3. A combination approach is recommended to maximize uptake (Rand, et al., 2015; Rand, Vincelli, Goldstein, Blumkin, & Szilagyi, 2017; Tull, et al., 2019).

Recent Provider Prompt Interventions

Interventions that prompt providers that vaccines are due have shown promise for increasing HPV vaccine uptake in several recent studies. For example, in their 2017 study testing the efficacy of an EHR prompt to increase HPV vaccine uptake during routine post-partum care in a single urban clinic, Soon et al. saw a significant increase in uptake of any dose of the vaccine post-intervention. For this intervention, a prompt appeared in the EHR for any woman 19-26 years of age who was due for any dose of the HPV vaccine. The prompt simply alerted the provider to ask about the HPV vaccine status of the patient. The authors measured clinic-wide HPV vaccine uptake pre- and post-intervention and found that there was a significant increase in uptake of any dose of the vaccine post-intervention (Soon, Sung, De La Cruz, Chen, & Hiraoka, 2017).

Martin et al. (2018) reported a significant increase in HPV vaccine initiation rates for college males in their pilot study of an EHR prompt for providers in a university health center. As part of a screening tool, a prompt to discuss the HPV vaccine appeared in the EHR for any eligible male. In this study, the authors used HPV vaccine eligible females as the control group. They found that initiation rates increased significantly in the males, but the prompt had no effect on completion rates. However, the study length of 8 months may not have been long enough to capture an effect on completion (Martin, et al., 2018).

Another pre- and post- study of an EHR prompt for providers in urban retail clinics saw a significant increase in HPV vaccine uptake post-intervention (Meyer, et al., 2018). For this intervention, patients at Mayo Clinic retail clinics between the ages of 9 and 26 were included and providers received a prompt in patients' EHR if patients were eligible for any dose of the HPV vaccine. These clinics were a part of a larger Mayo Clinic system and retail clinic patients had to be empaneled primary care patients within that system. Providers were provided training

on the prompt system, as well as a brief pre-intervention training on HPV vaccine safety, efficacy, and methods of addressing vaccine hesitancy with parents. The researchers reported a significant increase in median weekly HPV vaccination rates, with higher uptake rates for doses 2 and 3.

While these recent examples of provider prompt interventions offer encouraging evidence of efficacy, the strongest evidence for increasing HPV vaccine uptake with provider prompts comes from a randomized controlled trial conducted by Zimet et al. (2018). The researchers found that an elaborated provider prompt had a significant effect on HPV vaccine initiation in patients 11-13 who were also due for MenACWY and/or Tdap (Zimet, et al., 2018). In this trial, the researchers tested the effect of a simple and an elaborated prompt on initiation rates for patients in several urban pediatric clinics. The participant clinics used a computer automated system that provided screening tools, reminders, and other services to providers and was the front end of an EHR system used by a larger, county-wide safety net health system. The simple and elaborated prompts were activated in the EHR system, and providers were given no training on their use. The simple prompt merely notified the provider that the patient was due for the HPV vaccine, and the elaborated prompt included a suggested script for providers to use to talk to parents about the vaccine. The elaborated prompt arm had significantly higher rates of HPV vaccine initiation than the control arm. The simple prompt arm had higher rates than the control, but not high enough to reach statistical significance. Importantly, the rates of MenACWY and Tdap vaccination were the same across arms of the trial, highlighting the impact of the prompts on HPV vaccine uptake (Zimet, et al., 2018).

The relatively consistent results across these studies suggest that provider prompts can be effective at increasing HPV vaccination despite the mixed quality of these studies. The pre- and post-intervention studies saw a significant increase in receipt of any dose of the HPV vaccine post-intervention (Soon, Sung, De La Cruz, Chen, & Hiraoka, 2017; Meyer, et al., 2018). The pilot study in college males saw a significant increase in HPV vaccine initiation, as did the randomized controlled trial in 11-13-year-olds (Martin, et al., 2018; Zimet, et al., 2018).

While these results are promising, not all immunization providers have the technology in place to mirror these interventions. More and more clinics are using EHRs, and prompts are relatively easy to add into these systems (Soon, Sung, De La Cruz, Chen, & Hiraoka, 2017;

Zimet, et al., 2018). However, in several of these interventions, the EHR was connected to a statewide immunization registry or larger network of clinics (Meyer, et al., 2018; Zimet, et al., 2018). That technology is not available in all places, and clinics seeking to implement a provider prompt intervention might have to find alternative work-arounds until such technology is available to them (Zimet, et al., 2018).

Additionally, EHR prompts may address some provider barriers to offering the HPV vaccine, but they do not address all of them. Zimet et al. (2018) noted that providers may not mention or recommend the vaccine for a variety of reasons, including “time constraints, perceptions of risk associated with patient age, availability of insurance or other coverage, safety and/or efficacy concerns, and the perceived need to discuss HPV as a sexually transmitted infection” (pg. S67). Other interventions may be necessary to address these issues. Meyer et al. (2018) attempted to address some these issues by training providers and clinic staff prior to intervention implementation.

Use of Health Behavior Theory in Health Systems Interventions

While health systems interventions aim to change HPV vaccination behavior, only one of the recent health systems interventions reviewed above mentions using behavior theory to inform intervention content. Tull et al. (2019) noted that “behavior science” (pg. 117) offers strategies to achieve health goals. The authors explained that one of these behavior science-backed strategies is the reminder, though they do not offer further clarification of this claim. In their intervention, Tull et al. (2019) used two different text message reminders for parents, and the content of those text messages was based on behavior science. One of the messages, the ‘self-regulatory’ message, used implementation intentions to inform message content. The other ‘motivational’ message used the perceived susceptibility construct from the HBM. The HBM is described in detail in the Education Intervention section of this paper.

Implementation intentions are not a theory, but are a technique of health behavior change based in a variety of behavioral theories (Hagger & Luszczynska, 2014). Many prominent health behavior theories, including the TPB and the HBM, hypothesize that intention is the most important driver of behavior change and maintenance of that behavior change, however, research has made clear that intention is often not sufficient to bring about that change (Hagger &

Luszczynska, 2014). Implementation intention is a type of behavior planning technique that attempts to bridge the behavior gap (Hagger & Luszczynska, 2014).

Implementation intentions are often called “if-then” plans, and aim to make a cue to a behavior immediately accessible, and then make the behavior automatic in the presence of the cue (Hagger & Luszczynska, 2014). Importantly, these cues are environmental, not internal (Hagger & Luszczynska, 2014). A reminder text message to get vaccinated is an example of an environmental cue.

Though Tull et al. (2019) make it clear that behavior science informed their intervention, they do not explain how or give any examples of reminder content, and this makes it difficult for future researchers to apply similar methods in other contexts. They report that the self-regulatory text message reminders were based on implementation intentions, but do not comment further, and their approach is the same with the motivational text messages. Without knowing how implementation intentions or the HBM informed content, or being given examples of their use, future researchers will be unable to modify this intervention for use in another context, or use similar strategies to design a new intervention.

Health behavior theory may be informing these interventions without explicit mention by study authors. Reminder/recall and provider prompt interventions are described as cues to action by Francis et al. (2017), and while several health behavior theories use the ‘cue to action’ construct, none of the studies reviewed above note this connection.

Aim 2: Data Analysis and Summary

Methods

In July of 2019, I was hired as a Graduate Research Assistant to work on a University of Montana-funded small grant. The objective of the grant was to determine when, where, and how Montana adolescents and their families want to receive educational information about HPV vaccination. Dr. Sophia Newcomer of the University of Montana School of Public and Community Health Sciences partnered with Community Medical Center (CMC) to assemble an Adolescent Health Patient and Family Advisory Council (AHAC).

We recruited participants from Missoula Valley Pediatrics, located within CMC, via flyers and physician recommendation. Participants needed to be dyads of parents/guardians and adolescents. The adolescent had to be between 13 and 17 years of age. We were able to recruit three parents and four adolescents for the AHAC. The initial AHAC meeting was held on December 4, 2019 at CMC.

Prior to the meeting, semi-structured discussion tools were developed for both the parent and adolescent meeting. The content and format of the questions was driven both by previous research and by the information CMC wanted to acquire. Questions were different for the parent group and the adolescent group, per the request of CMC. The parents were asked a number of questions about their experiences with adolescent vaccinations generally, about the HPV vaccine, and about how they would like to receive information about the HPV vaccine. Adolescents were asked about their knowledge of adolescent vaccines, HPV, their experiences with their providers, and other questions not relevant to this paper. Questions were based on the semi-structured discussion tool, but the researchers also asked additional follow-up questions. Examples of the questions included:

- Thinking about when doctors or nurses have offered vaccines for your teens –can you please describe to us what those experiences have been like?
- Has a doctor or nurse ever discussed the vaccines that are recommended for your adolescent with you? What was that discussion like?
- In the past, how else have you learned about immunizations that were recommended for teens?

- What do you know about the HPV vaccine?
- Would you like information about vaccination to come from your child's school?

Less time in the adolescent meeting was focused on HPV vaccination. This was due to two factors: CMC had a wide variety of other questions they wanted to ask (confidentiality, teen-friendliness of clinic space, etc.), and the fact that these teens didn't know what HPV was or how one contracts it.

Parents and adolescents met separately, and the conversations were recorded on digital recorders. Two members of the research team met with each group. Consent for participation was gathered before the meeting, and researchers clearly explained that all questions were optional. No Institutional Review Board approval was needed, as the AHAC meeting was considered part of quality improvement operations for CMC.

To summarize the findings from the initial AHAC meeting, I have conducted a qualitative data analysis, using the process outlined in Creswell and Creswell (2018). Their first step, organizing and preparing data for analysis, includes transcription of recorded data.

The next step was to review the transcripts and identify themes. This process includes checking transcripts for errors against the audio recording, de-identifying participants, and taking notes on perceived themes. The digital transcripts were transcribed by GoTranscript.com, and then the transcripts were checked for accuracy against the recordings, and necessary corrections were made. All participants were de-identified and any references to names or places in the Missoula community were removed.

Themes were identified both deductively and inductively. First, the transcripts were reviewed using directed content analysis. Directed content analysis uses themes that are identified prior to data analysis (Hsieh & Shannon, 2005). These themes were identified based on previous research and confirmed with Dr. Newcomer. Emergent themes from the data were also included, in keeping with conventional qualitative content analysis (Hsieh & Shannon, 2005).

Using the identified themes, the data was then coded. Codes are words or short phrases that represent themes and sub-themes in the transcripts. The coding scheme was checked with Dr. Newcomer before proceeding. Using the coding scheme, the transcripts were coded in NVivo. Parts of the discussion unrelated to HPV Vaccination were not coded, and are not

discussed here. The coverage reports from NVivo are included in Appendix 3. Based on the findings from the NVivo analysis, a narrative discussion summarizing the main themes follows. I organize this discussion by exploring the main themes that arose, providing some quotes to illustrate each theme, and end with a brief discussion of other themes of note.

Findings

Parent Meeting Findings

Source of Knowledge: School

One of the main themes from the parent meeting was that these parents were very open to their children's schools providing education and information about the HPV vaccine. They noted that the schools already provide some information about adolescent vaccines, so offering information about the HPV vaccine wouldn't be weird or surprising. One parent said that she would be open to receiving information from the schools because "it's not like it's separation of medicine and state." Another parent observed that she trusted the schools to teach her kids, and so she was willing to trust them to teach her as well.

Starting the information flow early was pointed out as important, too. One parent said "if you started it in the fifth, sixth-grade, and by the time they are coming into get that seventh-grade vaccination, maybe [the parents are] like, 'Oh, yes, I've heard about that.' Or maybe it would open up conversation."

Another parent suggested introducing HPV information into the curriculum:

"You can't force it down somebody's throat, but if it could be incorporated into the curriculum... I know that they've done other health projects, it would be really cool if vaccination or HPV or something."

Several of the parents recognized that not all children actually go to a doctor regularly, and thus their parents might not learn about the HPV vaccine through clinic visits. They suggested that information coming from the school might help to counter that:

"If it's an avenue where you're providing information to people, especially if there are at risk youth who may not have the luxury of going to a Well-Child visit every year. Maybe

they haven't been to the doctor since they were, whatever, seven or eight. If there is a way to communicate with them or get more information to their guardians or parents or whoever, about the importance of it, what could it hurt?"

No consensus was reached regarding how the school might deliver that information. One parent suggested that posters on school bulletin boards might be useful, but another parent stated that they rarely go into the school. That parent thought that flyers or email letters would be a better way to get information about HPV from the school to other parents.

Provider Communication as a Facilitator

These parents recognized the importance of provider communication as a facilitator for receipt of the HPV vaccine. They wanted providers to communicate information and not just tell parents what to do, they thought the conversation around HPV should start early and continue frequently, and they emphasized that the provider should be prepared and knowledgeable.

As opposed to being simply informed that their child needed to receive a vaccination, these parents wanted to be given information when they asked. They didn't want to just be told what to do, even when they already had every intention of vaccinating their child. One parent appreciated a doctor who said "This is what I think we should do. Do you have any questions?" Another parent stated:

"I've had providers who definitely were like, 'You just get the vaccination because that's on the schedule, and you get it.' I was like, 'But I would like to know why or what is it preventing? Or what are the chances that my kid could actually get better?' Whatever, and still being totally pro-vaccination, I just want to know the why, but I'm a curious person. I always want to know those things."

Additionally, these parents noted that the relative newness of the HPV vaccine may make it unfamiliar to many people, and these parents also recognized that many people need to hear a message early, frequently, and in a variety of formats in order for the information to be absorbed and understood.

Because the HPV vaccine hasn't been around for as long as some of the other vaccines, some parents felt it was important for providers to mention it early and often to facilitate uptake:

“I think providers can't start talking early enough about it or enough about why we do this or why this was added, why this isn't something that maybe you had when you were younger.”

Several parents also observed that sometimes people need to hear a message frequently, and in different formats, for the information to be absorbed:

“[You need] variety in how you reach people, because some people are, "I want a hard copy, pamphlet of something, I need to be able to read it and digest it," and other people need to hear it maybe more than once, multiple times, yes, for it to sink in. Recognizing that not everyone...that you need to cast a wide net of how you're dispersing the information to people, because people will perceive it or take it to heart differently.”

The parents noted that the information from and recommendation of providers was so important, because parents don't always even know they should be asking questions about HPV or what questions to ask.

Importantly, even though all of these parents had declared themselves pro-vaccine, they emphasized that they still wanted to know that the provider was prepared and knowledgeable. “You can tell they go into their spiel, so it'll be like what is HPV and why should my kid take it, they'll do that, and then launch into their thing. I was like, okay, you're prepared. Thank you. That's all I wanted to know.”

Immunization Services: Reminder and Recall to Complete the Series

Another main theme that emerged from the parent meeting data was the importance of reminders to come back to complete the HPV vaccine. These parents were very clear about their need for help in this area – for their children and for themselves. They noted that coming back for the second or third dose is the difficult aspect of HPV vaccination:

“That part, I have to say, it's probably the hardest part, was just making sure we're good. We're not quite there yet. I think March is when we're supposed to come back in. Now it's on my calendar and it's a reminder. I did that, but I'll speak from a system standpoint at Community or wherever you guys work, having some sort of way, a tickler, as you're a patient navigator, to remind patients to come back in for those second and then third shots because that's real easy to forget.”

Several parents noted that scheduling appointments to return for the second and third dose, at the receipt of the first dose, was important. They noted that they weren't sure they would have remembered if it weren't for that pre-scheduling.

“I don't think that Dr. ----'s office let us leave without our follow-up appointment, so when we were done with the first ones, they definitely were like, ‘go to scheduling and get the next ones on,’ and I can't say what would have happened... if I would have declined at that time and said, ‘well, I'll call back later.’”

All of the parents agreed that life with adolescents is busy and full of competing priorities. One parent noted that she had been working in health care for many years and felt savvy about navigating the system, and still needed help remembering when to get her own follow-up doses. Another parent shared that she just recently started the series herself and had no idea when she was supposed to get the next dose. Recalls for follow-up doses can help parents navigate those competing priorities and make sure their children get a complete vaccination.

“A life with a teenager and multiple sports and orthodontics and everything else, it's like, I don't know what my life is going to be like six months from now. If I could know a month prior, that would be doable because you would know what the fall schedule is or what the spring schedule is, but reminders are essential because I think in this day and age, there's just so much, so many moving parts that it's really easy to let those things fall through the crack.”

Other Important Themes:

Other themes emerged from the parent meeting data that didn't receive as much coding coverage but are also relevant and deserve mention.

One of those themes was the safety of the HPV vaccine. While none of the parents we spoke with had safety concerns, all of them mentioned that other people they knew did have concerns. This was apparently a common topic of conversation around the HPV vaccine. These parents noted that in their circles, other parents weren't concerned about the HPV vaccine causing promiscuity (a concern that has also been reflected in the literature, e.g. Vogel, Appel, & Winkler, 2018), but there were concerns about the vaccine causing autism or harmful side effects:

“Interestingly enough, as I've just talked with friends and different family members... ‘Did you get the kids vaccinated?’ She's like, ‘No, I don't think so. I've heard that it causes autism.’”

“I feel like in my group of friends, that their philosophy has been less about an open gateway into sex. It's been more of just trust of the actual active ingredients or inactive ingredients in the vaccines themselves. That's been my experience with my friends when they've come to me for advice or asked me if I have got my kids vaccinated. It was less about sex and more about trusting the system.”

The parents we spoke with also mentioned the positives and negatives of using the internet as source of knowledge about vaccines:

“The internet is a great thing, but there's so much information out there. I think some people view it that if it's on the internet, it must be true. Like you said, [it's important to have] a reputable source of where's the information coming from.”

A few other comments from the parents are worth noting. They emphasized the importance of convenience, appreciating only having to see a nurse for return visits to complete the HPV vaccine series. Given their busy schedules, making it easier to get the vaccine was key. These parents also noted that making the vaccine more normalized helps increase people's willingness to vaccinate. Part of that normalization includes education, as they also noted that parents aren't always familiar with the HPV vaccine and what it can prevent: “That [HPV vaccination] wasn't a generally accepted thing and I know from other parents, too, not understanding it or what it's for or how it's helpful.”

Finally, in terms of education materials, parents liked handouts that were “easily digestible.” They wanted to see an emphasis on cancer prevention, images of both boys and girls, and fewer words.

“I think highlighting that it's cancer prevention in larger letters so it stands out. Then combining wouldn't you get it for your kids, and then the explanation of what it is, boys and girls, two shots, whatever.”

“This one...has a lot...I don't know that everyone would sit down and read it.”

“You could drill down to your biggest question, but things like this where you use graphics to demonstrate, I think it's easier for people to relate to, a lot of information in smaller doses.”

Adolescent Meeting Findings

In general, these teens supported vaccines and knew what vaccines were and that they are important. They knew multiple doses are needed to complete the HPV vaccine series.

General Knowledge about Vaccines

One theme that emerged was general knowledge about vaccines. The adolescents we spoke to had a fairly good grasp of the basic science of vaccines in general:

“Immunizations that are recommended for teenagers are just to protect you from any diseases or anything that you could get when you're older or in the future. They protect your body more than that it would without it.”

“I know that with every injection, it's like giving you a small part of the sickness basically, but I know that what it does and it helps you be able to fight it off later in life.”

Provider Communication Style

In terms of provider communication style, most of these adolescents wanted their provider to present them with relevant information, and to include them in discussions about vaccines and other health issues.

They wanted to know what vaccines they were receiving:

“I think it's really important because ... I like to know what it is before so that I can comprehend it ...I always want to know what's going on before it happens.”

“I'd just like to know what's going in my body before it happens.”

They also felt it was important to be involved in conversations about their health and really valued being listened to and allowed to express their opinions:

“[My doctor] really listens to me... because I'm the one that it's happening to so I know better than anyone, but I feel that's a really good thing that she's really understanding and

really listens to what you have to say and not just what your parents have to say, but also takes in their opinion.”

“She's really good at listening. She's not like one of those doctors that just listens what you're going to say, write it down and forgets about it. She listens the right way.”

Side Effects

The last major theme that emerged from the adolescent meeting data was discussion about side effects. None of the adolescents had concerns about the safety of the HPV vaccine, but some of them did have concerns about side effects, namely, the pain of the injection. These adolescents trusted that their parents would not have them get a vaccine if it was dangerous. One of them also noted:

“HPV shots, I knew that all kids had to get one, so I was like, it's not something that's bad or anything because I was like, everybody gets one, so I don't really need to worry about what's in it, because if everybody's getting it, then it's fine.”

Another adolescent talked about her experience anticipating vaccinations:

“They hurt and I didn't like them. I didn't fear them but I just remember not wanting to get one.”

Concerns about the pain of vaccines were not universal, however. Several of the adolescents noted that injections were not an issue for them:

“Shots never really affected me.”

“I don't really have a problem with shots and needles. I don't know if I did when I was younger.”

Other Important Themes

While less time was spent on other topics, a few additional themes are worth noting. First, none of these adolescents knew what HPV was, or how it is spread, despite all having received the HPV vaccine. They said that HPV was not a topic that had been covered in their health classes, nor was it something they talked about with their friends. One adolescent thought the subject might have come up in their Physical Education class, but they said that if it had, it wasn't covered in depth.

Second, the adolescents had heard negative things about immunizations, but they all agreed that they would do research themselves before believing things they saw on the internet. Further internet research and asking their parents were the routes they said they would take to find more information.

Discussion

To determine which interventions may be most relevant to increasing HPV vaccine uptake in Montana, I reviewed intervention literature and analyzed feedback from local parents and adolescents. Some of the data from parents and adolescents mirrored findings from the literature review, and some did not. The findings from the literature and the parent and adolescent feedback have a variety of implication for future HPV vaccine delivery research in Montana.

Across the different types of intervention, most studies on HPV vaccine uptake occurred in urban populations, which limits generalizability to rural Montana. Educational interventions were in mostly urban, minority populations and had mixed results. Research on provider communication interventions was completed in urban areas, where providers are already more likely to recommend the HPV vaccine compared to rural areas (Francis, et al., 2017). In terms of health systems interventions, some reminder/recall interventions for parents have been done in rural areas, but provider prompt research has mostly taken place in urban clinics.

In order to overcome the lack of generalizability to rural populations, interventions in rural populations should be informed by feedback from members of those populations. Rural populations may have different barriers and facilitators for HPV vaccine uptake, and tailoring interventions population specific barriers and facilitators results in increased intervention effectiveness (McKenzie, Neiger, & Thackeray, 2017). Speaking directly to members of the population that will be targeted in an intervention is a great way to gather valuable feedback and information that can be used to tailor interventions to account for population specific barriers and facilitators for a health behavior like HPV vaccine uptake (Simons-Morton, McLeroy, & Wendel, 2012).

Our conversation with Montana parents and their adolescent children was a first step in gathering feedback and information about their barriers and facilitators to HPV vaccination, along with their beliefs, attitudes, and perceptions about HPV and the vaccine. Their feedback can help fuel future attempts to tailor interventions to increase HPV vaccine uptake in Montanans, and provides us with some ideas about what might effectively increase uptake here.

A number of findings from the parental and adolescent data matched findings from the literature, and have implications for future HPV vaccination efforts in Montana. For example, reminders/recalls to complete the HPV vaccine series have shown effectiveness in the literature, and the parents we spoke with also enthusiastically endorsed reminder/recall interventions. Of all of the intervention types, reminder/recall interventions have been shown to be consistently effective in rural populations, and across cultural groups (Francis, et al., 2017). While there is some evidence that reminders can be effective at increasing vaccine series initiation (Rand, et al., 2015), the bulk of the evidence supports reminder/recall interventions for series completion (Dempsey & Zimet, 2015; Oliver, Frawley, & Garland, 2016; Francis, et al., 2017). Reminder/recall interventions would likely be effective to increase completion rates for Montana adolescents.

Given that all of the parents we spoke to labeled themselves as “pro-vaccine,” their endorsement of reminders/recalls highlights an issue many authors have pointed to, namely, the need for different interventions for parents who are hesitant to initiate, versus those parents who are willing to vaccinate but need help remembering to complete the series. Interventions to increase HPV vaccine uptake need to be further tailored to the targeted audience, and ‘all parents of adolescents’ seems to be too broad of an audience category. In fact, there may be degrees of hesitancy that must be addressed in different ways in order to increase uptake across the board.

Interestingly, all of these parents valued provider communication and recommendation of the HPV vaccine, even though they had already intended to vaccinate their adolescents. Provider communication interventions in the literature demonstrated effectiveness at increasing series initiation (Brewer, et al., 2017; Dempsey, et al., 2018). We did not ask parents if they would not have vaccinated their children without a recommendation, but the literature supports the need for a recommendation to increase vaccine uptake (Gilkey & McRee, 2016). If parents who already strongly support vaccination appreciate a provider recommendation and clear communication,

those things are likely even more important for vaccine-hesitant parents. Provider recommendations might be effective at increasing HPV vaccine uptake in Montana.

Educational interventions to increase HPV vaccine uptake have had mixed results, and some authors have observed that this inconsistency could be due to the limited effectiveness of a single education session (Fu, Bonhomme, Cooper, Joseph, & Zimet, 2014). The parents we spoke with noted that people may need to see or hear HPV vaccine information multiple times and in different ways, which could indicate why single education sessions are not always effective at increasing vaccine uptake. Educational theory emphasizes the importance of repetition and respect for different styles of learning, so the finding that single education sessions or types have mixed efficacy for HPV vaccine uptake is unsurprising. Additionally, these parents had clear preferences about various aspects of the educational material we presented to them, indicating that tailoring those educational interventions to a specific community would likely be more effective than standardized educational material. Multi-type, multi-session, tailored education might be effective at increasing HPV vaccination rates in Montana.

One theme of the parental discussion which did not emerge in the literature on educational interventions was parents' willingness to receive HPV vaccine education from their children's schools. School-based interventions seem to focus on providing the vaccine at school health clinics, rather than offering education to parents (Niccolai & Hansen, 2015). The closest any intervention came to school-based education for parents was a reminder/recall intervention tested by Tull et al. (2019), which sent text messages to parents through a school vaccine program in Australia. However, the content of those messages was not described in detail and the educational content, if any, was minimal. Interestingly, parents were more accepting of the content that emphasized their child's susceptibility to HPV than the messages encouraging them to make a plan to vaccinate (Tull, et al., 2019). Schools could be an additional source of HPV vaccine information for Montana parents.

Finally, there is no evidence from my research that any health behavior theory is superior to another in terms of increasing HPV vaccine uptake. The overall impact of health behavior theory remains unclear, which echoes the findings of an earlier review looking at behavior models in HPV vaccine uptake research (Ferrer, Audrey, Trotter, & Hickman, 2015). Without

more consistent reporting of how theory informs interventions, it is challenging to determine whether one theory prevails within effective interventions.

Despite inconsistent reporting as to whether and how health behavior theories were used to inform interventions, certain health behavior theories may underlie the motivations for specific interventions, or may be useful to consider in future intervention research. In particular, stage health behavior theories might be useful to design interventions that target parents at various points on the vaccine hesitancy spectrum. Only one of the reviewed interventions used a stage theory of behavior change (Dempsey, et al., 2018). Stage theories recognize that people pass through stages on their way to sustained behavior change (Simons-Morton, McLeroy, & Wendel, 2012). These theories often provide tools and techniques for moving a person from one stage to the next. An intervention that aimed to move a hesitant parent from unsure to ready to vaccinate could utilize stage theory techniques to change vaccination behavior.

Another piece of health behavior theory that may be helpful to design interventions to increase HPV vaccine uptake is the construct of subjective norms from the TPB. The perception of social approval is at the heart of the subjective norms construct (Simons-Morton, McLeroy, & Wendel, 2012). An individual who perceives a behavior to be socially normal is more likely to engage in the behavior. Provider communication interventions, particularly those that use a strong provider recommendation as a tool to increase uptake, have seen much success, particularly for series initiation. A strong recommendation from the provider, a respected figure, may put social pressure on the parent through the suggestion that the provider will approve of their decision, and that it is socially normal to vaccinate. Gilkey and McRee (2016) noted that presenting the vaccine as normal results in less hesitancy and more uptake. Brewer et al. (2017) speculated that the announcement approach works because it presents the HPV vaccine as normal, rather than singling it out. The parents we spoke with also suggested that making the vaccine more normalized might help increase uptake. The subjective norms construct could be used to inform interventions through training and provision of scripts to providers than emphasize that vaccination is expected, approved of, and other parents are choosing to vaccinate, ultimately increasing uptake.

Finally, provider recommendation, reminder/recalls, and provider prompts all may act as a cue to action (Moss, Reiter, Rimer, & Brewer, 2016). The cue to action construct appears in

multiple health behavior theories. In the HBM, a cue to action is new information related to a perceived threat (Simons-Morton, McLeroy, & Wendel, 2012). When a provider gives a strong recommendation about the importance of the HPV vaccine, this could be new information that will act as a cue to action for a parent. The FBM also includes the cue to action, by a different name. In the FBM, the trigger or prompt is something that a person notices, that they associate with the target behavior, and that happens when the person is both motivated and able to engage in the behavior (Fogg, 2009). The provider recommendation may work as a trigger for parents: the recommendation is clear, about the HPV vaccine, the parent may be motivated to protect their child's health, and the vaccine is immediately available. A reminder or recall may act as a cue to action for parents to make an appointment, and a provider prompt cues the provider that a patient is due for the vaccine. Given the effectiveness of provider recommendations and reminder/recall interventions, the cue to action construct seems to be worth considering when designing HPV vaccine uptake interventions.

Limitations and Directions for Future Research

In this paper, the literature review mostly covered single-component interventions, as multi-component interventions complicated evaluation of effectiveness for each component. However, many authors suggested that multi-component interventions may be more effective and encouraged future research in that direction (e.g. Francis, et al., 2017; Walling, et al., 2016). Choosing not to include multi-component interventions may have impacted the results of this research.

Of note, the provider communication interventions reviewed focused primarily on provider communication with parents of an adolescent child, and not on communication with the adolescent. While this makes sense, as parents must consent for their child to be vaccinated, the adolescents we spoke with wanted to be included in the conversation, and to be listened to by their provider. Granted, they all indicated that they weren't given much choice by their parents in terms of whether or not they would be receiving a vaccination, so focusing on the adolescent in a provider communication intervention might not increase uptake. However, the impact of provider-adolescent communication on HPV vaccine uptake is a possible direction for future research.

Also noteworthy was the minimal focus in the literature on school-based educational interventions, especially given the lack of knowledge the adolescents we interviewed had about HPV. While health classes are a place where students might learn about the importance of vaccination and how to prevent STIs, this review of the literature did not uncover any interventions designed for school health classes. The one reviewed school-based educational intervention relied on nurses to provide brief education about HPV and HPV prevention to students in a single session (Cooper, et al., 2016). Given that the adolescents we spoke with did not know what HPV was and reported that it was not discussed in their health classes, the importance of increased adolescent knowledge about HPV could be underestimated and could be an significant factor for adolescents with vaccine-hesitant parents. More research on adolescent knowledge is warranted.

The size of our parent and adolescent sample was one of the most significant limitations for the data analysis portion of this paper. We were only able to recruit 3 parents and 4 adolescents. This small sample size limits generalizability to other parents and adolescents in the state of Montana. Additionally, all of the parents were self-declared “pro-vaccine,” and all of the adolescents had received the HPV vaccine. Future research into parent and adolescent perceptions, attitudes, and beliefs about the HPV vaccine and interventions should include a larger sample size, parents who are vaccine hesitant or refusing vaccines, and adolescents who haven’t yet been vaccinated.

Recruitment was a challenge for this project, even with a participation incentive. Because this research was done collaboratively with CMC, recruitment was focused only on CMC patients. Future efforts should include a wider recruitment base.

Finally, the information we gathered from the parents and adolescents could be impacted by social desirability bias.

Conclusion

HPV-attributable cancers can be prevented with a complete HPV vaccine series, but vaccination rates are lower than the Healthy People 2020 goal of 80% coverage for eligible adolescents. In Montana, vaccine uptake is even lower than the national average. To protect Montana's adolescents from future HPV-attributable cancers, increasing vaccine uptake is important. This paper reviewed HPV vaccine intervention literature and analyzed local parent and adolescent feedback about HPV and vaccination interventions in order to inform strategies to increase HPV vaccine uptake in Montana.

While generalizability to rural populations is limited, a variety of interventions show promise for increasing HPV vaccination. However, given different barriers for series initiation and series completion, a combination intervention approach is likely necessary to increase uptake. Interventions will need to address the different needs of parents who are hesitant to vaccinate and parents just need reminders to complete the series.

No evidence emerged that any particular health behavior theory is superior to another in terms of increasing HPV vaccine uptake. However, many effective interventions were informed by one or more theories. Stage theories of behavior change may be useful to address the needs of parents on a spectrum of vaccine hesitancy.

This research takes important first steps to identify strategies to increase HPV vaccination in Montana. Future efforts should use a larger sample of Montana parents and adolescents, and include those who are vaccine hesitant. Learning more about the attitudes, beliefs, and perceptions of parents and adolescents about HPV vaccination will help inform efforts to increase uptake in Montana, and protect Montana's youth from HPV-attributable cancers.

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