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Cognitive bias in clinicians' communication about human papillomavirus vaccination

Caitlin E. Hansen, MD [Associate Research Scientist],

Department of Pediatrics, Yale School of Medicine, 333 Cedar Street, PO Box 208064, New Haven, CT 06520

Anna North, MPH [Project Coordinator],

HPV Working Group, Yale School of Public Health, 135 College Street, Suite 356, New Haven, CT 06510

Linda M. Niccolai, PhD, ScM [Professor]

Department of Epidemiology of Microbial Diseases, Yale School of Public Health, 60 College Street, New Haven, CT 06520

Abstract

National guidelines recommend human papillomavirus (HPV) vaccination for all 11–12-year-olds, but uptake among United States adolescents remains low. A major barrier to greater uptake is the lack of effective recommendations for HPV vaccine from clinicians. One potential influence on clinicians' recommendations for HPV vaccine that has been relatively unexplored is that of cognitive biases, or errors in judgement that result from 'mental shortcuts' used to make decisions under uncertainty. Therefore, we analyzed qualitative data from interviews with 32 pediatric clinicians using a framework of nine cognitive biases relevant to HPV vaccination: omission bias, ambiguity aversion, present bias, availability bias, optimism bias, naturalness bias, protected values, anchoring bias, and confirmation bias. We used a directed content analysis approach to iteratively code and analyze all transcripts in the dataset. We found evidence for several cognitive biases that were related to weaker recommendations for HPV vaccine. Commonly identified biases included anchoring bias (perception that vaccination unnecessary due to age/pubertal status); present bias (perception of burdens related to discussing vaccination), and optimism bias (belief that patient at low risk for HPV acquisition). We found less frequent evidence for ambiguity aversion (perception of missing information regarding vaccination) and omission bias (deferring vaccination). Other biases were identified infrequently or not at all. Our findings suggest that several cognitive biases may be an influence on clinicians' communication about HPV vaccine. Raising awareness of cognitive biases related to making HPV vaccine recommendations could help to strengthen the recommendations that clinicians provide.

Keywords

Human papillomavirus; vaccines; clinicians; qualitative methods

Introduction

Persistent infections with human papillomavirus (HPV) can lead to cancers of the anogenital tract and the oropharynx, as well as to genital warts. Over 38,000 cases of HPV-associated cancer are diagnosed annually in the United States (U.S.), including 23,000 cases in females and over 15,000 cases in males (Viens et al., 2016). Primary prevention of HPV infections and HPV-associated diseases is now possible through the use of HPV vaccines that have been available since 2006. In clinical trials, HPV vaccines have been shown to be safe and highly efficacious in preventing vaccine-type infections, (Schiller, Castellsague, & Garland, 2012) and ongoing post-licensure monitoring has demonstrated the widespread, real-world impact of vaccination in reducing HPV infections, genital warts, and precancerous cervical lesions (Drolet et al., 2015; Garland et al., 2016; Markowitz et al., 2016). In addition, the robust immune response conferred by HPV vaccination has been shown to be sustained over time (Ferris et al., 2014). Maximizing the full potential of HPV vaccine to reduce the morbidity and mortality associated with HPV-associated diseases will rely on successfully reaching all patients for whom vaccination is intended.

In the U.S., HPV vaccine is recommended for all adolescents at 11–12 years of age by the Center for Disease Control and Prevention's (CDC) Advisory Committee on Immunization Practices (ACIP), along with tetanus, diphtheria, and acellular pertussis (Tdap) and meningococcal conjugate (MenACWY) vaccines (Viens et al., 2016); all three vaccines are encouraged to be co-administered at the same clinical encounter. However, uptake of HPV vaccine remains poor. By 2017, only 49% of adolescents were up-to-date with the multi-dose HPV vaccine series, far below the Healthy People 2020 goal of 80% coverage, and substantially lower than uptake of Tdap (89%) and MenACWY (85%) vaccines (U.S. Department of Health and Human Services, 2017; Walker et al., 2018). Moreover, even fewer adolescents receive HPV vaccine at the ages that are targeted for vaccination: by 2016, only 34% of adolescents had started the HPV vaccine series by their 13th birthday (Blue Cross Blue Shield Association, 2018).

Because the setting for adolescent vaccination in the US is predominantly office-based, a recommendation for HPV vaccine from a clinician has been consistently reported as one of the most important facilitators of HPV vaccination (Darden et al., 2013; Holman et al., 2014, Perkins et al., 2014). Best practices for recommending HPV vaccine that are endorsed by the CDC (2017) and the American Academy of Pediatrics (AAP) (2017) call for clinicians to recommend HPV vaccine on the same day, and with the same high degree of importance, as the other universally recommended adolescent vaccines; to place HPV vaccine at the beginning or middle of the list of vaccines; and to focus on HPV vaccine as cancer prevention (e.g., "Now that your son is 11, he is due for 3 vaccinations today to help protect him from meningitis, HPV cancers, and pertussis"). However, studies have shown that the recommendations that clinicians provide for HPV vaccine frequently deviate from these best practices: HPV vaccine is often presented as optional, not urgent, and less important than the other vaccines that are routinely recommended for adolescents. (Gilkey & McRee, 2016; Henrikson, Tuzzio, Gilkey, & McRee, 2016; Niccolai, Hansen, Credle, & Shapiro, 2016).

There is a renewed need to expand and deepen our understanding of the barriers to high-quality recommendations for HPV vaccine in order to inform interventions that will work. Clinicians may fail to recommend HPV vaccine due to barriers that are internal (e.g., factors that are related to a clinician's own personal knowledge and attitudes related to HPV vaccine) or external (e.g., patient, guideline, and/or environmental factors) (Cabana et al., 1999). One potential internal barrier that remains relatively unexplored is that of clinicians' own cognitive biases. Cognitive bias refers to the errors in reasoning that result from reliance on heuristics, or "mental shortcuts," when making decisions under conditions of uncertainty (Tversky & Kahneman, 1974). Dozens of cognitive biases have been described, and their impact on medical decision making has been recognized (Saposnik, 2016). Several cognitive biases, summarized in Table 1, have been noted in the literature in relation to vaccination (Asch et al., 1994; Brown et al., 2010; Dibonaventura & Chapman, 2008; Dubov & Phung, 2015; Lown et al., 2012; Meszaros et al., 1996; Ritov & Baron, 1990; Seethaler, 2016; Sturm, Mays, & Zimet 2005), and cognitive bias on the part of clinicians has previously been raised as a potential pitfall in vaccine risk communication (Ball, Evans, & Bostrom, 1998). To the best of our knowledge, cognitive biases have not been directly studied in the context of HPV vaccination. Therefore, using data from a qualitative study conducted with clinicians to understand barriers and solutions to HPV vaccine uptake, we used cognitive bias as an analytic framework to explore if and how cognitive biases may be a potential influence on clinicians' recommendations for HPV vaccine.

Methods

Study Design and Participants

Purposive sampling was used to recruit primary care clinicians practicing in Connecticut who provide immunizations to adolescents. Multiple approaches were used to identify potential participants, including a statewide database of clinicians (FolioMed, Hyannis, MA), a notice posted in the Connecticut AAP Chapter Newsletter, referrals via professional networks, and referrals from interview participants. We sought to identify participants in different types of practice settings and geographic locations throughout the state to obtain maximal variation in responses. Participant recruitment continued until limited new information was acquired from additional interviews, suggesting that saturation had been reached (Guest, Bunce, & Johnson, 2006). The study protocol was submitted to the Yale University Human Investigation Committee and deemed to be exempt from review. Participants were not compensated for their participation.

Data Collection

Trained project staff conducted in-depth, open-ended interviews by telephone between June–October 2015. A semi-structured interview guide¹ was developed through a review of the literature and revised following pilot interviews with two clinicians (not included in the sample). Interview questions were designed to elicit information about barriers and solutions to HPV vaccine uptake; additional probes and follow-up questions were also asked. Participants were encouraged to reflect on their own clinical practice through questions that

¹Available from the corresponding author upon request.

aimed to explore how clinicians usually offer HPV vaccine, how they address parental reluctance to vaccination if it is encountered, perceived barriers to delivering HPV vaccine in the clinical setting, and opinions on what could improve uptake of HPV vaccine. Interview questions were not designed to elicit information about cognitive bias from clinicians explicitly. Rather, we used their descriptions of experiences to identify emergent topics related to biases. Respondents also completed a brief demographic survey. Interviews were audio recorded and transcribed by a professional transcription service for analysis.

Data Analysis

We used cognitive bias as an analytic framework, in order to better understand *why* clinicians may not be recommending HPV vaccination in a way that leads to greater vaccine acceptance. Given the focused nature of our research question, we undertook a directed content analysis to identify instances of cognitive bias related to clinicians' HPV vaccine recommendations in the dataset (Hsieh & Shannon, 2005). This analytic approach was informed by prior qualitative studies that have explored cognitive bias as a potential influence on other aspects of medical decision making (Magid et al., 2016; Matlock et al., 2017). First, we developed a coding guide, based on cognitive biases that were previously reported in the scientific literature related to vaccination, that we hypothesized might be also be relevant to HPV vaccination. It included nine forms of cognitive bias: ambiguity aversion, anchoring bias, availability bias, confirmation bias, naturalness bias, omission bias, optimism bias, present bias, and protected values, along with illustrative examples that described the potential effect that the bias could have on a clinician's HPV vaccine recommendation, to facilitate intercoder agreement (Table 1). Through an iterative process, we then applied this framework to the dataset (transcripts). Two coders independently read and coded all transcripts to determine which cognitive biases appeared to be present in clinicians' descriptions of their usual clinical practices related to HPV vaccination. Dedoose qualitative software was used throughout to code transcripts to organize and manage data. We met regularly to review discrepancies in coding, which were resolved through discussion. In cases of coding overlap, we referred back to the coding guide to help us attain consensus. Upon completion of coding, we jointly analyzed the findings, working via consensus to organize results and to select representative quotes.

Results

Participants (n=32) were predominantly medical doctors (88%) who trained in pediatrics (84%) and were in private practice (75%). Characteristics of the sample are presented in Table 2. Although participants generally reported awareness of guidelines that emphasize routine HPV vaccination of 11–12-year-olds and a majority (n=19) rated HPV vaccination as a high priority in their clinical practices, we identified a number of instances that suggested that cognitive bias could be operating in clinicians' decisions about when and how to recommend HPV vaccination to patients and families. Examples of biases are presented in detail below along with representative quotes and grouped according to the relative frequency with which they were identified: biases that were identified in greater than 10 interviews are grouped under "Cognitive Biases Frequently Observed"; those that were

identified in fewer than 10 interviews are presented under “Cognitive Biases Less Frequently Observed”. Findings from the analysis are also summarized in Table 1.

Cognitive Biases Frequently Observed

Anchoring bias.—Anchoring bias was identified when clinicians reported that they relied heavily on certain patient characteristics to recommend HPV vaccine or discuss it with parents. We found many instances where initial impressions of individual patients, such as age or pubertal status, were ‘anchored’ on to by the clinician in the context of discussing HPV vaccination. For example, several clinicians reported that they might deprioritize a discussion about HPV vaccination for patients who were viewed as “late bloomers,” or socially immature adolescents. As one clinician explained, “For the 13-year old who has never had her period...and the parents are very squeamish about vaccines, I might focus on other issues that visit, and choose to bring it up at the next visit.” These initial impressions of patient characteristics that were associated with a low risk of HPV acquisition were thus a rationale for not discussing HPV vaccine. Clinicians’ communication about HPV vaccine appeared to be influenced by patients who appeared “really, really, young”: as one respondent explained, “I’m less insistent when they’re little”. In this way, many clinicians reserved making stronger recommendations for adolescents who were older or observed to be in later stages of pubertal development based on this “anchor”.

Optimism bias.—Several clinicians described how longstanding relationships with patients and families allowed them to feel optimistic about their patients’ low risk of HPV acquisition. Clinicians also shared how their beliefs that their patients would not be at risk for HPV acquisition until later in adolescence afforded them “leeway” in recommending the vaccine. As one clinician explained, “I’m not gonna really push it unless they’re going to college...or if I’m suspicious that they’re sexually active. I think that’s the difference between my population and some other populations is that these kids we know for years and years and years.” Several clinicians also commented on their belief that their patients were highly unlikely to fall out of care, and therefore, even if they missed an opportunity for vaccination, that they would become immunized against HPV eventually. As one remarked, “our patient population, they come every year for check-ups and we have continuity of care...it’s not like this one chance that you miss...it’s almost never that someone finishes high school without having all three.” In this way, optimism about the likelihood of having subsequent opportunities to vaccinate contributed to postponement of HPV vaccination.

Present bias.—We found evidence that anticipated burdens to the clinic visit related to HPV vaccine administration dampened clinicians’ enthusiasm to discuss this vaccine. Some clinicians perceived that recommending HPV vaccine required an in-depth discussion, which could preclude discussion of other health issues. Relatedly, clinicians also discussed perceptions that objection to HPV vaccine in the context of needing additional vaccines during the visit led them to give a more equivocal recommendation. As one clinician noted, “6th graders are often getting lots of other shots, so we bring it up at the 6th grade visit, but they also have to get their meningitis. They have to get their tetanus, and sometimes we say, ‘Well, if they’re not interested now, we can do it another year.’” Finally, several clinicians discussed instances in which they perceived that recommending HPV vaccine might lead to

an uncomfortable discussion. In one example, a clinician said, “I have a few patients that are religious...sometimes I feel hesitant talking about these things, especially with the parents like, ‘What are you accusing my kid of being and doing?’” Therefore, the perception of negative aspects related to discussing HPV vaccine in the present moment led clinicians to delay offering HPV vaccine, or recommend it less emphatically.

Cognitive Biases Less Frequently Observed

Ambiguity aversion.—Some clinicians did not feel that they could offer a strong recommendation for HPV vaccine to 11–12-year-olds because they perceived important information regarding the vaccine’s duration of immunity and its efficacy to be lacking. Clinicians who expressed concerns that immunity could wane over time worried that patients who were vaccinated at the guideline-recommended ages might be left susceptible to acquisition of HPV infection as they grew older. Perceptions of limited information regarding duration of HPV vaccine immunity affected the strength with which recommendations for vaccination were delivered. As one clinician said, “We often tell parents, ‘We’re gonna talk about this now, but you may have some time to decide whether you want to do this or not.’ We don’t know yet how long this vaccine lasts...we can’t promise anyone anything longer than that or will you need a booster in your 40s kind of thing.” Similarly, a few clinicians shared how perceptions of missing data related to the efficacy of HPV vaccine hindered their ability to strongly recommend it to patients. One clinician remarked, “I think the more difficult sell is that it’s—I should say efficacy and doing what it is we think it’s going to do has not been proven yet. Which is to prevent cancer in adults. We need a whole generation of data, which we don’t have. So, we have to tell them that it theoretically will prevent or reduce the risk of a variety of cancers, but there is no actual data on that yet.” Clinicians who expressed gaps about vaccine efficacy and safety expressed a desire for more data to better inform their recommendations.

Availability bias.—Due to the long delay between HPV infection and the development of cancer, pediatricians rarely see preventable HPV-associated cancers, and may be less familiar with other HPV-associated diseases, such as genital warts. This may make HPV prevention something that is less cognitively available, or readily able to be brought to mind. As one clinician reflected,

“I think one of the challenges [of] being a pediatrician is that you don’t see the consequences down the road of HPV. Obviously, as pediatricians we’re trying to do preventive care, and...we have to keep that concept in mind, even though we don’t see kids as adults. Since we don’t see the consequences of HPV, it’s not always in the forefront of our minds.”

In addition, several clinicians contrasted how they discussed vaccination against meningococcal infection, which occurs infrequently but can be swiftly fatal, with vaccination against HPV. As one pediatrician acknowledged, “Telling you that I’ll give you a vaccine to help protect you against a germ where you can die within two days if you get sick, that’s pretty compelling.” By contrast, vaccination against HPV, described by one clinician as “not an illness that they can catch just by going to school,” seemed to be less urgent.

Omission bias.—A few respondents reported that they routinely omitted discussion of HPV vaccine until after the target ages for vaccination, and instead introduced vaccination for 13-year-olds and older adolescents. Because clinicians felt confident that their patients would remain at low risk for HPV acquisition and would return to care (“it’s not like this one chance you miss”), the downside of deferring vaccination until a later visit was perceived to be minimal. Another factor that motivated clinicians to omit mention of the vaccine was perceptions that parents were uninterested in vaccination: as one clinician stated, “AAP recommends at age 11 and 12. I find most of the parents of my population do not want it then. I tend to offer it at 13 and 14.”

Protected values.—Protected values are values that resist tradeoff regardless of what the consequences of doing so may be. We found fewer examples of this bias. Only one respondent reported not offering HPV vaccine to boys due to a belief that the vaccine was not needed. This appeared to represent this clinician’s absolutely held belief that HPV vaccination was never necessary for boys, which led to a practice of not recommending vaccination for any male patient. A few clinicians indicated that they would not try to change the mind of a parent who did not approve administration of HPV vaccine for their child, because of the high value they placed on a parent’s right to refuse vaccination. As one respondent explained, “I think a parent has a right to make their own decisions about the vaccine” and indicated that adolescents could make their own decisions about vaccination once they attain early adulthood, which was not felt to be detrimental because “it’s still within the age range of being immunized.” These examples illustrate how clinicians’ own protected values could influence which patients they offer HPV vaccine to, and the strength with which they make these recommendations.

Cognitive Biases Not Observed

Confirmation bias and naturalness bias.—We did not find evidence suggestive of either of these biases in our interviews. For example, we did not find evidence of confirmation bias, or a tendency to interpret new evidence to fit existing beliefs. This may be because the interview guide was not designed to include domains aimed to elicit this particular bias; for example, we did not seek to challenge clinicians’ existing practices or beliefs with new evidence, but rather sought to understand the reasons behind their current practices. In addition, we found no examples of naturalness bias: no participants expressed preferences for natural immunity from HPV infection over vaccine-induced immunity acquired via HPV vaccination.

Discussion

Several studies have identified recommendations from clinicians for HPV vaccine as critically important to increasing parents’ acceptance (Darden et al. 2013, Holman et al., 2014; Perkins et al., 2013), yet many clinicians cite challenges to giving strong recommendations consistently (Gilkey & McRee, 2016). This study builds upon these self-reported barriers and makes a unique contribution to the literature by exploring clinicians’ suboptimal recommendations for HPV vaccine through the lens of cognitive bias. Our findings from clinicians’ perspectives of their approach to recommending HPV vaccine in

clinical practice suggest that cognitive biases may influence clinicians' communication about HPV vaccine in a way that could prevent effective recommendations from being delivered; for example, several of these biases may lead clinicians to delay making a recommendation until the adolescent is older. It is also important to note that we found evidence that these biases may be operating even though overall our sample reported HPV vaccination to be a high priority in clinical practice.

Three of the most commonly identified biases in our data were anchoring bias, present bias, and optimism bias. These biases could inhibit high-quality recommendations for HPV vaccine from being delivered in an interconnected fashion. For example, a clinician may know that HPV vaccine is recommended for 11–12-year-olds, but may anchor on to an initial impression of an 11-year-old who appears “young”. This may lead to optimism about the adolescent's low risk of HPV acquisition, which could in turn discourage a strong, urgent recommendation from being delivered. Similarly, a clinician could presume that the present burdens of a conversation about HPV vaccine, which may involve discussion of the sexually transmitted nature of the virus, is unlikely to be well received by the parents of the “young” appearing adolescent, and omit mention of the vaccine entirely.

Our findings have implications for how to improve the effectiveness of clinicians' HPV vaccine recommendations. As an initial step, it will be important to raise clinicians' awareness of how their own beliefs about HPV vaccine, including their own potential cognitive biases, may be hindering greater implementation (Niccolai & Pettigrew, 2016). For example, promising strategies for recommending HPV vaccine in clinical settings have been identified (Brewer et al., 2017; Dempsey et al., 2018), but may be challenging for clinicians to adopt if they are unaware of their own “blind spots” related to making HPV vaccine recommendations. Providing clinicians with additional education regarding examples of cognitive biases in HPV vaccine communication may help lead to greater insight. For example, some clinicians reported that they did not strongly recommend HPV vaccine at the target ages of 11–12 years because they did not want to discuss sexuality and worried about damaging relationships with parents – a tendency to place more weight on the costs of discussing HPV vaccine in the present moment rather than the benefits, namely cancer prevention, that can be realized in the future. Data indicate, however, that parents tend to regard HPV vaccine favorably, with equal importance to other childhood and adolescent vaccines (Healy, Montesinos & Middleman, 2014), and that responding to vaccine-hesitant parents may be less time-consuming than clinicians realize, and can often lead to same-day vaccination (Shay et al., 2018). Strategies that normalize HPV vaccination as part of routine care for all patients, such as bundling all adolescent vaccines into a single recommendation, could help overcome problems of deferring HPV vaccination, or risk-based approaches. Ambiguity aversion could be addressed by providing data on HPV vaccine effectiveness on preventing precancerous lesions, and the durability of the vaccine's immune response. Further education to raise awareness among pediatricians of the full spectrum of HPV-associated cancers, including oropharyngeal cancers that affect males and are increasing in incidence, may help to counter availability bias. Finally, emphasizing the sequelae of HPV infection that can directly affect pediatric populations, such as recurrent respiratory papillomatosis or the association of preterm birth with treatment for cervical dysplasia in mothers with history of HPV infection, may also help to overcome availability bias by

making HPV prevention more immediately relevant to the clinical populations that are cared for by pediatricians.

Another way to counter cognitive biases could be strategies that encourage clinicians to adopt reflective reasoning in their clinical practices. Reflective reasoning, or deliberately reflecting upon one's initial impressions, has been demonstrated to enable physicians to overcome availability bias in clinical decision making (Mamede et al., 2010), and similar principles might be applied to HPV vaccine. Because time is an essential element of reflective reasoning, health systems, insurers, and policy makers should consider ways to overcome time pressures and the associated present bias that could disincentivize discussions about HPV vaccine, such as reimbursement for vaccine counseling, or incentive-based approaches, such as those tied to quality of care measures, which have been shown to improve timely uptake of early childhood immunizations (Chien et al., 2010), and may be a useful strategy to improve rates of uptake of HPV vaccine as well. In the absence of such structural-level changes, additional research that provides evidence on how to efficiently and effectively communicate about vaccines with families in the time-pressured clinical practice setting is also needed. Our findings also lend support for implementation of clinical decision support tools – tools that enhance decision making within clinical workflows – more widely. Specifically, the use of electronic health record (EHR) alerts has been demonstrated to increase adherence to HPV vaccination guidelines (Fiks et al., 2013), possibly by reducing the impact of clinicians' own cognitive errors in medical decision making (Graber et al., 2012).

Lastly, our findings could also provide insight into the outcomes of HPV vaccination interventions that have been conducted to date. For example, while EHR reminders have been shown to improve HPV vaccination rates, a pop up reminder screen for HPV vaccine may be ignored if a clinician perceives there to be gaps in information regarding the safety and efficacy of HPV vaccine (ambiguity aversion); that the reminder does not apply to the prepubertal patient sitting in the exam room (anchoring); or that by acting upon the reminder, a long and uncomfortable discussion that detracts from other important medical issues will ensue (present bias). By considering and addressing cognitive biases, it is possible that existing, effective interventions to improve HPV vaccine uptake could be refined to be even more impactful.

A major strength of this study is the use of qualitative methods that permitted a deeper exploration of clinicians' motivations behind their vaccination practices. We believe that the biases observed in this study are comparable to those described in the vaccination literature; specifically, ambiguity aversion and omission bias have been described in other studies that examined the influence of cognitive bias on vaccine decision-making (Asch et al., 1994; Meszaros et al., 1996; Ritov & Baron, 1990). However, this analysis is also subject to several limitations. While dozens of cognitive biases have been described, we only focused on nine types in the current analysis, based on the cognitive biases that have previously been reported in the vaccination literature. However, there likely exist other biases relevant to HPV vaccination in addition to the ones that we examined, as well as other influences on clinicians' communication about HPV vaccine that were not assessed in the present study. In addition, because the interview guide was not explicitly designed to elicit these biases, it is

possible that saturation about the use of cognitive biases was not reached. We also acknowledge that another limitation of this study is that some biases could fall into more than one category. For example, patient factors such as perceived young age (anchoring bias), could also be related to perceptions that HPV vaccine will be more uncomfortable to discuss (present bias). In the present analysis, we addressed this by using strict definitions of each bias (provided in Table 1) to determine the best fit. In addition, because we interviewed clinicians from only one state, our data may not be representative of clinicians nationally. However, as there has been little prior research examining the influence of cognitive bias on the part of clinicians, this study provides a unique and novel contribution to the literature. Lastly, our findings are based on clinicians' report of their usual HPV vaccine recommendation practices, and not on evaluations of their actual behavior. Further research examining HPV vaccination recommendations in the clinical setting will be needed to better define the role of cognitive bias in clinicians' communication about HPV vaccine.

Conclusion

Given the substantially low rates of HPV vaccine uptake greater than 10 years following its introduction, a renewed focus on addressing obstacles to vaccination in clinical practice is needed. Findings from this analysis that focused on examining clinicians' internal barriers to adherence to HPV vaccination guidelines suggest that cognitive biases could be in effect. As effective recommendations by clinicians are critical to improving rates of uptake of HPV vaccination, a better understanding of how cognitive biases may be influencing clinicians' recommendations for HPV vaccine will be important to inform the development of strategies to improve communication about this vaccine. These findings should prompt clinicians to examine their own assumptions and motivations behind their current HPV recommendations and can be used to develop interventions with greater likelihood of success in promoting higher vaccination coverage.

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Table 1. Cognitive bias in clinicians' communication about HPV vaccination: findings from qualitative analysis

Cognitive Bias	Description	Example of effect on clinician's HPV vaccine recommendation	Representative Quote
Anchoring bias	Tendency to make decisions based on first impressions (e.g., age, pubertal status)	Prepubertal patient is not deemed to be at risk for HPV and no vaccine recommendation is made	"It becomes a lower priority in a visit when I'm pretty sure that those kids never get out of their parents' sight."
Optimism bias	Tendency to be more optimistic about a particular health risk, believing a greater risk for other people	Chances of HPV infection higher, and gaps in care continuity greater for other adolescents; therefore no urgency to vaccinate	"I like to think that they're fairly honest with their sexual histories, and so I think we're pretty lucky that we have a lot of kids who really are not having sex before 15 or 16. We see them every year. We don't worry as much about losing them to follow up."
Present bias	Tendency to place more weight on costs and benefits in the present moment, rather than on long-term consequences	Inconveniences of HPV vaccination today (e.g. time to discuss vaccine, anticipated uncomfortable discussion with parents) outweigh the long-term consequences	"Sometimes in a 20-minute well visit, a parent can take 5 minutes talking about the HPV vaccine, and you just simply don't have the time."
Ambiguity aversion	Perception of missing or conflicting information leads to preferences to continue without treatment	Forgo HPV vaccine recommendation when safety or immunogenicity information appears to be inconsistent or incomplete	"I cannot find out how long the immunity lasts for. If it's only five years, I don't want to give it to a twelve-year-old...I wanna sort of push it out as late as I can."
Availability bias	Tendency for things to be judged as more frequent based on how readily they come to mind	HPV-associated diseases not seen commonly, therefore enthusiasm for recommending vaccination is dampened	"It's hard to say. Oh, I've seen so many kids with genital warts, and if this were my kid, I'd be doing it (<i>vaccinating against HPV</i>) yesterday," but we don't."
Omission bias	Tendency to prefer a potentially harmful inaction to a potentially less harmful act	Omit discussion of vaccine until after target ages of 11–12 years	"Starting at age 13 or 14, I certainly talk about it."
Protected values	Values absolutely held and not amenable to tradeoffs	HPV vaccination is wrong/not needed	"I do not offer it for boys...I don't think it's really necessary for boys."
Confirmation bias	Tendency to interpret new evidence to fit existing beliefs	Anecdotal evidence about adverse events are used to call HPV vaccine safety into question	None identified
Naturalness bias	Tendency to prefer natural products even when identical or worse than synthetic alternatives	Better to develop natural immunity to HPV infection than develop immunity from vaccination	None identified

Table 2.

Sample Characteristics

Sample Characteristics	Number (%) ^a n=32
Gender	
Female	22 (68.8)
Male	10 (31.3)
Age	
31–50	12 (37.5)
51–60	12 (37.5)
>60	8 (25.0)
Race/Ethnicity	
Non-Hispanic White/Caucasian	28 (87.5)
Non-Hispanic Black/African American	2 (6.3)
Hispanic White/Caucasian	2 (6.3)
Medical Training	
Physician	28 (87.5)
Nurse practitioner	4 (12.6)
Specialty	
Pediatrics	27 (84.4)
Family Medicine	5 (15.7)
Type of Practice	
Private Practice	24 (75.0)
Community Health Center	4 (12.5)
Hospital-Based Clinic	4 (12.5)
% Patients Publicly Insured	
0–25	16 (50.0)

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Sample Characteristics		Number (%) ^a
26-50		8 (25.0)
>50		7 (21.9)

Percentages may not add to 100% due to rounding and missing data.