PEDIATRICS PERSPECTIVES

The Role of Cognitive Bias in Suboptimal HPV Vaccine Uptake

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Human papillomavirus (HPV) vaccination coverage in the United States is suboptimal, leaving many adolescents and young adults vulnerable to infection. In 2014, only 40% of girls and 22% of boys aged 13 to 17 years received all 3 recommended doses.[1] This level of coverage results in 14 million US adolescents inadequately immunized against HPV. In sharp contrast, coverage for other vaccines that are also recommended for routine use in adolescents is substantially higher, including 88% for tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed (Tdap) and 79% for meningococcal conjugate (MCV4) vaccines.

Many studies have demonstrated that a key factor hindering better coverage for HPV vaccine is lack of strong recommendations from clinicians.[2] Clinicians have reported several reasons for this, including anticipated parental hesitancy, lack of perceived risk among their patients, and concern about the need for time-consuming conversations or discussions about sexual activity.[3] Another factor that potentially limits higher coverage is clinicians' cognitive biases against HPV-associated diseases. This topic is receiving substantially less (if any) attention in the scientific literature because it is not likely to be reported by clinicians themselves who may be unaware of the impact of these preconceived notions.

HPV-associated diseases include 6 types of cancer and genital warts that cause a substantial amount of morbidity and mortality. The current burden of diseases prevented by Tdap and MCV4 vaccines are substantially lower (Table 1). Collectively, tetanus, diphtheria, pertussis, and meningococcal disease cause fewer than 200 deaths per year in the United States in comparison with the >6000 deaths from HPV-associated cancers. Clinicians who provide care for children have the primary responsibility for immunizing their patients against HPV at the recommended ages of 11 to 12 years, yet HPV-associated cancers may be less salient to these clinicians (often pediatricians) because these cancers take years or decades to develop and are not typically diagnosed or treated in young children. Important cognitive biases about HPV-associated diseases may be affecting the nature of clinicians' recommendations for HPV vaccine in a way that is keeping coverage unacceptably low.

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Dr Niccolai conceptualized and designed the study and drafted the initial manuscript; Dr Pettigrew contributed to conceptualization and design and reviewed and revised the manuscript; and all authors approved the final manuscript as submitted.

DOI: 10.1542/peds.2016-1537

Accepted for publication Jun 6, 2016

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

To cite: Niccolai LM and Pettigrew MM. The Role of Cognitive Bias in Suboptimal HPV Vaccine Uptake. *Pediatrics.* 2016; 138(4):e20161537

TABLE 1 Burden of Diseases Prevented by Vaccines Recommended for Adolescents in the United States As Reported by the Centers for Disease Control and Prevention

	Annual Number of Cases	Annual Number of Deaths
Meningococcal disease[a]	1146	115–172
Tetanus[b]	29	4
Diphtheria[c]	<1	<1
Pertussis[d]	20 046	19
HPV[e]	26 000 (cancer) 360 000 (genital warts)	6210 (cancer)

[a] Average annual estimated number of cases of meningococcal disease during 2002–2011. Deaths were estimated by using the reported case-fatality ratio of 10% to 15%. Centers for Disease Control and Prevention. Prevention and Control of Meningococcal Disease: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR*. 2013;62:4-5 (No. RR-2).

[b] Average annual number of cases during 2001–2008. Deaths estimated using reported case-fatality ratio of 13.9%. Centers for Disease Control and Prevention. Tetanus surveillance—United States, 2001–2008. *MMWR*. 2011;60:365–369.

[c] Based on 2 cases reported 2004–2015. Available at: http://www.cdc.gov/diphtheria/about/index.html. Accessed July 27, 2017.

[d] Average annual number of cases reported 2000–2014 (range, 7580–48 277). Available at: www.cdc.gov/pertussis/surv-reporting/cases-by-year.html. Accessed July 27, 2016.

[e] Cancer cases reported during 2004–2008. Numbers are estimated from the actual number of diagnosed cases multiplied by the proportion attributable to HPV for each specific cancer (cervix, oropharynx, anus, vulva, vagina, penis). Estimate for deaths obtained by multiplying total number of cancer deaths in 2015 by the attributable proportion due to HPV. This estimate does not include oropharyngeal because mortality for head and neck cancers is not presented separately for this site. Centers for Disease Control and Prevention. Human papillomavirus-associated cancers—United States, 2004–2008. *MMWR*. 2012;61:258–261. Available at: www.seer.cancer.gov/statfacts and http://www.cdc.gov/std/hpv/stdfact-hpv.html (last accessed July 27, 2016).

THE ROLE OF COGNITIVE BIASES IN REDUCING RATIONAL THINKING

In the 1970s, psychologists Daniel Kahneman and Amos Tversky led pioneering work in behavioral economics related to decision-making processes. They described how individuals often rely on the use of simple judgmental processes, or heuristic principles, when faced with the complex task of assessing the probability of future uncertain events.[4] Although these heuristic principles may be helpful in decision-making, they may also lead to systematic errors and bias.

One such judgmental strategy, the availability heuristic, may be particularly relevant for clinicians' thought processes related to providing strong recommendations for adolescent vaccines. Availability is the ability to recall events in one's mind, and bias may occur when more recent and memorable information is given preference in decision-making.[4] This bias can be influenced by at least 2 factors that can result in erroneous judgments including retrievability and imaginability. The role that each of these biases can play in influencing clinicians' assessment of the significance of HPV-associated diseases is described below.

Bias of Retrievability

Retrievability bias refers to the ease with which events are brought to mind.[4] The future probability of low-frequency events may be more easily retrieved, and therefore overestimated, if they are more familiar and salient. In the United States, most pediatricians today infrequently see meningococcal disease or pertussis due to their relatively low prevalence, yet these diagnoses may be more easily brought to mind given that cases and outbreaks receive substantial attention in the pediatric literature, professional circles, and the media. In contrast, pediatricians do not often read or hear about their patients being affected by HPV-associated cancers that tend to affect older populations. Although clinicians are certainly aware of the significance of a cancer diagnosis, HPV-associated cancers may not be salient to them in the context of providing care to children and adolescents.

The low retrievability of HPV-related diseases, in turn, may result in clinicians presenting HPV vaccine as optional or less urgent for their patients and in a way that is different from other strongly recommended adolescent vaccines.[5,6] A recent qualitative study of clinicians revealed that their limited experiences with HPV-associated diseases may result in underestimation of their true risk.[3] For example, limited experience with HPV-associated diseases was reflected in 1 statement that HPV will not kill boys, and another pediatrician reported the belief that his/her patients were more likely to die of meningococcal meningitis than from cervical cancer. In another study, cervical cancer mortality was described as "like 20 a year, right?"[7] Though none of these statements is accurate, these perceptions may weaken the strength of recommendations for HPV vaccine.

Bias of Imaginability

Assessments of future probabilities are also influenced by one's imagination in a way that can produce errors in judgment.[4] Pediatricians may assess the risk of meningococcal disease by imagining frightening scenarios in which patients are severely ill, hospitalized, in need of immediate treatment, and at high risk of death. They may also imagine the sudden onset of illness. These vivid and alarming images may result in overestimation of risk. In contrast, lacking similar experience with cancer mortality, clinicians may not present HPV vaccine as strongly as other adolescent vaccines.

Examples of this bias also exist in the literature. In 1 qualitative study, a clinician noted that compared with cervical cancers, the other diseases "just feel more dramatic."[3] In another study, HPV was not viewed as an important public health threat because cervical cancer is "treatable" and "slow growing."[7] These notions

can decrease the urgency for recommendations for HPV vaccine, somehow viewed as less important,[6] in contrast to MCV4 or Tdap.

CONCLUSIONS

Widespread use of MCV4 and Tdap vaccines has greatly reduced the burden of several important diseases, and these vaccines are a tremendous public health success. The same potential for HPV-associated diseases is not currently being realized. This may be due in part to unconscious biases that clinicians might have when considering their patients' risk for contracting different vaccine-preventable diseases and the severity of disease outcomes. In particular, the way in which they think about HPV-associated cancers may be influencing the weaker and less urgent recommendations they provide for HPV vaccine.

Vaccine uptake is a complex phenomenon involving many challenges, and increasing uptake will require multipronged efforts. Raising awareness of clinicians' biases that can result in erroneous judgments will be an important component of the effort to address the problem of low uptake of HPV vaccine. Strengthened efforts to ensure that clinicians understand the burden and seriousness of diseases caused by HPV in the context of providing care to children and adolescents are needed. This could be achieved through continuing medical education, maintenance of certification programs, and academic detailing. Furthermore, greater dissemination of early evidence of HPV vaccine impact on reducing associated diseases in the pediatric literature could help to heighten the sense of urgency with which HPV vaccines are recommended. Acknowledging and confronting these biases will allow us to implement programs and interventions to increase the strength and urgency with which HPV vaccine is recommended for all adolescents to improve coverage rates for important and potentially life-saving HPV vaccines.

ABBREVIATIONS

HPV: human papillomavirus
MCV4: meningococcal conjugate
Tdap: tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed

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Pediatrics 2016;138;
DOI: 10.1542/peds.2016-1537 originally published online September 9, 2016;

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