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A Retrospective and Prospective Look at Strategies to Increase Adolescent HPV Vaccine Uptake in the United States

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Abstract

The HPV vaccine debuted more than ten years ago in the United States and many strategies have been evaluated to increase HPV vaccination rates, which include not only improving current vaccination behaviors but also sustaining these behaviors. Researchers and practitioners from a variety of backgrounds have engaged in this work, which has included efforts directed at public health and government policies, health education and health promotion programs, and clinical and patient-provider approaches, as well as work aimed to respond to and combat anti-HPV vaccination movements in society. Using a previously developed conceptual model to organize and summarize each of these areas, this paper also highlights the need for future HPV vaccine promotion work to adopt a multi-level and, when possible, integrated approach in order to maximize impact on vaccination rates.

45

Introduction

46 Genital human papillomavirus (HPV) is the most common sexually transmitted infection
47 (STI), with the CDC estimating that more than 90% of men and more than 80% of women will
48 be infected with at least one type of HPV in their lives.¹ Genital HPV strains are categorized as
49 low-risk and high-risk, with the low-risk strains known to cause genital warts and the high risk-
50 strains known to cause several types of cancer.² Virtually all cases of cervical cancer are caused
51 by HPV, with 70% of cervical cancer cases linked to just two types of HPV – 16 and 18.²

52 The introduction of the multi-dose HPV vaccine, however, began a new era in STI and
53 cancer prevention. Alex Azar, the deputy secretary of the Department of Health and Human
54 Services at the time, said the approval of this vaccine was “a major step forward in public health
55 protection.”³ However, many in public health and healthcare also expressed caution, noting that
56 it might be challenging to promote a vaccine for STI prevention. The 9-valent HPV vaccine
57 (9vHPV) is the HPV vaccine currently available in the U.S. and the CDC recommends that all
58 children be vaccinated routinely at 11 or 12 years of age; in other words, prior to sexual initiation
59 and at the same visit when the meningococcal (MenACWY) and tetanus, diphtheria, and
60 pertussis (Tdap) vaccines are administered.⁴ Writing in the *New England Journal of Medicine* on
61 the eve of the vaccine’s introduction, Steinbrook noted:

62 The acceptance of the HPV vaccine — by physicians, parents, preteens, and the public at
63 large — is also uncertain. As with many issues related to sex, people may have strong
64 views. Increased acceptance is likely to require ongoing discussion and educational
65 efforts.⁵

66 In the 11 years since this statement, the diffusion of the HPV vaccine has increased,
67 albeit quite slowly. Data from the 2016 National Immunization Survey-Teen indicates that about

68 56% of 13-17 year old male adolescents and 65% of females have started the HPV vaccine
69 series, with only 38% of males and 50% of females finishing the vaccine series.⁶ These current
70 vaccination rates fall well below the Healthy People 2020 objective to reach 80% series
71 completion for all adolescents.⁷ Despite the modest levels of vaccination, we are reaping some
72 public health benefits; comparisons of pre-vaccine and post-vaccine HPV prevalence reveal a
73 64% decrease of HPV types 6, 11, 16, and 18 among females 14-19 years of age.⁸

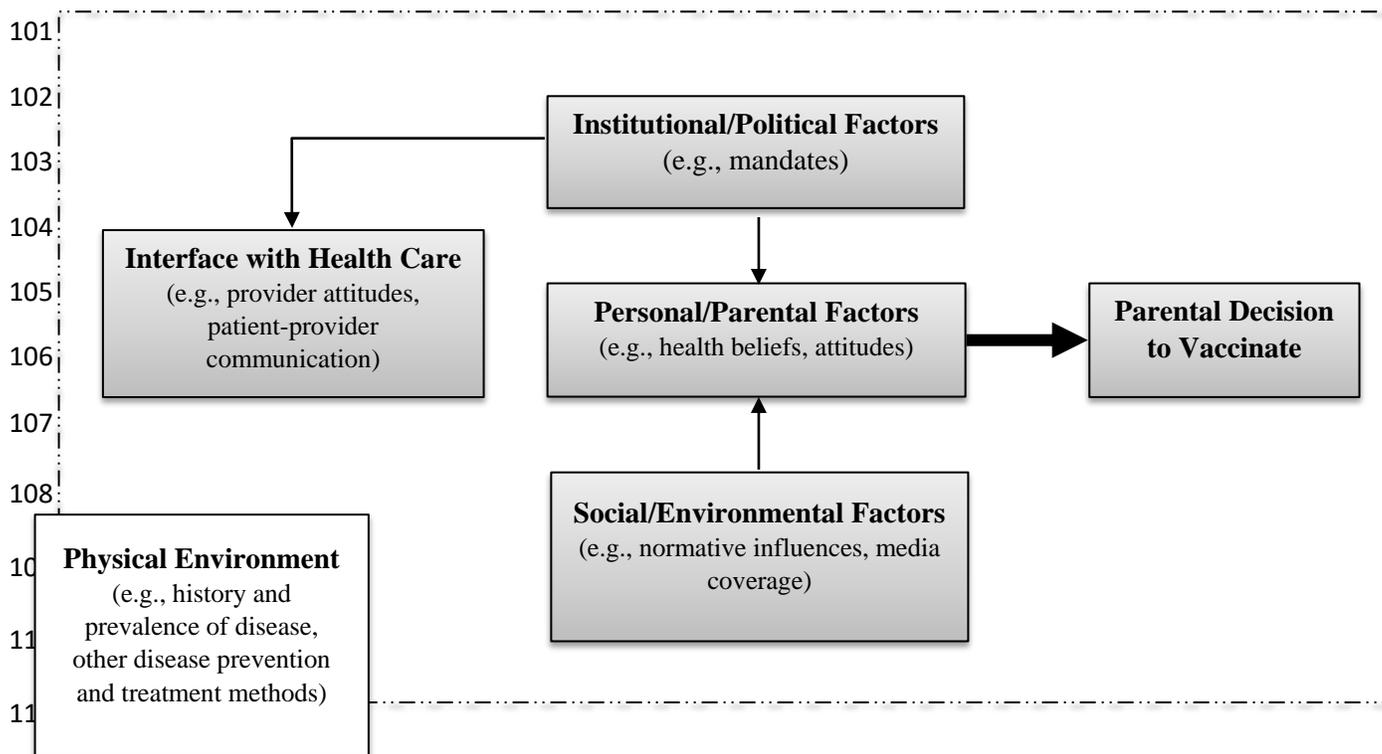
74 Numerous strategies have been evaluated to increase HPV vaccination rates, to not only
75 improve current vaccination behaviors but also sustain these behaviors. Importantly, the
76 promotion of the HPV vaccine is somewhat unique in a number of ways. First, promotion of this
77 vaccine is complicated in that it is a multi-dose vaccine that is not generally required for school
78 entry, has a broad age range (ages 9-26), and prevents sexually transmitted infections. Second,,
79 in addition to public health policies and promotion strategies, there have also been paid
80 advertisement campaigns by Merck, the maker of the Gardasil HPV vaccine, including the well-
81 known “One Less” campaign and the more recent “Did you know?” campaign. While these mass
82 media advertisements have been shown to have an effect on awareness and decision to
83 vaccinate,⁹ they are not the focus of this review. Instead, we focus on the many efforts directed at
84 public health and government policies, health education and health promotion programs, and
85 clinical and patient-provider approaches, as well as work aimed to respond to and combat anti-
86 HPV vaccination movements in society. Importantly, we have organized this paper according to
87 a previous conceptual model we developed outlining key issues in parental decision-making
88 about child and adolescent vaccination.¹⁰ The original article defines the scope of the model in
89 this way:

90 “when parents consider whether to have their child immunized, their decision or
 91 willingness to immunize may be influenced by social-environmental factors, parent-
 92 specific or personal factors, the family’s interface with the health care system,
 93 institutional policies and interventions related to vaccines, and the physical environment
 94 of health” (p. 442).

95 Several years later, the model was critiqued when another scholar argued that it would be
 96 improved by including explicit mention of the role of political factors, especially the interplay
 97 between government and local/state policies.¹¹ Taking this critique into consideration, the
 98 revised model is included here.

99

100 Figure 1. Factors Affecting Parental Decisions on Childhood/Adolescent Vaccination



113 In this paper, we use this conceptual model to organize our review of strategies and their
114 success in addressing HPV vaccination of adolescents in the United States, and draw attention to
115 potential future intervention approaches for consideration and study.

116

117 **Institutional and Policy Factors Influencing HPV Vaccination**

118 Institutional and policy-based initiatives can and do play a large role in driving uptake of
119 the HPV vaccine. However, this is a relatively complicated area with the need to consider
120 different federal and state initiatives for vaccination, new and changing professional and national
121 disciplinary committee’s recommendations and guidelines, and even healthcare-based
122 institutional policies that could affect parental decisions to vaccinate.

123 **School-based policies**

124 In the U.S., perhaps the most effective tool for achieving high vaccination rates involves
125 school entry requirements, often referred to as mandates.¹² These requirements, which are
126 determined on a state-by-state basis, have been remarkably successful in improving coverage for
127 many vaccines, including, but not limited to, MenACWY and Tdap.¹³ Moreover, when
128 exemptions from school entry requirements are easily granted (e.g., on the basis of “personal
129 beliefs”), the result is decreased vaccination rates and outbreaks of vaccine-preventable
130 diseases.^{14,15} Since the introduction of HPV vaccination in the U.S. there has been a good deal of
131 debate around school entry requirements. Intensive efforts to pass legislation in 2006 and 2007,
132 shortly after the HPV vaccine was licensed, led to a backlash in public opinion and a number of
133 critical analyses of these efforts were published.¹⁶⁻²⁰ The first two jurisdictions to pass school
134 entry requirements for HPV vaccine, Virginia and the District of Columbia, enacted legislation

135 that was quite weak, applied only to girls, and had no real enforcement.²¹ For example, the
136 Virginia HPV vaccination requirement reads as follow:

137 Effective October 1, 2008, a complete series of 3 doses of HPV vaccine is required for
138 females. The first dose shall be administered before the child enters the 6th grade. After
139 reviewing educational materials approved by the Board of Health, the parent or guardian,
140 at the parent's or guardian's sole discretion, may elect for the child not to receive the
141 HPV vaccine.²²

142 Not surprisingly, when such inherently flawed public health policies are implemented, they have
143 little impact on the intended outcome, HPV vaccination rates.²³ While it is difficult to fully
144 evaluate its effects at this point in time, Rhode Island, which has the nation's highest HPV
145 vaccination rates, implemented a stronger, gender neutral school entry requirement in 2015.²⁴
146 Although enactment of school entry requirements for HPV vaccine is politically challenging and
147 somewhat controversial,²⁵ it remains an important strategy to consider in order to ensure
148 maximum protection against cervical and other HPV-related cancers.

149 **Vaccine policies**

150 Another public policy approach is a reductions in the number of vaccine doses
151 recommended for series completion. With evidence for efficacy of a 2-dose regimen in younger
152 adolescents, the Advisory Committee on Immunization Practices (ACIP) recently changed their
153 recommendation from three to two doses for those who receive the first dose before age 15
154 years.²⁶ The two doses should be administered six to twelve months apart. This policy change
155 may serve to increase vaccination rates by reducing costs and logistical barriers, and by
156 providing a motivation for initiating vaccination at younger vs. older ages. Furthermore, there is
157 preliminary evidence suggesting that a single dose of HPV vaccine may be sufficient to provide

158 reasonably long-lasting protection.²⁷⁻²⁹ A future policy shift to a one-dose regimen would likely
159 have a very positive effect on HPV vaccination rates.

160 **Age-based policies**

161 Other public policy initiatives that could impact HPV vaccination rates include
162 implementing a recommendation that vaccination should be initiated at ages 9-10 rather than at
163 ages 11-12 (the vaccine is already licensed down to age 9 years) and harmonizing the
164 recommendations for males and females ages 22-26 years. The earlier initiation of vaccination
165 might help to minimize the association of HPV vaccine with initiation of sexual behavior and
166 may allow for the completion of the two-dose series at the 11-12 year old visit when MenACWY
167 and Tdap are administered. A recent review found that providers typically waited until much
168 later in adolescence, and beyond the target age set by the CDC (11-12 years), to recommend the
169 HPV vaccine to parents and adolescents; this was usually a result of parental preference for
170 waiting to discuss it.³⁰ However, to our knowledge, no research has explicitly examined parent or
171 provider perspectives on the issue of vaccinating at an earlier age.

172 On the other end of the age spectrum, “catch-up” vaccination is routinely recommended
173 for all women up through age 26, but not for all men. For men ages 22 through 26 years, ACIP
174 only routinely recommends catch-up vaccination for men who have sex with men, transgender
175 persons, and those with immunocompromising conditions.²⁶ These divergent recommendations
176 based on sex add to the complexity of public health messaging and contribute to confusion
177 around HPV vaccination policy.

178 **Provider policies**

179 Another policy approach that could help to improve HPV vaccination rates is
180 implementation of a benchmark that requires providers to achieve a pre-determined level of

181 vaccination in their eligible patients. Health insurance plans that implement such policies can
182 reward providers who reach the designated level and impose consequences on those who fail to
183 achieve the benchmark. Currently, the National Committee for Quality Assurance (NCQA)
184 issues the Healthcare Effectiveness Data and Information Set (HEDIS) measures, which are
185 benchmarks used by many health insurance plans. Included among the HEDIS measures is the
186 expectation that all doses of HPV vaccine be administered by age 13.³¹

187 **Future Directions**

188 In sum, there are a number of institutional and policy strategies to increase HPV
189 vaccination that could have large and lasting effects on uptake rates. Researchers should
190 continue to partner with policy makers to better investigate the potential impact of these policies
191 on actual behavior, as well as how the public may perceive and accept these policies. Gaining
192 support from respected public health and medical organizations like APHA or AMA could also
193 help to increase support for, and realization of, these policy ideas.

194 **Clinical and Health Care Influences on HPV Vaccination**

195 A second area in which HPV vaccine promotion has taken place is in the clinical setting,
196 such as primary care clinics, pharmacies, and county health department immunization clinics.
197 With several exceptions (e.g., school-based vaccination programs), most vaccinations take place
198 in such clinical settings, making it an ideal context for promoting HPV vaccine. In this section,
199 we review how parents' and adolescents' interactions with health care providers within the more
200 formal health care system play a role in HPV vaccination behaviors.

201 **Role of Provider Recommendation**

202 Perhaps not surprisingly, a provider recommendation for HPV vaccination is consistently
203 shown to be one of the most important factors driving vaccination intention and behavior for

204 parents of adolescent girls.³²⁻³⁵ On the other hand, many clinicians do not always make
205 appropriate and timely HPV vaccination recommendations to parents of adolescents, potentially
206 leading to a number of missed opportunities.³⁶⁻³⁸ For example, providers' quality of HPV vaccine
207 recommendations vary on indicators such as timeliness (i.e., based on patient age), consistency
208 (i.e., using risk-based communication strategies when recommending the vaccine), and urgency
209 (i.e., same day vs. at a later visit).³⁸ While clinicians have provided a number of reasons and
210 rationales for delaying or not recommending the HPV vaccine,^{30,39} it is clear that interventions
211 are needed at the provider level to equip these clinicians with the confidence and skills to make
212 this important recommendation to parents and patients.

213 **Provider training**

214 Medical educators increasingly recognize that equipping providers with the knowledge
215 and communication skills to promote vaccine acceptance by parents and teens should begin early
216 in professional training of medical students.⁴⁰ Need for early intervention prior to solidification
217 of negative attitudes toward hesitant or refusing parents was illustrated in a recent study with 132
218 medical students and pediatric residents.⁴¹ Compared to vignettes portraying parents who
219 question evidence-based medical recommendation about pediatric antibiotic use or ear tube
220 placement, a vignette portraying a vaccine-hesitant parent elicited more negative attitudes, less
221 willingness to address parent concern, and a preference to refer rather than continue care.
222 Vaccine-specific curriculums have been developed that target both 3rd year medical students⁴²
223 and pediatric interns⁴³ and employ a variety of teaching approaches, such as lectures, role-plays,
224 simulated patients, and case-based discussions.

225 Beyond medical school and residency, there has been limited work in provider training in
226 the clinical setting. One intervention included training providers to talk about HPV vaccination

227 with parents in one of two ways, either as a one-way announcement to parents about the need to
228 vaccinate against HPV or as a conversation/shared-decision making approach in which the
229 parents and clinicians discussed the HPV vaccine.⁴⁴ Interestingly, the announcement arm of the
230 intervention, which could be seen as a more paternalistic approach, was successful at
231 significantly, though modestly, increasing HPV vaccination initiation in both boys and girls,
232 while the conversation approach did not result in any statistically significant increases. Another
233 approach called Performance Improvement Continuing Medical Education (PI CME) has been
234 used in a variety of clinical settings for different health topics. In the HPV vaccination arena, one
235 intervention utilized a combination of provider education, support to providers, individualized
236 feedback on the providers' vaccination rates, and incentives to improve HPV vaccination.^{45,46}
237 They found that providers receiving the PI CME program were significantly more likely to
238 vaccinate boys and girls with their first dose and with the follow-up HPV vaccine doses.
239 However, these interventions and others like it can be time and resource intensive and may not
240 be feasible for wide scale dissemination.⁴⁶

241 **Technology**

242 eHealth technologies provide an opportunity to address HPV vaccination initiation and
243 completion in the clinical setting. Clinical decision support (CDS) aids, usually in the form of
244 reminders in the electronic health record to the provider, are showing some promise in improving
245 vaccination rates.⁴⁷⁻⁵⁰ Usually based on an algorithm of a limited number of variables which
246 combines CDC guidelines and recommendations with several patient demographic variables
247 (e.g., age, sex), the clinician is given a reminder prompt at the time of the visit to discuss and
248 recommend appropriate vaccines.^{47,48} In two studies which investigated these clinical decision
249 support aids, results showed significantly higher HPV vaccine initiation⁴⁹ and both higher

250 initiation and completion rates⁵⁰ for adolescent females. However, in a prospective intervention
251 study, clinician reminder prompts did not increase initiation or series completion of HPV
252 vaccination.⁵¹ Despite their promise, CDS programs still have many limitations (e.g., alert
253 fatigue for clinicians, easy ability to override alerts) and more work is needed to maximize the
254 benefit (e.g., developing alert systems that include both clinician and patient roles) that can be
255 gained from this type of intervention.⁵²

256 Perhaps the most promising application of eHealth is the use of mobile technology,
257 namely text messaging, to prompt parents and their adolescents to begin or continue the HPV
258 vaccine regimen. Those interventions that have incorporated text messaging have mostly
259 targeted the parents of adolescents and included not only prompting parents to initiate the HPV
260 vaccine series with the first dose,⁵³ but also used texting reminders for getting the follow-up
261 doses of the HPV vaccine at the appropriate time intervals.⁵⁴⁻⁵⁶ Text messaging can also be
262 combined with other intervention elements, such as in-person consultation, to increase the
263 efficacy of the intervention.⁵⁷ In addition to simple reminders, text messages can also contain
264 particular message features, such as educational messages about HPV and cancer, the source of
265 the health threat, or the role of personal agency, to increase parental intention to vaccinate their
266 children.^{58,59} Text messaging may be a particularly promising area for increasing uptake of dose
267 1 and timely completion of the second HPV dose, especially given that the Pew Research Center
268 reports that 73% of American adults are text messaging users, sending and receiving an average
269 of 42 texts per day – and that report was done 6 years ago.⁶⁰ This is also a technology which is
270 widely used by underserved groups (e.g., racial minorities, low income groups) for health
271 information, making it an ideal interventions strategy for reaching those most at risk.⁶¹

272 Finally, a promising area of eHealth technology for parents in clinics utilizes written
273 educational materials or digital technology to deliver HPV vaccination education and promotion
274 programs. For example, in a clinic feasibility study, parents participated in a self-persuasion
275 tablet-based intervention in which they watched a brief HPV and HPV vaccine educational video
276 and then answered questions which prompted them to generate 3 reasons for vaccinating⁶² Sixty
277 percent of those parents (n=15) still undecided about vaccination after viewing the video shifted
278 to endorsing vaccination after participating in the self-persuasion tasks.

279 **Future Directions**

280 Despite the success of several eHealth or digital intervention studies, it does not appear
281 that these strategies have been widely disseminated or adopted by a critical mass of clinics to
282 increase HPV vaccination. Many of the strategies that fall under this umbrella are newer and
283 reliant on the development of sophisticated technologies and algorithms for tailored messaging
284 and recommendations based on (often changing) clinical guidelines. Work in this area could
285 benefit from further research and dissemination of successful programs, especially given that
286 some of these programs are potentially scalable and have been shown to be relatively cost
287 effective at improving HPV vaccination rates.⁶³ In tandem with exploring and tracking success of
288 eHealth strategies, providers may need continued training to effectively communicate about the
289 HPV vaccine in order to make appropriate recommendations. As previously mentioned, the
290 majority of HPV vaccination happens in the clinical setting, making it an appropriate and
291 opportune context in which to devote resources and attention to increase vaccine uptake.

292 **Social/Environmental Factors Influencing HPV Vaccination**

293 In schools and communities across the country, a number of strategies have been
294 implemented to increase HPV vaccine uptake with varying success. In this section, we discuss

295 different HPV vaccination strategies that have addressed the physical environment and relevant
296 normative and social influences in a community to drive behavior.

297 **School-located vaccination programs**

298 A promising approach to increase HPV vaccination access for adolescents in the United
299 States is receipt of vaccination in schools rather than clinical settings. In the United Kingdom
300 and Australia, implementation of school-located HPV vaccination programs has led to rates of
301 HPV vaccine completion among 11-to-12-year-old girls exceeding 80%.^{64,65} Although the U.S.
302 has a history of school-located vaccination for other vaccines,^{66,67} few school-based HPV
303 immunization programs have been implemented, due, perhaps, to political factors, public
304 opinion, and logistical challenges.⁶⁸ Nonetheless, school-based vaccination, when it can be
305 implemented, may be a viable approach to increase HPV vaccination rates, especially in
306 underserved populations.⁶⁹

307 On the other hand, school-located vaccination presents several challenges that must
308 be addressed in any future interventions. Reimbursement remains a consideration with school-
309 located vaccination because schools may not have a mechanism to bill insurance providers and
310 payment for school-located vaccination could be denied by insurers as an out-of-network service.
311^{70,71} Other barriers identified in one HPV school located intervention are limitations that may be
312 imposed by state laws and school administrations such as requirements for parents to consent and
313 accompany students for vaccination.⁷² Parents may never receive consent forms from children,
314 especially middle school aged children⁷³, and may not be able to accompany students due to
315 work or transportation barriers. Future interventions should consider opt-out consent processes
316 and/or eliminating requirements for parental accompaniment. Additionally, it may be beneficial
317 to consider including Tdap and MenACWY with any school-based HPV vaccine to lessen any

318 resistance to the HPV vaccine given that all three vaccines can be administered at the same age.⁷²
319 Obtaining buy-in from the local health department and school administrators is critical to
320 increase participation in school-located vaccination because of the messaging and education that
321 they can provide to children and parents about the vaccine. Other considerations for school-
322 located vaccination include vaccination storage, administration, and documentation.

323 **Community-based interventions**

324 Community-based interventions have the potential to increase demand for vaccination.
325 Although several community-based patient education interventions have measured acceptability,
326 attitudes, and intention towards HPV vaccination among adolescents and their parents, few have
327 measured vaccination uptake in adolescent populations.⁷⁴ Patient navigators and social marketing
328 campaigns show promise in increasing HPV vaccination uptake in the community setting. In one
329 study, adolescents who received education from patient navigators were significantly more likely
330 to receive recommended adolescent vaccines than those who did not.⁷⁵ Social marketing
331 campaigns seem to demonstrate some effectiveness, with one study showing partial success at
332 driving vaccine uptake in two of four rural counties.⁷⁶ Despite promise in a few areas, little work
333 has compared different intervention strategies to identify what may be the most effective,
334 including cost-effectiveness.

335 The use of mass media and digital technologies to deliver interventions is also a
336 promising area. It is well documented that people have difficulty appreciating small safety risks,
337 such as those posed by HPV vaccine side effects. In an online intervention, provision of
338 information comparing HPV vaccine safety to the risk of physical harm posed by a common
339 childhood activity—team sports participation in soccer or basketball— actually improved
340 mothers' willingness to vaccinate their 9-13 year old children.⁷⁷ Communicative strategies like

341 these, which could consider other vaccine-youth activity comparisons, might help more parents
342 appreciate the very small safety risks posed by HPV vaccine. Although other types of patient
343 education interventions have not measured HPV vaccination uptake among adolescents, DVD
344 and web-based communication approaches could potentially increase HPV vaccination. A DVD-
345 based intervention showed promise in helping Latino and Korean Americans make an informed
346 HPV vaccination decision for their children.⁷⁸ A web-based program that was tested in adult
347 college students, but not adolescents or their parents, resulted in significantly more positive
348 attitudes in the website group at the end of the intervention.⁷⁹ Research efforts are expanding on
349 this promising approach by evaluating web-based approaches to reach parents and adolescents
350 with informative and engaging messages about HPV vaccination.^{80,81} DVDs and web-based
351 programs are an affordable way to communicate to a large group of people and could be
352 developed to target cultural factors that limit vaccination uptake in underserved communities.

353 **Future Directions**

354 Overall, more research is needed to determine the best strategies for interventions to
355 increase HPV vaccination access and community demand, and specifically, these interventions
356 should target underserved populations who may be most at risk from HPV-related cancers. More
357 research is necessary to demonstrate whether HPV school-located vaccination is cost effective
358 and feasible. Multiple strategies, such as school-located vaccination to increase access and a
359 DVD to increase community demand, hold promise, but research is needed to identify which
360 components of a multi-faceted approach may best serve these communities. In addition,
361 interventions may have more reach and be more cost effective if they can target multiple
362 behaviors; for example, HPV vaccination could be combined with other vaccinations to increase
363 uptake of multiple immunizations.

Countering the Anti-HPV Vaccine Rhetoric

Environmental and Personal/Parental Factors Influencing HPV Vaccination

In today's media-saturated world where ideas and stories, regardless of truth, can quickly garner a great deal of attention, any strategy aimed at promoting the HPV vaccine must also take into account anti-vaccination sentiments and messaging. As long as there have been vaccines, there has been resistance to their use; this is of course one of the main reasons that government and institutional policies have been needed to ensure high levels of vaccination in the public and one of the main arguments for implementing school-entry requirements.⁸² The HPV vaccine fortunately has been immune from the misconception and public conversation around the myth that vaccines cause autism, as much of that debate is centered on infant and early childhood vaccines. However, it has come with its own controversies, including the idea of risk compensation related to increased sexual activity and safety and risks associated with such a "new" vaccine. In this section, we review how the media coverage and public conversations about HPV vaccination contributes to an environment where parents are often left with negative beliefs about the vaccination, as well as highlight work that has sought to address these parental concerns.

Risk Compensation

One reason behind opposition to the HPV vaccine was the fear that it would promote earlier sexual initiation or increased sexual activity among the adolescents who received the vaccine.⁸³ Because HPV is a sexually transmitted infection, some parents voiced the opinion that vaccinating children would be equivalent to giving them permission to engage in sexual activity.^{84,85} Media coverage of the HPV vaccine echoed these concerns, with many newspaper articles^{86,87} and online news articles⁸⁸ pushing these ideas. In addition, some religious groups⁸⁹

387 and conservative social and political groups^{90,91} have voiced strong objections to vaccinating
388 girls so young against an STI. Despite this, a recent systematic review of 20 research studies
389 investigating this issue found no evidence for risk compensation following HPV vaccination.⁹²

390 **Safety and Vaccine Side Effects**

391 Another concern that was expressed about HPV vaccine was that it was too “new” and
392 therefore potentially unsafe, despite conclusive research that HPV vaccination is safe and well-
393 tolerated.^{93,94} A content analysis of U.S. and Canadian newspapers found that while stories did
394 mention the threat of HPV-related disease (e.g., cervical cancer), they often also included “fright
395 factor” messages about HPV vaccine.⁹⁵ These messages included doubts about the long-term
396 efficacy and safety of the vaccine, as well as the idea that the vaccine was mostly being
397 promoted because of lobbying by pharmaceutical companies, not because it had health benefits.
398 For online coverage, more than 50% of Youtube videos about HPV vaccine were found to be
399 negative in tone; interestingly, these negative videos had more “likes” than positive or
400 ambiguous videos.⁹⁶

401 Negative ideas and fears are exacerbated when prominent leaders, like politicians, repeat
402 anecdotes not based in fact to the media. Michelle Bachman, a candidate for the 2012
403 Republican Presidential Primary, was a particularly outspoken opponent of HPV vaccination. In
404 an interview on the Today Show, she contributed to the vaccine safety and side effect fears by
405 recounting the following story of a mother who came up to her at a rally:

406 She told me that her little daughter took that vaccine, that injection. And she suffered
407 from mental retardation thereafter...This is the very real concern and people have to draw
408 their own conclusions.⁹⁷

409 Her false claim was subsequently refuted by the American Academy of Pediatrics, but statements
410 like hers can remain influential and damaging to efforts at cancer prevention through
411 vaccination. Researchers are increasingly recognizing the importance of not only the role of
412 media in influencing clinical decisions like vaccination, but also the role of everyday
413 interpersonal communication within social networks.⁹⁸ For example, one study looked at parents'
414 social networks (e.g., friends, fellow parents, healthcare providers) and found that those parents
415 less willing to vaccinate had large social networks of people telling them to not conform to
416 vaccination guidelines (e.g., on time vaccination).⁹⁹ In addition they tended to consulting more
417 sources of information (e.g., internet, magazine) that also promoted non-adherence to
418 recommended vaccination schedules.⁹⁹ In other words, mass/public communication about
419 vaccination and interpersonal communication about vaccination go hand-in-hand. While this
420 study was specifically examining parents of young children, it's possible these same patterns
421 exist in parents of older children although more research is needed in this area. More broadly,
422 we know that about 20 percent of individuals caring for loved ones (e.g., parents of children)
423 have gone onto social media sites to gather health information and 38% of them have gone on
424 social media sites to specifically consult others' reviews of medical products (e.g., drugs,
425 vaccines).¹⁰⁰ In sum, research the role of various mass media and interpersonal influences (and in
426 the case of social media, both) is important in parents' vaccination decisions, suggesting the need
427 to devote more time and attention to not only better understanding the effects of these influences,
428 but also how to account for them in vaccination promotion work.

429 **Work Addressing Anti-Vaccine Messaging**

430 Public opposition to vaccines in any form, whether individuals stories of patients with
431 claims of adverse side effects or larger initiatives aimed at discounting the safety and efficacy of

432 the vaccine, are important because it can influence individuals' intentions and behaviors to
433 vaccinate. In an experiment in which college students were exposed to either a positive or
434 negative blog post about HPV vaccination, those in the negative group reported lower perceived
435 vaccine efficacy and safety, more negative attitudes, and lower intentions to vaccinate compared
436 to the control and positive blog groups.¹⁰¹ Writing about recent anti-HPV vaccine sentiments,
437 some scholars advise that "the infectious disease and oncology community should be aware of
438 these [stories and ideas in the media]...not corroborated by the evidence base, and they must
439 be able to communicate this to patients and the general public."¹⁰² In other words, not only
440 must we be designing and implementing health promotion programs to encourage vaccination,
441 but practitioners, public health officials, and health communication specialists must also
442 incorporate communication strategies to counter anti-vaccine messaging and sentiments in the
443 general public.

444 Scholars in health communication have begun to address this need with respect to
445 HPV vaccination. In a study using inoculation messaging techniques, unvaccinated adult
446 individuals who were exposed to messages that inoculated them against attacks on the HPV
447 vaccine or attacks on vaccines in general were less vulnerable to these attack messages in a
448 video experiment compared to the control condition.¹⁰³ Applying sound communication
449 principles, such as inoculation theory, could be an effective method for countering anti-HPV
450 vaccine sentiments. However, to our knowledge, no research examining this strategy with
451 parents of adolescents has been done. In addition, continued surveillance of public and media
452 concerns circulating in the news and popular press is important in order to inform what
453 informational gaps should be addressed with public health education and health promotion
454 strategies.

455 **Future Directions**

456 Unfortunately, as Dube´ and colleagues note, there are “few, if any, public health strategies [that]
457 have effectively and long-lastingly succeeded in countering anti-vaccination movements”,⁸²
458 suggesting a need for renewed attention and innovative strategizing to address vaccine resistance
459 in the general public in lasting ways. Efforts to combat anti-HPV vaccine messaging is an area
460 where health communication and persuasion scholars may be particularly adept at developing
461 intervention strategies for counter-messaging. For example, the HPV vaccine promotion
462 community may benefit from a well-known or celebrity champion (e.g., a celebrity endorsement)
463 as part of the overall strategy for combating anti-vaccine sentiments.¹⁰⁴ More rigorous evaluation
464 of which targeted messaging strategies actually drive vaccine acceptance and uptake for vaccine-
465 hesitant individuals can help drive success in this area.¹⁰⁵ Perhaps most important is that *anyone*
466 working on increasing HPV vaccine uptake – whether in the clinic, state or federal government,
467 community, schools, or media-based work – must take into account that parents’ decision-
468 making around this vaccine may be shadowed by personal beliefs such as the sexually
469 transmitted nature of HPV and safety concerns about the vaccine itself.

470 **Conclusion**

471 This review highlights some of the major strategies that have been used to promote HPV
472 vaccination, focusing specifically on policy, clinical training and interventions, community and
473 school-based programs, and an increased awareness of the need to counter anti-vaccine rhetoric.
474 In addition, we draw attention to promising areas for future policy and research efforts in key
475 areas, many of which are consistent with those identified during the 2016 meeting of the
476 National HPV Vaccination Roundtable.¹⁰⁶ Researchers, practitioners, politicians, educators, and

477 pro-vaccination groups are making great strides in increasing the HPV vaccination rate, but there
478 is much progress that remains to be made.

479 Moving forward, it is essential to recognize that no single strategy or focus will lead to
480 success. Instead, we should work simultaneously on multiple levels (e.g., public health policy,
481 mass media communication, clinical practice, and health education) to ensure that we move
482 towards the Healthy People 2020 goal of 80% HPV vaccine series completion. The factors
483 within the conceptual model used to guide our analysis should not be seen as separate parts, but
484 rather as individual pieces of the larger puzzle for increasing HPV vaccination and reducing
485 HPV-related disease. We challenge those in the field to begin working to better integrate
486 multiple approaches for maximum success, something echoed by other scholars as well.,¹⁰⁷

487 In fact, *most* public health issues benefit from a, multi-level, integrated approach. For
488 example, recent statistics on smoking rates in the United States are at an all-time low, which the
489 CDC credits to a variety of “strategies proven to work...like funding tobacco control programs at
490 the CDC-recommended levels, increasing prices of tobacco products, implementing and
491 enforcing comprehensive smoke-free laws, and sustaining hard-hitting media campaigns.”¹⁰⁸
492 This example illustrates that over time and with sustained efforts on multiple fronts, significant
493 and sustained population health behavior change is possible. In addition, an integrated, multi-
494 faceted approach to address vaccination promotion and vaccine concerns also maximizes
495 potential success because a “one size fits all” intervention approach will never address all
496 concerns nor be equally effective with all people.¹⁰⁵ This is particularly true for the U.S., which
497 does not have a national health insurance system or the ability to implement uniform national
498 HPV vaccination policies across states and jurisdictions.

499 But what does this look like for HPV vaccination? Ultimately, it will require integrated
500 efforts to: 1) influence sound public health policy; 2) develop effective media messaging
501 strategies that incorporate health promotion and education as well as counter-messaging for anti-
502 vaccination rhetoric; 3) evaluate and implement strong clinic-based communication and support
503 systems; and 4) minimize logistical barriers in order to maximize HPV vaccination rates and
504 protect our children from the pain, suffering, and expenses associated with HPV-related diseases.
505 We can now promote this vaccine as important for both sexes and for several types of cancer,
506 which may help the general public support HPV vaccine as an incredible public health
507 innovation. While some individual puzzle pieces are in place for increasing HPV vaccine uptake
508 in our country, the next step is putting these pieces together in a comprehensive approach to
509 educate and persuade parents to vaccinate, thereby increasing uptake of this life-saving vaccine.

510

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