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The Cost-effectiveness of Human Papillomavirus Vaccine Catch-up Programs for Women

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Keywords

human papillomavirus; vaccine; cost-effectiveness analysis; HPV; models

During the past decade, numerous models have been developed to estimate the impact and cost-effectiveness of human papillomavirus (HPV) vaccination in developed countries [1, 2]. These models have been and continue to be important tools to inform HPV vaccine recommendations. Although the existing models vary greatly in their structure, the findings of these models can be summarized in 3 general themes [1, 2]. First, routine vaccination of preteen girls is a cost-effective use of public health resources in the context of established cervical cancer screening programs if the vaccine provides a sufficient duration of protection. Second, HPV vaccination of young women becomes less cost-effective as the age of vaccination increases, although the importance of age at vaccination can vary considerably across models and there is no consensus on a threshold age at which HPV vaccination ceases to be cost-effective. Third, adding males to a female-only vaccination program is not as cost-effective as female-only vaccination. Although the cost-effectiveness of male vaccination can vary substantially across models, male vaccination can be considered cost-effective in some scenarios, particularly when vaccine coverage of females is low and when all potential benefits of the vaccine are included in the analysis [1–3].

In a study in this issue of *The Journal of Infectious Diseases*, Burger et al [4] add new information to our understanding of the cost-effectiveness of HPV vaccination of young women. Specifically, the authors examine the health benefits and cost-effectiveness of a delayed, 1-year catch-up vaccination program for women in Norway when varying the upper vaccination age limit to 20, 22, 24, and 26 years. The catch-up program is labeled as “delayed” because it would be initiated at least 5 years after the commencement of a vaccination program for 12-year-old girls.

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The authors use a hybrid approach in which results from a dynamic transmission model are linked to an individual-based cervical cancer model and also to Markov models of other HPV-related health outcomes to estimate the population-level benefits of vaccination (eg, herd immunity), including reductions in HPV-associated health outcomes in males. Their approach is one of the most detailed and comprehensive modeling approaches that has been developed for analyses of HPV vaccination strategies, and it has been used extensively in recent years across a range of different settings [5–7].

Consistent with previous reports, the authors found that the incremental benefits decreased and the cost per quality-adjusted life year (QALY) gained increased as the upper age limit for vaccination increased. Under most scenarios examined, a 1-year catch-up program through age 22 years was found to be cost-effective. The results varied substantially for vaccination beyond age 22 years, although vaccination could be cost-effective through the oldest age they examined (26 years) if the vaccine provides protection in women with previous exposure to HPV. A model by Turner et al [8] also found that the cost-effectiveness of HPV vaccination of young adults is more favorable when assuming vaccine protection for nonnaive women. These findings call attention to the need for more data on vaccine protection for nonnaive women and for consideration of these potential benefits when developing HPV vaccine recommendations for young adults.

The model described by Burger et al also suggests that catch-up vaccination could reduce the time needed to achieve population-level impacts of vaccination. This finding is consistent with findings of other published models [9, 10]. Moreover, it is consistent with findings of initial studies of vaccine impact in settings in which catch-up vaccination programs were successful in achieving high coverage rates among young women [11]. For example, in the first year after commencement of the HPV vaccination program in Australia, which included a catch-up program for women through age 26 years in addition to school-based vaccination for girls aged 12–18 years, notable population-level reductions in genital warts were observed in women younger than 28 years but not among women older than 28 years [12]. Similarly, an approximate 75% decrease in HPV vaccine type prevalence was noted in women aged 18–24 years attending family planning clinics 4 years after commencement of vaccination [13].

In the United States, routine HPV vaccination of males and females is recommended at age 11 or 12 years. Vaccination is also recommended for males through age 21 years and for females through age 26 years who have not been vaccinated previously or who have not completed the vaccine series. Whereas the catch-up program examined by Burger et al is a temporary, 1-year strategy, the US recommendation for vaccination of males through age 21 years and for females through age 26 years does not have a planned expiration date. Burger et al found that with each passing year, the value of a catch-up program decreases. Our modeling activities have yielded similar findings, showing that a long-term (eg, 100-year) catch-up strategy for vaccination of women through age 26 years is less cost-effective than a short-term (eg, 5-year) catch-up strategy [14]. Although we found that the cost-effectiveness of catch-up vaccination becomes less favorable over time, a long-term strategy of HPV vaccination of women through age 26 years could nonetheless be considered cost-effective [3, 14].

New data to inform HPV models continue to become available from vaccine trials and other sources. For instance, data from the control arm of a multinational randomized trial of the bivalent HPV vaccine have recently been used to assess the degree of naturally acquired immunity against HPV 16 and 18 [15]. Burger et al found that the cost-effectiveness of HPV vaccination appears more favorable when lower natural immunity is assumed, a finding consistent with results of previous studies [8, 16, 17]. HPV modelers should continue to adjust their models as needed to incorporate new data. At the same time, HPV models can be quite useful to examine scenarios in which data are lacking. For example, what if the population of young adult women who have acquired and cleared HPV consists disproportionately of those who are predisposed not to develop HPV-related sequelae? In such instances, the cost-effectiveness of vaccinating these young adults might be less favorable than suggested by models that do not allow for this possibility. As another example, what if a permanent recommendation of catch-up vaccination through age 26 years might detract from the emphasis on routine vaccination at ages 11 and 12 years? Models are well-suited for exploring hypothetical scenarios such as these, in which data are lacking and might not be available in the near future, if at all.

HPV vaccination is expected to lead to great reductions in the health and economic burden of HPV-related disease. The reductions observed so far in the prevalence of HPV vaccine types, genital warts, and cervical precancers are quite promising [11]. The impact of HPV vaccine will become even more notable in the future, as substantial declines in HPV-associated cancers and deaths due to these cancers are likely over the upcoming decades [18]. As HPV vaccine programs mature and as new HPV vaccines become available, there will be a continued need for mathematical models such as that of Burger et al to inform HPV vaccine recommendations. Although cost-effectiveness is only one of the many factors to consider in determining HPV vaccination strategies, the use of cost-effectiveness analyses can help to allocate today's public health resources as efficiently as possible to achieve the greatest possible public health gains in the future.

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