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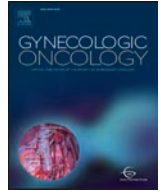
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Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Clinical Commentary

Human papillomavirus: The other invisible enemy



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COVID-19 has reshaped the fabric of our world. This invisible enemy has claimed the lives of 296,078 individuals across the world as of May 13, 2020, with undoubtedly more deaths to come. Alongside the healthcare workers who are the new front-line infantry in this battle, governments and pharmaceutical industries are working with unprecedented fervor to fight this pandemic. In the United States, the scientific community has received a necessary infusion of funding, to the tune of nearly \$5 billion dollars, allocated for COVID-19-related research and disease prevention. The world's scientific experts are striving to develop novel therapies, repurpose current medications, and most importantly find a vaccine to prevent us and future generations from experiencing the full lethality of this virus.

The sad reality is that COVID-19 is not the only invisible enemy we are fighting. But what is even more disheartening is that we have yet to uniformly and effectively implement the vaccines that we already have to eradicate the other silent killers, resulting in millions of lives lost in the process.

This is the case with Human Papillomavirus (HPV). In 2008, Professor Harald zur Hausen was awarded the Nobel Prize for his work demonstrating the connection between HPV and cervical cancer. His early discoveries ushered in a new era of research that has illuminated the mechanism of HPV-induced carcinogenesis in over 90% of cervical cancers, 90% of anal cancers, and 70% of oropharyngeal cancers. It also led to the development of an HPV vaccine that is highly effective at reducing the incidence of high-risk HPV subtypes that are implicated in HPV-related cancers without substantial side effects [1]. We have seen the efficacy of the HPV vaccine first-hand in areas of the world where vaccination coverage is high. For example, Australia has an HPV vaccination rate of nearly 80%, and a recent modeling study estimated that cervical cancer could be virtually eliminated within the next 20 years if the vaccination coverage and cytology-based screening is maintained [2]. And while this vaccination effort does come with a cost, the estimated cost per quality-adjusted life year gained by HPV vaccination suggests that it is a cost-effective prevention strategy [3].

We have the breakthrough for HPV at our fingertips. But why, then, did nearly 381,500 people worldwide die from cervical, anal, and oropharyngeal cancer in 2018 [4]? Why is the rate of fully vaccinated adolescents in the United States only 35%, and why is the rate of partially vaccinated individuals globally an abysmal 1.4% [5,6]? And why is HPV

vaccination implementation so fragile that the rate of vaccination in Japan fell from 70% to less than 1% due to a handful of unconfirmed reports of adverse events despite decades of research on vaccine safety?

As we search for a vaccine for COVID-19, it is essential that we continue to ask these questions and remind ourselves of the vaccine that is still not being used to its full potential despite 14 years of evidence solidifying its safety and efficacy. With the momentum we have built in this global fight against COVID-19, we too can improve vaccine implementation and eradicate our invisible enemies once and for all.

Author contributions

Mary Kathryn Abel: Data curation, roles/writing: original draft, roles/writing: review and editing

Warner Huh: Roles/writing: review and editing

John Chan: Conceptualization, data curation, funding acquisition, roles/writing: review and editing

Declaration of competing interest

Dr. Huh discloses that he is a consultant for Pathovax. Dr. Chan discloses that he has received grants and/or honoraria for speaker bureaus and/or consultation fees from AbbVie, Acerta, Aravive, AstraZeneca, Clovis Oncology, Eisai, GlaxoSmithKline, Merck, and Roche. Other than the listed disclosures, the authors report to other relevant disclosures.

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