One hundred thirty-five million human papillomavirus (HPV) shots delivered in the United States and counting. Yet the article by Sonawane et al. is a provocative reminder that concerns about the safety of the HPV vaccines have only gotten worse. The results are sobering evidence of how insidious and persistent these concerns are across the United States, with increased rates nearer to 100% than 50% across 30 states. The increase in safety concern is widespread and may be independent of region or political leaning, as significant concerns were reported in California as were in South Dakota and Mississippi. At the very least, this is an indication that the concerns about the HPV vaccine may be more deeply entrenched than previously understood, and reversing this trend could require a broader discussion across the national landscape regardless of region or geography.

Back to the beginning: June 8, 2006. After several years of clinical trials and testing, the US Food and Drug Administration approved the HPV vaccine for the first time in the United States. The Advisory Committee on Immunization Practices followed swiftly, providing evidence-based recommendations about the newly minted HPV vaccine, dosing schedule, and other guidelines about its use. Almost immediately, the HPV vaccine resistance brewing in the background all the while was unleashed in full force. The vaccine is too new. I do not believe I need it. I don't know enough about the vaccine. My children are not sexually active. Most relevant to this article, I am not sure the vaccine is safe.

While uptake has steadily increased over the years, the HPV vaccine has endured all kinds of barriers since it was first introduced, unlike most other childhood vaccines before it. One extrapolation from the study by Sonawane et al. is a reminder that there may be more innuendos, half-truths, exaggerated case studies, and propaganda driving concerns about HPV vaccine safety than actual scientific facts. Using the National Immunization Survey-Teen, the authors provide clear evidence that concerns about HPV vaccine safety have increased remarkably, by 80% from 2015 to 2018. This means that more parents of vaccine-eligible teens may have become concerned about HPV vaccine safety over time, and that concern has driven their decision to either wait a little longer or decide not to vaccinate their children altogether. Paradoxically, as of 2015, which was the first of the 4 years covered by the study by Sonawane et al., and almost a decade since approval of the HPV vaccine in the United States, evidence suggested a decrease or stabilizing trends in vaccine hesitancy due to safety concerns, at least for young girls. So, what changed? Were there more cases of adverse reactions to the HPV vaccine leading up to 2015 and beyond? Not according to Sonawane et al. While vaccine safety concerns escalated significantly between 2015 and 2018, reports of adverse reactions from the vaccine during that time period actually decreased, specifically, by 45%.

Without question, any report of adverse effects of the HPV vaccine should be taken seriously, and safety surveillance of the vaccine must continue as long as it is indicated. However, the decrease in reports of adverse effects raises the question about what is at the heart of safety concerns about the HPV vaccine. It is not atypical for parents, guardians, or others who care for children to express concerns about a new product, and that has been the case for the HPV vaccine since it was first approved. The initial skepticism about the HPV vaccine was not helped by the framing of the vaccine or the constant linkage to a sexual transmitted infection, which would have concerned parents about the potential of discussing sex-related issues with their children who are likely not sexually active. There were and still are concerns, though erroneous, about the vaccine driving young children into thinking it is safe to experiment with sex if they have been vaccinated. The heavy marketing and perceived interference by lobbying groups, government officials, and the pharmaceutical industry also drove...
many individuals to question the science behind the vaccine approval or the safety of the vaccine. There have also been the philosophical argument about parental rights, the right to self-determination, and other self-motivated factors about decisions related to health and welfare.\textsuperscript{6} However, all of these factors are likely inextricably linked to this greater concern of vaccine safety. The issue of vaccine safety was also a part of physician skepticism or hesitancy about discussing or more actively recommending the vaccine. For a while, one of the leading factors associated with intention to vaccinate was discussion with a clinician or the lack thereof.\textsuperscript{3} It is therefore encouraging that Sonawane et al\textsuperscript{1} found that this barrier to vaccine uptake has weakened, and that fewer parents are citing lack of a physician recommendation as the driver of HPV vaccine hesitancy.

This leads us back to the elephant in the room: safety concerns. If the HPV vaccine is being discussed and/or recommended more actively by physicians now than ever before; if the vaccine uptake is increasing slowly but surely, for both males and females; if more studies are showing cancer and precancer prevention gains due to the vaccine; and if there are decreasing numbers of reports of adverse effects of the vaccine; why are more parents concerned now about vaccine safety than when it was first launched or in 2015, now that over 135 million doses have been administered in the United States? The answer to these questions may lie not in evidence-based medicine or scientific facts, but in non-science based doubts and disinformation raised on social media. We are in a unique era, and the counterfactual trends reported by Sonawane and colleagues illustrate that we are experiencing an epidemic of disinformation jet-fueled by social media. To be clear, social media is not to blame for all concerns about vaccine safety. There has always been resistance to vaccines, dating back to the polio vaccine and even before that. In fact, it took decades of mandates, protests, and resoluteness to establish the vaccines that eventually eliminated both smallpox and polio in the United States in the 1970s.\textsuperscript{7} There are several lessons that could be learned from this historical precedent, but one of those lessons is that individuals and groups have always protested against vaccines, and that it often takes some form of mandates, and placing the public good over personal rights and autonomy, to establish an effective, long-lasting vaccination program.\textsuperscript{7} But we should not lose sight of the historical precedent: that individuals and groups were antivaccine and spread concerns and conspiracy theories back then, long before many readers of this article were born, and certainly long before the era of social media. Yet no one could dispute the role social media and technology in general have played in the modern movement against the science and facts about the safety of vaccines in general, and the HPV vaccine in particular. Studies have shown that while individuals trust medical professionals for health information, a growing number are turning to the internet for first and second opinions about HPV, HPV vaccines, and HPV-associated cancer. The internet is here to stay and there are untold benefits of the information superhighway. However, much of the information available on the internet, including social media, is not peer-reviewed or evidence-based, and unfortunately, information warning about the HPV vaccine is often based on half-truths or is completely baseless. Sonawane et al\textsuperscript{1} remind us that while individuals may be increasing their concerns about vaccine safety, the actual reports of adverse effects do not match up.

It is important that the lessons from the study by Sonawane et al\textsuperscript{1} are communicated beyond the scientific community, as the issues about HPV vaccine safety concerns may be directly applicable to another vaccine currently dominating our consciousness: the COVID-19 vaccine. It is likely that in the near future, there will be studies describing vaccine hesitancy in both HPV and COVID-19 vaccines, and it would not take any crystal ball to predict that they might be correlated. Although HPV and COVID-19 vaccines have distinct characteristics and demographic targets for vaccination, it is likely that individuals who are hesitant about the HPV vaccine owing to safety concerns may also be hesitant about the COVID-19 vaccine for similar reasons. As we deal with the fallout of the COVID-19 pandemic and its impact on our society, Sonawane et al\textsuperscript{1} remind us that the HPV vaccine is safe. It will be important to continue monitoring the trends identified by Sonawane et al to see if they continue beyond 2018. Our hope is that as more evidence is provided on HPV vaccine safety and the vaccine’s real-life impact in reducing the incidence of HPV-related cancers, including oropharyngeal cancer, the resistance towards vaccination due to safety concerns will have subsided considerably.
While we continue to monitor and take seriously any adverse effects, and as more studies emerge providing more information about HPV vaccines, scientists, clinicians, and the general public do not have to whisper; we can shout it from the rooftops that the HPV vaccine is safe and is a cancer prevention vaccine!

REFERENCES