

## Risk Compensation and COVID-19 Vaccines

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Throughout the coronavirus disease 2019 (COVID-19) pandemic, the world has become intimately familiar with the concept of “risk compensation.” In situations that are perceived as risky, people naturally adjust their behavior, compensating to minimize that risk (1). From the start, those who perceived the novel coronavirus as threatening would, in most cases, wear masks, wash their hands, and avoid large crowds as cases began to surge. But the effects of risk compensation tend to fade over time as the novelty of a threat wears off (1). For COVID-19, this has manifested as “pandemic fatigue,” decreasing adherence to risk reduction strategies in some populations and complicating public health efforts. Now, as COVID-19 vaccines are rolled out across the globe amid messages of optimism and euphoria, public health officials will have to contend with another feature of risk compensation. A vaccine heralded as the panacea to the pandemic risks further weakening adherence to other safety measures like social distancing and masks. This phenomenon, in which individuals respond to safety measures with a compensatory increase in risky behavior, is named the “Peltzman Effect” after University of Chicago economist Sam Peltzman who first described it in 1975 (1, 2).

In the decades since it was described, Peltzman's phenomenon has been inconsistent, identified in some safety interventions but not others (1). The introduction of medications providing HIV preexposure prophylaxis (PrEP), while dramatically lessening risk for HIV transmission, has also been associated with decreased intention to wear condoms, higher numbers of sexual partners, and increased incidence of sexually transmitted infections in some studies (3-5). The magnitude of this effect can be significant: In one survey, more than 35% of PrEP users reported decreased intention to use additional protection (4). On the other hand, the Peltzman Effect has been notably absent in studies of the human papillomavirus vaccine, which did not result in any discernible change in sexual behaviors despite widespread media speculation (6). A key feature of the Peltzman Effect is that any reverse risk compensation cannot counteract a safety measure entirely; users of PrEP still benefit from a dramatically decreased risk for contracting HIV. But the benefit is less than what would be expected due to the compensatory behavior.

Will COVID-19 vaccines result in increased risk-taking behavior? A comprehensive review of the Peltzman Effect identified 4 main factors as likely contributors to risk compensation, all of which appear to be present in the COVID-19 pandemic (1). To produce an increase in risky behavior, a measure must first be *visible*, a criterion that COVID-19 vaccines unquestionably meet. Unlike smoke

detectors, which can function in the background, every individual who receives the COVID-19 vaccine will be acutely aware that they have done so. The next 2 points—*motivation* and *control*—go hand in hand. Risk compensation is more likely to occur if people are highly motivated to take on the risky behavior and if it is within their control to do so. Both of these apply to the current pandemic, because it is both personally desirable and relatively easy to return to a prepandemic lifestyle free of masks and social distancing. The final factor, the overall *effectiveness* of the intervention, depends on the vaccine. The Pfizer-BioNTech and Moderna vaccines currently granted emergency use authorization in the United States and other nations are more than 94% effective (7). From a medical standpoint, this is highly desirable, increasing the likelihood of vaccine-acquired immunity. For the Peltzman Effect, however, this high efficacy is likely to further reduce adherence to other precautions. Meanwhile, vaccines with lower efficacy may be less prone to this effect.

One of the most alarming features of the Peltzman Effect is that it may have a bystander component. In some studies, drivers were found to pass closer on the road to bicyclists who were wearing helmets, whereas they gave substantially more clearance to bicyclists without helmets (8). This suggests that simply witnessing someone else taking a precaution can potentially increase one's likelihood of taking a risk. Consciously or not, even those who have not received a COVID-19 vaccine may forgo masks and social distancing if they know that others are receiving the vaccine. As the number of people vaccinated increases, this effect may also grow due to a misplaced sense of security in “herd immunity” long before widespread immunity is truly present. Unfortunately, the very optimism that is necessary to encourage widespread acceptance of the vaccine will undoubtedly contribute to the overconfidence that will ultimately worsen this effect.

It is important to note that for COVID-19, a Peltzman Effect may manifest in different ways for different patient populations. Widespread misinformation and a highly politicized public health landscape have resulted in a wide spectrum of behaviors in response to COVID-19. Among those who refuse other precautions—the “antimaskers,” or those who reject social-distancing guidelines—the Peltzman Effect will be nil. They cannot reduce their preventive behaviors any further and would therefore benefit from the maximum positive effect of vaccination. It is, paradoxically, the population with the highest prevaccine adherence to the recommended preventive measures who are most at risk for the Peltzman Effect and toward whom any attempts to moderate this effect should be directed.

With these considerations in mind, what can be done to minimize the potential harms from the Peltzman Effect? First, physicians counseling patients about

COVID-19 vaccines should acknowledge the possibility of this response. Telling people to change nothing about their behavior after vaccination is unlikely to be effective. When it comes to easing safety precautions, risk reduction, rather than total abstinence, should be the goal. A clear, realistic set of priorities should be established, laying out the best practices to be followed after vaccination. Prioritizing mask-wearing, regardless of vaccination status, may result in the greatest public health benefit. Achieving this, however, may require a compromise on other restrictions (for example, allowing social gatherings with other vaccinated individuals) or heightened messaging and policy focus toward this goal at the expense of other postvaccination precautions. Targeting this message to individuals who abided by mask-wearing guidelines before vaccination is likely to find greater success than attempting to compel mask-wearing among those who never followed such guidelines to begin with.

Cognitive biases thrive on our ignorance of them. Acknowledging and understanding the Peltzman Effect is therefore critical to counteracting its possible negative effects. We are entering a new phase of the pandemic, defined by both the ongoing vaccination effort as well as the emergence of novel variants of the virus, some of which may increase transmissibility or immune escape (7). An easing back of safety precautions may, unfortunately, coincide with the rise of variants whose risks surpass those of the original strains. And although vaccination is thought to prevent serious illness and death secondary to COVID-19, the effect of vaccination on transmission of severe acute respiratory syndrome coronavirus 2 is still unclear—meaning asymptomatic spread may be possible from vaccinated individuals (9). The cognitive biases that drive risk compensation are thus functioning with outdated and faulty information. Without taking steps to combat this trend, increased laxity, combined with increased virulence, may well prolong the devastation of the virus.

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