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Letter to the Editor

Proposing a Novel Criterion for Achieving Herd Immunity in Global Epidemics (Pandemics): The Importance of Vaccination Velocity

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Dear Editor-in-Chief

Herd Immunity and definition

Herd immunity, a term widely endorsed by the WHO, refers to the indirect protection against infectious diseases conferred to individuals through vaccination or prior infection. The WHO emphasizes the significance of achieving herd immunity primarily through widespread vaccination campaigns, recognizing its pivotal role in curbing the incidence rates and mortality associated with infectious disease outbreaks within communities (1). Herd immunity materializes when unvaccinated individuals are shielded from disease by the presence of vaccinated individuals (1-3).

Characteristics contribute to the establishment of herd immunity

1- The disease agent should be limited to a single host species.
2- The infection must provide rigid immunity.
3- The distribution of immunized and unimmunized people in the community should be random.
4- Herd immunity is most effective against diseases that spread through person-to-person contact (4).

These nuanced facets underscore the intricacies of achieving and maintaining herd immunity, a crucial goal in the battle against infectious diseases on a global scale.

Achieving HI by vaccination not by infection

Achieving herd immunity without vaccination is challenging and ethically problematic due to the risks associated with exposing individuals to the virus. Moreover, reports indicate instances of individuals being infected with the virus multiple times, which can lead to severe and fatal diseases. Even in developed nations, recurring infections can strain healthcare systems beyond their capacity to manage such outbreaks effectively (2).

Mathematical formula for herd level achievement

In the context of establishing herd immunity, a key mathematical formula is employed to determine the threshold for population immunity, expressed as 1-1/R0. This formula illustrates that the higher the number of individuals infected with the virus, the greater the proportion of the population that must achieve herd immunity. It is essential to note that the R0 factor assumes initial susceptibility of all community members to the virus, with susceptibility dynamically influenced by factors such as viral strain prevalence, spatial constraints, and shifts in individual immunity levels (5).

For COVID-19, 60%-65% of the population must acquire immunity to facilitate herd immunity. The specific percentage required varies for each infectious disease, contingent upon its level of contagiousness. Diseases with high transmission rates necessitate a larger proportion of the population to achieve herd immunity, exemplified by the need for 94% immunity to interrupt the measles transmission chain effectively (3). Additionally, the threshold for herd immunity may vary regionally, reflecting differences in vaccination rates across geographic regions (3,4).

In essence, this mathematical formulation provides critical insights into determining herd immunity thresholds, considering multifaceted factors influencing the required level of population immunity to mitigate infectious disease spread.

Epidemics, Pandemics, and the Crucial Role of Vaccination Velocity (shifting and drifting)

Achieving herd immunity against COVID-19 presents unique challenges due to constant mutations, including drift and shift mutations, impacting the virus's behavior (3). For certain viruses like seasonal influenza, vaccination does not provide permanent protection against drift and shift mutations, necessitating annual vaccination campaigns to maintain herd immunity (3,4).

Given the high level of conflict between countries during pandemics and widespread epidemics like COVID-19, the component of "vaccination velocity" should be added to the existing four characteristics defining herd immunity. Low vaccination velocity increases the risk of drift and shift mutations in the disease serotype, reducing vaccine effectiveness.

Research highlights the significance of vaccination velocity, showing lower mortality rates in countries with rapid and extensive vaccination campaigns. Countries like China, the United Arab Emirates, Chile, the United Kingdom, Sweden, Luxembourg, Australia, Hungary, Israel, Qatar, and the United States achieved high vaccination coverage rates within short timeframes. Disparities in vaccine distribution, with middle- and high-income countries receiving the majority of doses, while low-income countries, particularly in Africa, face limited access, hinder universal herd immunity attainment (6,7).

Vaccination is a cornerstone of preventive medicine, crucial not only in routine circumstances but also during widespread epidemics (8). It protects communities from severe infections, hospitalizations, and fatalities, with a focus on vulnerable populations, notably children (6). While routine vaccination covers 14 diseases, during epidemics, the availability of needed vaccines and the speed of their delivery are also necessary. In this situation, the timely production and distribution of the vaccine in the shortest possible time requires the cooperation of the public and private sectors. The CDC Advisory Committee, health organizations, and related organizations will decide how to prioritize vaccination distribution so that vaccination is equitably available to target groups (9). In essence, vaccination emerges as a linchpin in safeguarding public health, necessitating seamless availability and swift deployment of vaccines to protect communities and mitigate the impact of infectious disease outbreaks.

Conflict of interest

The authors declare that there is no conflict of interests.

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