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Achieving Immunization Equity in a Pandemic

Liew Yi Song Terence[1,*], and Khoo Chun Yuet[2]

[1]Emergency Department, Ng Teng Fong General Hospital, National University Health System, Singapore
[2]Department of General Surgery, Singapore General Hospital, Singapore

***Corresponding author:** Liew Yi Song Terence, Emergency Department, Ng Teng Fong General Hospital, National University Health System, 1 Jurong East Street 21, 609606, Singapore, Tel: +65 83213015; E-mail: liew.yisong.terence@gmail.com

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Abstract

In the presence of a rapidly progressing pandemic, rapid mitigating measures must be taken to curb further spread of disease. One such measure is the development of vaccines targeted at the disease of interest to induce immunity, preventing further disease transmission. Immunization is the process of rendering an individual immune to a disease, usually via the act of inoculation, or vaccination. Vaccinations provide both direct protection (to immunized individuals) as well as indirect protection (via herd immunity). While essential in the resolution of any pandemic, the "me first" mentality will result in inequitable distribution of vaccines amongst countries and regions. This vast disparity in vaccine distribution will result in far greater global mortality, and measures must be put in place to ensure equitable vaccines allocation.

Keywords: Immunization equity; Vaccination; Pandemic; Covid-19

Introduction

In an ideal world, all diseases should be eradicated to prevent harm to the human race. This can only be done if (1) there exist an effective intervention to interrupt transmission of pathogens, (2) availability and accessibility of extremely sensitive and specific diagnostic tools to detect asymptomatic infection and (3) humans must be essential in the life cycle of the pathogen [1]. Smallpox is a prime example, with the World Health Organization (WHO) declaring smallpox eradicated in 1980. However, eradication of disease is practically difficult with ideal conditions that may prove impossible to be met. With equitable distribution of vaccines and continued transmission mitigating measures, the world can eventually achieve disease elimination rather than disease control alone.

What Makes a Good Vaccine?

Researching disease treatments requires strong foundational understanding of the offending organism's pathogenesis. This includes (1) viral implantation and entry point, (2) local replication within target cells, (3) spread to disease sites and (4) viral shedding sites for transmission to occur [2]. The various steps of pathogenesis can be a target for potential novel treatment modalities, including vaccines.

To understand the principles of a good vaccine, we must first identify the ideal vaccine without consideration of resource limitations and scientific feasibility. An ideal vaccine must (1) have perfect efficacy to individuals of all ages, (2) provide lifelong immunity with a single administration, (3) easy to administer (orally preferable), (4) of low to zero cost with unlimited supply, (5) have no adverse reaction and (6) stable under all conditions (does not require specific conditions to prevent loss of efficacy) [3]. However, in a practical world, few of these conditions can be achieved. Pharmaceutical companies invest vast amounts of resources and man-hours to produce vaccinations, and financial incentives play a major role in such research and development. All newly developed medications carry its own risks of adverse effects. A careful risk-benefit analysis must be performed to ensure that a safe yet efficient vaccine is used for the larger population, especially when clinical trials are conducted at accelerated rates.

Current State of Equity

Despite the known efficacy and successes of immunizations in reducing the incidence of vaccine-preventable diseases, the uptake of immunizations vary in different regions [4]. Drawing lessons from the H1N1 pandemic, the predictors of pandemic vaccination uptake include a high social economic status, healthcare workers, a prior chronic disease, and having a previous vaccination before [5]. The drawbacks from having good vaccine uptake include misconceptions about vaccines, fear of side effects and perceptions of not being at risk of contracting illness [6].

In addition to the general barriers to vaccination uptake, we would also like to highlight the challenges in maintaining vaccination equity due to resource limitations. This includes (1) availability of vaccines to suburban/rural or lower-income nations, (2) cost effectiveness of vaccination (as compared to perceived cost of contracting disease), (3) accessibility of transport routes to channel the vaccines to these

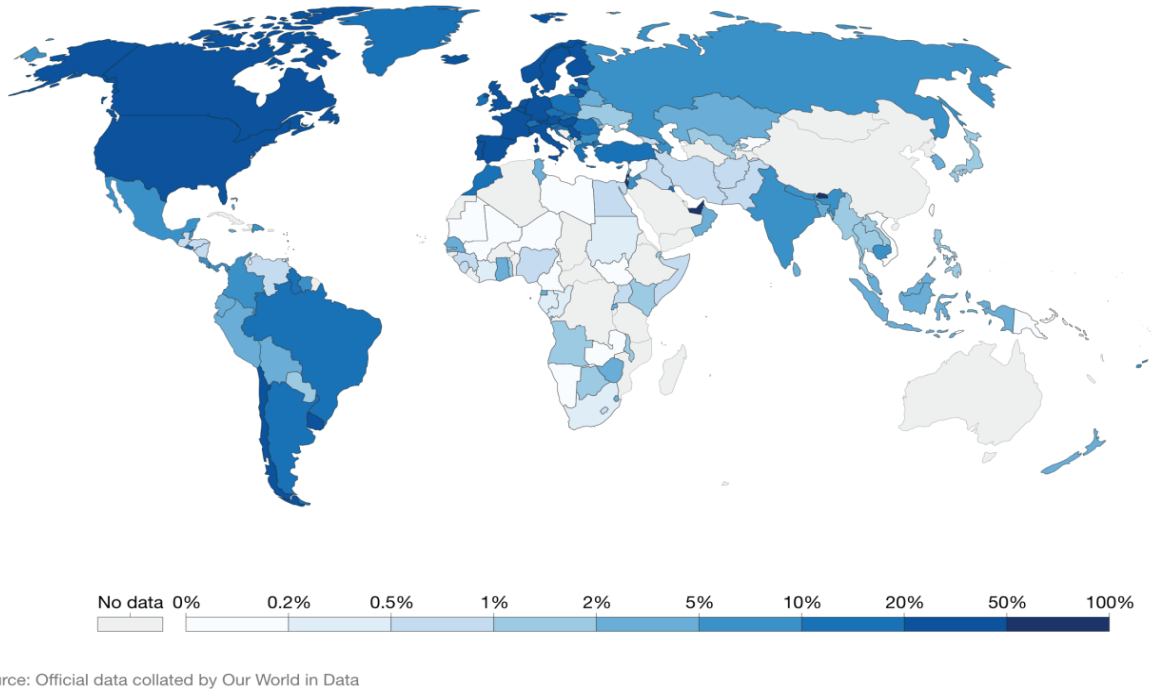

Figure 1: Percentage of world population with at least one dose of COVID-19 Vaccine [10].

areas, (4) identifying those who have not been vaccinated, (5) storage concerns (with many vaccines having specific cold chain transport infrastructures) and (6) the availability of healthcare workers or trained staff to perform the vaccination. Moreover, barriers to immunization among disadvantaged groups are not addressed through government policies, governance, or program implementation. These remain some of the challenges that will be faced and must be mitigated before equitable immunization strategies can take place, especially in light of the COVID-19 pandemic.

COVID-19 Vaccine Dilemma

Vaccine nationalism contributes significantly to immunization inequity [7]. Nations are contemplating strategies to procure vaccines for their own population, even at the expense of other nations. A well-documented example is the use of legal agreements such as the Advance Purchase Agreements (APA) with pharmaceutical companies [8]. True enough, after the first COVID-19 vaccines were reported to be safe with excellent efficacy, more than 80% of the potential vaccines were already sold due to pre-arranged agreements [9]. Many of these countries are developed nations with vast resources and capabilities to procure large volumes of vaccines for their own population, resulting in vast disparities in COVID-19 vaccination uptake worldwide. With more than a billion doses of COVID-19 vaccines administered to date, the unequal distribution of vaccinations has become apparent (Figure 1).

It has been long recognized that the benefits of herd immunity are immense, extending far beyond the immunized population alone [11]. It can protect unvaccinated individuals by preventing circulating pathogens in susceptible populations [11]. However, to achieve the herd effect, the vaccine must have a sufficiently high uptake rate. In a recent study supported by Bill and Melinda Gates Foundation, the authors used a global metapopulation transmission model to show the effect of inequitable distribution of vaccines [12]. The uncooperative allocation scenarios resulted in an extensively larger mortality rates compared to the cooperative allocation scenarios [12]. It is clear that immunization equity is the most effective strategy to minimize mortality in a pandemic.

Mitigating Measures

Some measures have been taken in an attempt to minimize inequitable vaccine distribution. The COVAX, co-lead by GAVI, WHO and Coalition for Epidemic Preparedness Innovations (CEPI) aims to deliver vaccines and COVID-19 treatments to healthcare workers and the most vulnerable and susceptible 20% of participating nation's population [13]. This initiative has garnered support from a large proportion of nations worldwide, and is a victory to the human race. However, worldwide cooperation is required, and such efforts are still hampered by existing vaccine nationalism practices today.

To further maximize immunization equity, the following additional measures can be considered: (1) adoption of worldwide vaccination education with frequent vaccine drives to maximize uptake, (2) adequate and continuous training and education of healthcare workers residing in rural/less developed areas, (3), prioritizing regions with largest disease burden and (4) maximizing number of doses per vial to prevent wastage. It is important to realize that while these measures are insufficient when performed alone and in isolation, the collective effort of governments will go a long way to maximize lives saved in a pandemic.

Conclusion

Acknowledgement of immunization inequity is the first step world leaders must make to ensure that vaccinations can be distributed

equitably. Vaccine hoarding and monopoly can lead to poorer outcomes in terms of overall mortality from the pandemic. Vaccines should not be distributed based on financial capabilities, but on a need basis. In the current COVID-19 pandemic, it may be justifiable to channel larger proportions of the vaccine to the urban areas where the largest disease clusters are found, but efforts must be made to provide outreach strategies and distribution of vaccines to the rural regions and less affluent nations. Healthcare is an essential service for all, and our actions in terms of vaccine distribution must reflect this.

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