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Research article

Technology Transfer of COVID-19 Vaccines: Opportunities and Challenges

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Abstract.
A solution to the ongoing global COVID-19 pandemic is the mass production of vaccines. Safe and effective vaccine development is one avenue to combat the ongoing pandemic. However, although the WHO has approved several vaccines for emergency use, developing and least-developed countries are still in an unfavorable position as they cannot secure those vaccines. Technology transfer initiatives are one solution to speed up the production process. Nevertheless, this proposal is still a work in progress. Despite the willingness of developing and least developed countries to manufacture the vaccine, several challenges, such as infrastructure and intellectual property rights, are hindering the technology transfer process.

Keywords: technology transfer, COVID-19, vaccine development, vaccine inequality

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1. Introduction

The unprecedented impact of the Covid-19 Pandemic has hit the global society massively. The covid-19 vaccine becomes one solution to minimize the impact of the pandemic. The vaccine is one of the compelling methods to lessen the damage. Studies found that a vaccinated group of people will have a lower mortality rate compared to the unvaccinated one when contracting the virus. However, during the Covid-19 pandemic, equal vaccine distribution became a concerning issue.

This article aims to construct technology transfer as one means to accelerate equal vaccine distribution globally. Most of the articles focused on vaccine technology transfer viewed the issue from a medical perspective. This article offers a new perspective in the literature by providing an international cooperation perspective on the issue of vaccine technology transfer. Moreover, this article highlights the opportunity and challenges countries face to conduct technology transfer initiatives.

The following part of the article is divided into four sections. The first section focused on the historical aspect of vaccine technology transfer initiatives. The following section will analyze the opportunities for vaccine technology transfer. The challenges of vaccine

technology transfer will be presented in the next section. The last section will conclude the article.

1.1. Overview of Vaccine Technology Transfer

Technology transfer is an interdisciplinary concept involving two adjacent parties focusing on sharing and learning new knowledge to solve practical problems. Scholars defined technology transfer as an intentional, goal-oriented relation between two actors, during which the boundaries of technological knowledge increase through the transfer of one or more technological components [1]. Those actors include states, universities, or private companies. Several studies tried to limit the actor to states actor, resulting in the definition becoming more limited. Those studies defined technology transfer as the act of transferring technologies and concepts from developed countries to less technology developed countries [2], [3]. This study focuses on the technology transfer conducted between actors across the state's borders.

World Health Organization (WHO) initiated one of the successful examples of vaccine technology transfer. The WHO Global Action Plan (GAP) for Influenza Vaccines aims to prepare against a pandemic by shifting the vaccine production capacity to interested manufacturers and governments located in developing countries globally. The program bears its fruits by enlarging the vaccine production capacity by 600 million in 2015 [4]. Table 1 shows the grantees of the WHO GAP for Influenza Vaccines initiative.

Table 1: Grantees of WHO Influenza Technology Transfer Initiatives.

Country	Institute	Year
Brazil	Instituto Butantan	2007
India	Serum Institute of India	2007
Indonesia	Bio Farma	2007
Mexico	Birmex	2007
Thailand	Government Pharmaceutical Organization	2007
Vietnam	Institute of Vaccines and Medical Biologicals	2007
Egypt	Vacsera	2009
Iran	Razi Institute	2009
South Korea	Green Cross Corporation	2009
Romania	Cantacuzino Institute	2009
Serbia	Torlak	2009
Kazakhstan	RIBSP	2011
South Africa	Biovac	2011
China	BCHT	2013

Several countries that participated in the GAP Influenza Vaccines initiative reaped the benefit of the technology transfer program. As an example, the Serum Institute of India (SII) can develop a live attenuated influenza vaccine to combat the H1N1 2009 influenza pandemic in just under one year [5]. In a similar vein, the Government Pharmaceutical Organization (GPO) of Thailand is able to produce its own influenza vaccine and is planning to develop its own inactivated influenza vaccine [6].

During the Covid-19 Pandemic, countries with previous experiences in producing vaccines through the technology transfer initiative proved to be better prepared to develop the vaccine for tackling the pandemic. For example, Bio Farma in Indonesia is teaming up with Sinovac Biotech Ltd, a Chinese vaccine company, to produce Coronavac, a Covid-19 vaccine developed by Sinovac Biotech Ltd [7]. The vaccine technology transfer also enables countries like India to become a global hub for the Covid-19 vaccine manufacture by contributing around 60 percent of the global vaccines supply capacity [8].

1.2. Opportunities for Covid-19 Vaccines Technology Transfer

With the unprecedented impact of the Covid-19 pandemic, countries worldwide are seeking an effective and efficient method to fight the pandemic in the long run. Countries expect the pandemic to stay for a long time, and they need to adapt and return to their normal activities sooner. Several factors contribute to opening the opportunity of the Covid-19 Vaccines Technology Transfer, namely the nature of the pandemic, the supply side issues of the vaccine, and the willingness of the developing countries.

Scientists predict that the Covid-19 pandemic would not simply disappear like the other pandemic. It is more likely that the Covid-19 pandemic will turn into an endemic and continue circulating worldwide while causing outbreaks in several parts of the world [9]. As the pandemic turns into endemic, vaccines will become more critical than ever. A model shows that a vaccine with 90 percent efficacy would need to cover 55 percent of the population in minimum while still adhering to social distancing measures [10]. As the vaccine effectiveness wears off over time, the population needs to be revaccinated, and it adds the incentive for countries to learn vaccine development in the long run.

Technologically advanced countries produce much of the vaccine circulated globally. Moreover, developed countries are buying the vaccine from the producer, leaving developing and least developed countries without many options for the vaccine. A study found that 80 percent of the global population only had approximately 5 percent of the Covid-19 vaccine supply. In comparison, 20 percent of the population got access

to the remaining 95 percent of the Covid-19 vaccine supplies [11]. WHO already reminds the world that equal access to the Covid-19 vaccines is the only way for countries to eradicate the pandemic. The WHO also sets up the Covid-19 Vaccines Global Access (COVAX) to distribute the vaccine equally. COVAX is a system that makes both its self-funded members and funded members benefit from the arrangements. However, albeit its important role in the vaccine distribution process, COVAX founds a challenge in which the supply of Covid-19 vaccines is limited. A more democratic production process assisted by a technology transfer initiative could help to solve the problem.

Developing countries have already expressed their willingness to develop their vaccine production capability. On April 13, 2021, several African leaders developed an ambitious plan to build manufacturing facilities and support locally manufactured vaccines' research and development. The project aims to boost the share of vaccines manufactured in Africa to 60 percent by 2040 [12]. Countries globally are also ramping up their capabilities by partnering with other institutes, such as the Bio Farm-Sinovac partnership or Chulalongkorn University-University of Pennsylvania partnership, to develop and manufacture the Covid-19 vaccines [7], [13].

1.3. Challenges for Covid-19 Vaccines Technology Transfer

Despite the opportunity for the Covid-19 vaccines technology transfer, as of today, the technology transfer initiative is still far from realization. Moreover, vaccine production is a long-term tedious process that requires patience. Several challenges hinder the initiative, namely the infrastructure, the complexity of the vaccine production process, and the intellectual property barriers to vaccine development.

Novel technology in vaccine development such as mRNA, viral vector, or protein subunit technology provides opportunities for developing the new vaccine. However, such new technology requires a much more advanced infrastructure for development and distribution. For example, an mRNA Covid-19 vaccine requires a cold chain facility for its distribution, making the logistical issue one of the main barriers for the vaccine to be distributed globally [14].

Another challenge for vaccine development and production is the development process itself. Vaccine production is a long and tedious process, with possible failures accompanying the process along the way. Moreover, vaccines development and trial are adhering to a stringent standard with various documents that need to be logged in and submitted along the process. The vaccine development process in a single

institution is already an extraordinary challenge, and conducting the process between two institutions is an even more complicated process.

The last challenge of the vaccine development process is the intellectual property barriers. India and South Africa proposed a temporary waiver of the World Trade Organisation's (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) that enable countries to defer their commitment under TRIPS which allows them to produce Covid-19 medical products, including vaccines. Several countries opposed the proposal citing that the TRIPS waiver will deter future investment and innovation in the medical sector. Moreover, the countries argued that drug companies already have voluntary licensing that gives manufacturer license to produce their vaccines [15]. However, a voluntary licensing system would not give all capable manufacturers license to produce the vaccine. For example, SII is the only holder of voluntary license from AstraZeneca to manufacture AstraZeneca vaccine, although many manufacturers in the region are capable of the production process.

2. Conclusion

This article explained the opportunities and challenges of the Covid-19 vaccines technology transfer. With the scenario of the Covid-19 pandemic turning into an endemic and staying around for a long time, increasing vaccine production capacity is one solution to adapting to the situation. Countries around the world have expressed their intention to scale up their vaccine production capacity. However, vaccine development is not a simple process. Infrastructure and the nature of the vaccine development process, which takes time, may make countries back off from the process. Moreover, intellectual property issues may hinder the technology transfer process as several countries still do not support the notion.

This article shows that technology transfer is a complex international issue. Countries, especially developing and least developed countries, need to team up to fight for equitable access in vaccine procurement. This article also shows that technology transfer initiative is beneficial for countries, as shown by the result of GAP for the Influenza Vaccine.

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