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Can COVID-19 be Eradicated via Mass Vaccination and What are the Worldwide Challenges Ahead?

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Abstract
COVID-19 is a contagious disease caused by the virus SARS-Cov-2. It displays symptoms of which include a persistent dry cough, a fever, anosmia, ageusia, and general fatigue. As of 24 January 2021, the total worldwide COVID-19 confirmed positive case reported is around 99.5 million with over 2.2 million people dead. Hence, the worldwide devastation of COVID-19 is still bleakly apparent in this global age. Many endeavors for a solution to this looming problem have come unstuck. Alongside the millions of deaths as a result of this virus, countless swathes of the world's population have experienced economic, financial, health, educational, and emotional fallout, and the measures are employed to limit the infections. As a consequence of the detrimental impact left in its wake, efforts to develop an immunological solution to the pandemic have been seen with intense focus worldwide. While the usual timescale for the development, formulation, testing, and approval of any novel vaccine sits around 10 years. The vaccine of Pfizer/BioNTech has recently been approved for use in the UK, USA, Bangladesh, Saudi Arabia, and many other countries in just 1 year. With this promising revelation, this article delves into whether mass vaccination truly can curtail the spread of the disease worldwide including the UK, and what type of further challenges is still laid ahead due to the emergence of COVID-19's variants. Aside from clear concerns regarding the safety and efficacy of the pharmaceuticals considering their hasty approval, queries about the storage, transport and distribution of the vaccine are ever pertinent. Besides, despite the worldwide population being potentially susceptible to the virus, evidence has shown vastly different morbidity and mortality rates between different communities, serving as a sinister omen in an already desolate picture. These challenges, along with the issue of growing public opposition to the practice mean that despite this advancement there is still much left to conquer.

Keywords: COVID-19, Vaccination, SARS-CoV-2, Eradication, Pfizer/BioNTech, Moderna-BioNTech, Pandemic.

I. Introduction

COVID-19 is a contagious disease caused by the virus SARS-Cov-2, the known symptoms of which include a persistent dry cough, a fever, anosmia, ageusia, and general fatigue plus potentially psychological disorder (Heywood *et al*., 2020; Bennet *et al*., 2019; Tougakos *et al*., 2020; Rhodes *et al*., 2020; Label *et al*., 2020). The initial cases of this novel coronavirus were first reported in China in November of 2019 (Adil *et al*., 2020) and subsequently proliferated around the globe particularly in Asia, Europe, the USA, and Africa. Around April 2020, approximately 34% of the world population was in some kind of lockdown with various restrictions imposed (Khachfe *et al*., 2020; Koh, 2020).

The contagious nature of the virus eventually led to the change of classification of the virus from a 'public health emergency to a 'pandemic' by the WHO. In March 2020, the UK government announced its first national lockdown, originally intended for three weeks duration (Miles *et al*., 2020). Similarly, the COVID-19 effect is felt

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globally with high death rates including, Bangladesh (Anwar *et al*., 2020), India (Dsouza *et al*., 2020), Saudi Arabia (Alsofayan *et al*., 2020), Africa (El-sadr *et al*., 2020) and all European countries (Pillai *et al*., 2020) with the discussion of different measures to curtail the spread challenge of the infections.

This precipitated a flurry of national lockdowns across the globe, plunging the economies of many nations into recession. In all these countries, restrictions on public life affect employment, education, health, and economic growth to certain degrees depending on the countries, governmental policies, and regional infection rates. However, despite these measures, the UK and many other countries entered their second and even third national lockdown but still not being able to fully control the proliferation of the infections (Koh, 2020).

The economic impact of the pandemic is still to be fully evaluated. Preliminary studies have indicated that the UK, like all other countries of the world, is experiencing its worst recession since 1979, outperforming the horrific impact of the 2008 global financial crisis (Nicola *et al*., 2020; Akhtar *et al*., 2021). The economic impact of the COVID-19 worldwide demonstrates just one aspect of the impact of the virus, and it can therefore be seen why a solution to the pandemic is required (Ahmed *et al*., 2020). Since the onset of the virus, the development of a vaccine for mass vaccination has been hailed as the 'way-out' of the pandemic. However, the average time for the development of a vaccine ranges from 8-10 years, this timescale would likely lead to further destruction of world economies and countless more deaths (Mullard, 2020).

Consequently, numerous pharmaceutical companies developed vaccine task forces with the hope of manufacturing a vaccine in a timescale never seen before. Whilst this accomplishment initially seemed questionable at the cost of safety and effectiveness, Pfizer/BioNTech announced a vaccine on the 18th November 2020, with an acclaimed 95% efficacy (Nicola *et al*., 2020; Tanne, 2020; Appleby, 2020).

II. Why is there a Need to Develop a Vaccine?

Vaccination is the introduction of a dead or weakened pathogen (or component of a pathogen) to a host's system to generate immunity against a particular pathogen and to prevent associated diseases. The vaccine is considered to be one of the greatest inventions in the history of medical sciences. Vaccines are a means of saving millions of lives. Diseases with high infectivity and mortality were feared in the past, being perceived as a disaster or a punishment (Legutki *et al*., 2010).

Improvements in technology and understanding of microbiology followed by the creation of vaccines have now overcome such thinking (Plotkin, 2011; Oman *et al*., 2020; Kochar *et al*., 2020). The earliest form of vaccination was observed in the 12^{th}-15^{th} century, known as 'Variolation'. Powered scabs or fluid are taken from the pustules of smallpox patients who were scratched in a healthy host's skin. It was not until the late 18th century that Edward Jenner used cowpox virus instead of smallpox scabs in a scientific investigation, this was the origin of the term 'vaccine'. Vaccine or any drug development takes 10-15 years (Plotkin, 2011; Burki *et al*., 2020; Hodgson *et al*., 2020; Sreepandmannabh *et al*., 2020).

Important to note that the vaccine/drug development process cannot be split into 3 phases. Rather clinical trial (performed at the end of drug development) has 3 phases which are described here. The process starts with a development plan which includes the following: identification of the target population, risk assessment of the target diseases and the vaccine itself, environment factors, identification of the dose and route of administration, plans to induce herd immunity, and regulatory strategies (Jieliang, 2020; Jung-yun, 2020).

Phase 1 ensures acceptable safety and reactogenicity of the vaccine, they are tested at both local and systemic levels. Dose-ranging usually takes place at this point. The statistical analysis is more descriptive and exploratory instead of precise quantitative data as the trials mainly contain (Vaccine Development, Testing, and Regulation (Fu *et al*., 2020).

In phase 2, the immunogenicity of the active component and the safety of the vaccine within the target population are determined. The optimal dose, scheduling, and safety profile of the vaccine are also defined. Different trails are set out with different doses, the number of doses, the time

between doses to ensure the optimal dose regimen (Tanne *et al*., 2020).

Phase 3 is the final step before the product is licensed. Here the vaccine is tested on a larger population. A placebo versus an active control group is usually carried out to ascertain its efficacy. All the statistical analysis is then submitted to the country's regulatory authority to ensure the safety and efficiency of the vaccine in line with WHO guidelines (Baden *et al*., 2020).

III. Which SARS-Cov-2 Vaccines are the Forerunners?

There are currently 2 types of vaccines being produced with 5 promising candidates. Vector-based vaccines use a harmless host-virus, modified to express parts of SARS-CoV2 to stimulate an immune response. The second type uses mRNA, a DNA-like molecule to stimulate the host's cells to produce parts of the SARS-CoV-2 virus which should also lead to an immune response (Gao *et al*., 2020).

Moderna and Pfizer-BioNTech have opted to use mRNA while Oxford-AstraZeneca, Gamaleya, and CanSino Biologics have opted to use an adenovirus vector to develop vaccines. Pfizer is currently in the leading position of vaccine development and the only one to be approved by a foreign country, notably the UK's Medicines and Healthcare products Regulatory Agency (Peel and Neville, 2020).

Till now, Pfizer has had the largest phase 3 trial with 43,000 participants globally. Once 170 cases of COVID-19 were reached, preliminary results were published showing a 95% reduction in COVID-19 cases with severe cases being reduced by 90%. Very few side effects were noted with headache and fatigue being the most common at 2.0% and 3.8% of volunteers, respectively (Oliver *et al*., 2020).

Moderna-BioNTech has produced a similar vaccine to Pfizer with comparable results. It provided 100% protection against severe cases of COVID-19 and reduced total cases by 94.5% carried on 30,000 people. The vaccine uses a chimpanzee adenovirus as the vector (Callaway, 2020).

Early Phase 1 trials showed that 91% of participants produced neutralizing antibodies in response to the vaccine and it did not decrease with age (Folegatti, 2020). Phase 2/3 trials used 24,000 participants and those given a single dose had 90% fewer cases of COVID-19. However, due to a subcontractor error, another group received a double dose which was found to be less effective. In response, Oxford and AstraZeneca have committed to a larger phase 3 trial involving 60,000 people (Callaway, 2020, Mahase, 2020).

The Gamaleya institute has also produced a vector-based vaccine (named Sputnik V) but unlike Oxford-AstraZeneca, used 2 human adenoviruses (Ad26 and Ad5). Early results have shown efficacy of 95%. However, the results were released prematurely as the study is not expected to be completed before May 2021 (Burki, 2020).

IV. What Challenges are Ahead?

With the development of several vaccine iterations near completion, the next trial comes in its deployment across the globe. In this mission, challenges will be present at each level, just as they have done before. There are many angles to consider, both in terms of the individual patient and the global setting. Due to the overwhelming impact of COVID-19 on the global, while there have been many reports and speculation regarding the price of each vaccine, the cost per individual dose differs significantly between manufacturers and between countries. This represents an example of a challenge to the national economy of a developed country, where any future action taken concerning the current pandemic must be subjected to thorough financial scrutiny (Bennet *et al*., 2020).

A study published in the BMJ asserts that there are too many unknown variables to accurately answer the question about The financial scrutiny regarding COVID-19 would have negative consequences on public health. The UK government has already laid out guidelines for these groups to minimize virus transmission, particularly limiting person-to-person contact (Appleby, 2020).

A provisional vaccine priority list published by Public Health England gives priority of the immunization to those at very high risk and those over 70 years old, and while there remains concerned regarding the efficacy and safety of this vaccine in the elderly, though the evidence from trials is promising for these cases (Hodgson, 2020). To ensure the uptake of the vaccine especially in higher-risk populations, the UK

government has taken necessary steps for adequate coverage of lower socioeconomic communities, the elderly, and communities, where the knock-on effects of the pandemic have been particularly profound (Burki, 2020).

Alongside inequality in access to healthcare, vaccine uptake may be reduced due to compliance issues. The anti-vaccination movement which exists in many forms across the globe poses a significant role in vaccination rates as the prevalence of misinformation and misunderstanding about vaccines. With the popularity of social media, opinions and information can be shared on global platforms that resist the immunization programs that remain in the public sphere. Overcoming this hurdle will likely be difficult in some communities and strong opposition will persist within some groups despite countermeasures (Burki, 2020; Jielang, 2020).

The WHO, in a joint campaign with the UK Government, is promoting the "Stop the Spread" movement which exists to raise awareness about the risks of misinformation regarding COVID-19 and how the public can counter it using trusted sources and by double-checking any information they read (Jung-Hyun, 2020). Additionally, concerns regarding the storage and distribution of the vaccine are still pertinent; the Pfizer/BioNTech vaccine for example is required to be stored at -70°C, meaning that logistical solutions will need to be put in place for the efficacy of the vaccines. It will not only be costly but also limit the accessibility of the vaccine for some communities. To mitigate these risks, infrastructure should be put in place to allow the safe and effective storage and distribution of the vaccines as much as possible within the shortest time scale. With the approval of the Pfizer/BioNTech vaccine in the UK recently, a report published in the Independent details the plan set out by the Pfizer/BioNTech currently has plans to produce up to 50 million doses of the vaccine globally this year in dedicated facilities in the US, Germany, and Belgium (Lovett, 2020).

After arriving in the UK, the vaccine will be tested to ensure that it has not been damaged during delivery, as the sub-zero temperature must be maintained during the entire delivery period. Once assessed, the vaccines may then be stored in specialized facilities at -70°C where they can safely be kept up to 6 his facility gives up to Pfizer/BioNTech have specified that these packages may only be opened on 2 times per day for less than 3 minutes each to guarantee the thermal storage, and that vaccine may only be transported a total of 4 times after which it must be used or destroyed (Tanne, 2020; Appleby, 2020).

This means that not only do vaccines have to be transported in a very time-sensitive manner, but that they must also be administered within strict timescales The health secretary of the UK has said that those hospitals that already have below freezing storage capabilities (of which there are around 50) will be the first to receive the vaccine. Because of the very limited timescales, the vaccine must be stored and administered, and it seems fit that the UK will need to recruit or at least retrain and reprioritize many logistic staff and healthcare professionals to fulfill these requirements (Tanne, 2020; Appleby, 2020).

V. Discussions

COVID-19 is a transmissible disease caused by the virus SARS-Cov-2. It exhibits symptoms like an untiring dry cough, a fever, anosmia, ageusia, and general fatigue. COVID-19 is an outspoken subject worldwide including, the UK, USA, Asia, Europe, and Africa, which cannot be disregarded. Concerning resolutions for both the short- and long-term future, the development of vaccines is the most scientifically and medically backed route towards stabilizing the global population.

It can be argued that there are notable side-effects associated with this method of treatment; however, it is fair to say that the substantial benefit from such means does outweigh the latter risks. Eradication of COVID-19 via mass vaccination worldwide is a courageous statement to make for the foreseeable future maintaining safety and leading to a healthy community.

A return to normality in all walks of life is something that looks very much to be associated with achieving herd immunity with a successful vaccination. As of today (24 January 2021), overall worldwide COVID-19 definite affirmative cases are around 99 million and at least 2.2 million people perished. This is alarming. The whole world is seeking a solution to this pandemic.

Henceforth, with the worldwide wreckage of COVID-19 still hopelessly obvious in this global age, many investigators are researching a solution

to this impending setback. While the customary schedule for the development, formulation, testing, and approval of any novel vaccine sits around 10 years, the vaccine of Pfizer/BioNTech has recently been permitted for use in the UK, USA, Bangladesh, Saudi Arabia, and many other countries under 1 year. Bangladesh, however, has decided to purchase the COVID-19 vaccine advanced by Pfizer-BioNTech via COVAX. As of today 23rd January 2021, up to 5 million people have received the first dose of COVID19 vaccine in the UK, whilst the worldwide supply of the vaccine is getting ready for first vaccination and subsequently, mass vaccination is anticipated.

VI. Conclusions

In this review paper, the author posed the question: "Can COVID-19 be Eradicated via Mass Vaccination and What are the Worldwide Challenges Ahead?". Based on the material presented in this review paper, it is at an early stage to make a definite conclusion that mass vaccination can eradicate COVID-19 but there are many challenges of the COVID-19 vaccine concerning storage and transportation.

However, the COVID-19 vaccine is looking very promising based on current data available from the UK. As the UK has so far vaccinated over five million people with simultaneous national lockdown and the COVID-19 reproduction factor (R factor) is going down, so it is encouraging.

The authors anticipate that within the next six months, the whole of the UK population will receive the first dose of vaccine, and globally the USA, Asia, Europe, and Africa will have vaccinated a large number of the population. The authors will keep an eye on and present another paper with the pros and cons of worldwide COVID-19 vaccination in due course.

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