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# Taking Benefit of Economies of Scale in Producing Vaccine in Natural Setup of Human Body: Coronavirus Pandemic

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This article is an attempt to provide lead for mass production of coronavirus vaccine (if the vaccines are produced by any research laboratories, clinically successful and approved by regulatory body like FDA) naturally. The unprecedented and unique spread of coronavirus has devastated the whole world and its economy. Scientists, research laboratories and governments are working hard to develop vaccine to combat the deadly disease. Once a reliable vaccine is produced, the next challenge will be to produce in large quantity and supply feasible dose units of vaccine across the globe. Based on primary understanding, we want to provide a lead, if human body can be used to produce further dose of vaccine, if artificially vaccine is injected to a person, his body may have capacity to produce transferable antigens to another human. Thus, a person who received first injection of vaccine will develop in his body the germs like normal infection minus its potency. The vaccination is controlled infection. His body will have germs like virus or bacteria, which can be used as subsequent dose to other person. His blood, plasma or otherwise can be transmitted to another person like artificially vaccination. Thus vaccinated person become the donor<sup>2</sup> and this could be replicated to certain extent. This experiment also required theoretical study and assessment or evaluation of the result; i.e. practical aspects of possibility of production of antibody, its transferability, feasibility, safety, potency of antigens and immunity developed in the recipient. The process may be different for different virus and vaccines.

Humankind has developed no system of immune response more effective than the one that's been inside us for hundreds of thousands of years. Vaccines are developed on this basic theme. Vaccines are not drugs that directly kill germs like other chemical compounds, but it trigger the human defense system to act against invader germs. Extension of this principle is suggested by a lead that vaccinated person's blood, plasma or part of it can be sucked and injected to another person like a vaccine once sufficient attenuated or weakened germs are developed in donor. In other words, why vaccinated person's body can't be treated as production unit for further vaccine? The basic research question that should be addressed by practical experiment are: (i) can human body produce attenuated or weakened germs in sufficient quantity with same potency once a person is vaccinated by a vaccine manufactured in a factory? (ii) Can blood or plasma of such vaccinated person be sucked and injected to another person? (iii) Potency of transmitted blood or plasma in terms of quantity of attenuated or weakened germs be measured (iv) Compatibility of blood, plasma or otherwise between donor and recipient, the

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<sup>2</sup> Donor is person who was vaccinated using vaccine manufactured in a factory, and whose blood or plasma is to be used to vaccinate another person. That another person is termed as 'recipient' and 'donor' if his blood or plasma is still used to vaccinate next person

necessary standards and protocols must be established (v) What could be the optimum time for using secondary vaccine<sup>3</sup>?

All vaccines work according to the same basic principle. They present part or all of the pathogen to the human immune system, usually in the form of an injection and at a low dose, to prompt the system to produce antibodies to the pathogen. Antibodies are a kind of immune memory which, having been elicited once, can be quickly mobilised again if the person is exposed to the virus in its natural form.

Vaccines are used to create or improve immunity of a person. Immunity is the ability of the human body to tolerate the presence of material indigenous to the body ("self"), and to eliminate foreign ("nonself") material. This discriminatory ability provides protection from infectious disease, since most microbes are identified as foreign by the immune system. Immunity to a microbe is usually indicated by the presence of antibody to that organism. Immunity is generally specific to a single organism or group of closely related organisms. There are two basic mechanisms for acquiring immunity, active and passive.

Active immunity is protection that is produced by the person's own immune system. This type of immunity usually lasts for many years, often during a lifetime. Passive immunity is protection by products produced by an animal or human and transferred to another human, usually by injection or oral drops. Passive immunity often provides effective protection, but this protection wanes (disappears) with time, usually within a few weeks or months. Booster dose is required to reactivate immunity over a period of time.

Vaccines are like a training course for the immune system of the human body, which prepare the body to fight disease without exposing it to the actual disease. When any foreign particle or organisms such as bacteria or viruses enter the body, immune cells called lymphocytes respond by producing antibodies, which are protein molecules. These antibodies fight the foreign organisms known as an antigen and protect human body against further infection. According to the Centers for Disease Control and Prevention (CDC), a healthy individual can produce millions of antibodies in a day, fighting infection so efficiently that people never even know they were exposed to an antigen. The vaccines are made of dead, weakened, altered antigens from the germ or its specific part. Vaccine can't cause an infection, but the immune system still sees them as an enemy and produces antibodies in response. After the threat has passed, many of the antibodies will break down, but immune cells called memory cells remain in the body for a very long period - may be the whole life of the vaccinated person.

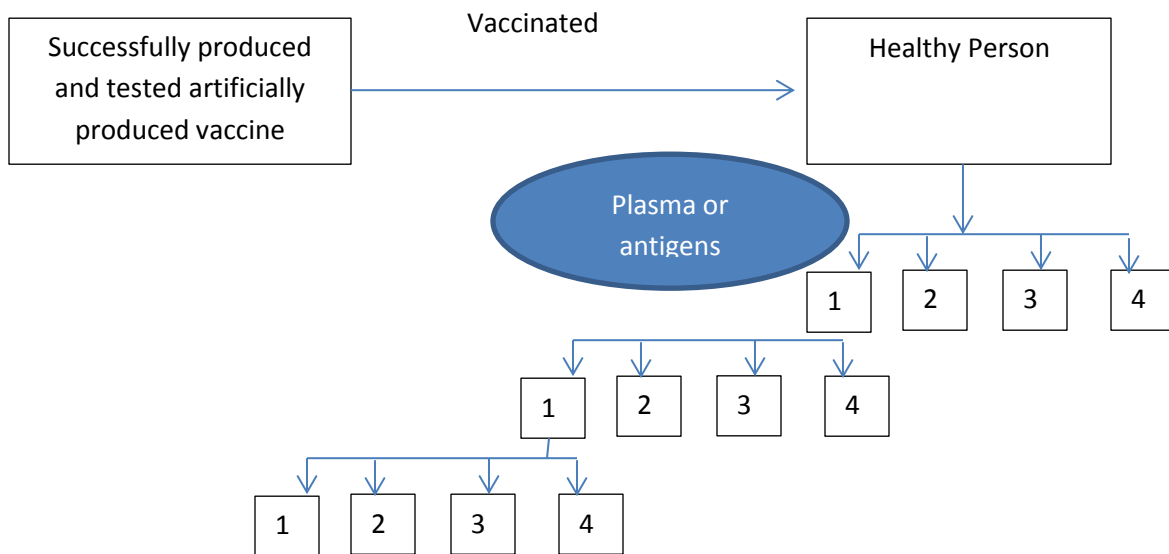
When the body encounters that antigen again, the memory cells produce antibodies fast and strike down the germs (virus or bacteria) at the earliest. Vaccines also work on a community level. Some people can't be vaccinated, either because they are too young, or because their immune systems are too weak, according to the CDC. But if everyone around them is vaccinated, unvaccinated people are protected by something called herd immunity. They're unlikely to even come in contact with the disease, so they probably won't get sick. When it comes to vaccines, sometimes it can pay to follow the crowd.

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<sup>3</sup> Secondary vaccine is term coined for blood or plasma sucked from body of a person who was vaccinated earlier

The most effective immune responses are generally produced in response to a live antigen. However, an antigen does not necessarily have to be alive, as occurs with infection with a virus or bacterium, to produce an immune response. Another way to produce active immunity is by vaccination. Vaccines interact with the immune system and often produce an immune response similar to that produced by the natural infection, but they do not subject the recipient to the disease and its potential complications. Many vaccines also produce immunologic memory similar to that acquired by having the natural disease. Vaccines are primarily classified into (i) live attenuated and (ii) inactivated vaccine. It is sub-classified as subunit, conjugate, polysaccharide vaccines, recombinant vaccines and toxoid etc. based on part of the germ used in developing vaccine. The vaccines are produced in different environment and have different characteristics. Inactivated vaccines cannot be replicated and hence our discussion is focused on live attenuated vaccine if it can be produced in human body to take benefit of natural replication, economies of scale in production and eased supply chain. The additional benefit is to use existing infrastructure (natural, human body), hygienic conditions, and reduced cost and time of production. There are associated risks in natural production. Unlike artificial production facilities, human body may not give standardized results and quality control and other risks are to be considered. There is possibility of transmission of any communicable diseases if the blood or plasma of transferor is infected.

The following diagram gives glimpse of proposed production lead:



It is important that donor's compatibility of blood is to be verified with that of the recipient. The donor must be healthy and free from any infections.

Vaccination is a process of mildly infecting person through modified germs which are capable to trigger antibodies to defend body from germ invasion. A vaccine works by training the immune system to recognize and combat pathogens, either viruses or bacteria. To do this, certain molecules from the pathogen must be introduced into the body to trigger an immune response. These molecules are called antigens, and they are present on all viruses and bacteria. Your immune system reacts to the vaccine in a similar way that it would if it were being invaded by the disease — by making antibodies. The antibodies destroy the vaccine germs just as they would the disease germs — like a training exercise. Then they stay in your body, giving you immunity. It is also necessary that depending upon nature of the virus, its life cycle and variation in germ characteristics across generations; it may be needed to give buster dose of the vaccine. Coronavirus is novel and its detailed study is imperative and it will take time to understand it fully when some season will pass to examine it minutely across different part of the world.

Vaccine is akin to training of a student. Merely theoretical training may not be sufficient to translate knowledge into actions. Students must be given real life training so they can actually work in the field, like we have internships and apprenticeships. After gaining basic real life experience students are put to independent jobs. Similarly, once vaccine is injected, the body will take some time to actually learn and act when foreign organism invades body. Therefore, once vaccine is given to a person, sufficient time must lapse till the body actually becomes capable to defend the germs. If the body of original recipient is immune and thereafter serum or culture containing weakened germs may be sucked (then that person will become donor) and injected to another person like vaccination.

Traditionally, immunisation has been achieved using live, weakened forms of the virus, or part or whole of the virus once it has been inactivated by heat or chemicals. These methods have drawbacks. The live form can continue to evolve in the host, for example, potentially recapturing some of its virulence and making the recipient sick, while higher or repeat doses of the inactivated virus are required to achieve the necessary degree of protection.

There is another potential problem. As soon as a vaccine is approved, it's going to be needed in vast quantities – and many of the organisations in the Covid-19 vaccine race simply don't have the necessary production capacity. Vaccine development is already a risky affair, in business terms, because so few candidates get anywhere near the clinic. Production facilities tend to be tailored to specific vaccines, and scaling these up when you don't yet know if your product will succeed is not commercially feasible. If once vaccinated human body can be used to generate attenuated or weakened germs to transmit into another human, this production and supply gap can be bridged. The business entities may not be interested in such innovation as they lose revenue; in that case the civil societies, non-profit organisations and government should come forward to support such initiatives by direct actions or other policy measures. Outside of pandemics, the WHO brings governments, charitable foundations and vaccine-makers together to agree an equitable global distribution strategy, and organisations like the vaccine alliance, have come up with innovative funding mechanisms to raise money on the markets for ensuring supply to poorer countries. But each pandemic is different, and no country is bound by any arrangement the WHO proposes – leaving many unknowns. It is possible that a booster dose may be necessary and that can be through manufactured vaccine in subsequent time. This model can help

buying time; i.e. human body can be used for initial dose of vaccine but over a period sufficient manufactured vaccine may be available which can be used while administering booster dose.

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