

# A Review of New Coronavirus Vaccines and Virus Detection Methods

Lin Liu, Yun Liu

Southwest University, Chongqing, 400700, China

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**Abstract:** As the new crown virus epidemic becomes more and more intense around the world, more and more people are pinning their hopes of containing the epidemic on the development of new crown virus vaccines. At present, the new crown vaccines developed by countries around the world are gradually being marketed. This article summarizes the development of five major new coronavirus vaccines: inactivated vaccines, live attenuated vaccines, adenovirus vector vaccines, recombinant protein vaccines, and nucleic acid vaccines. It also illustrates relevant assays for the new coronavirus.

**Keywords:** New Coronavirus; Vaccine; Detection; Research Progress.

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## 1. Introduction

On December 30, 2019, a new type of coronavirus (2019-nCoV) that can cause human respiratory infections and pneumonia was first infected in Wuhan, China. And it quickly attracted global attention [1] [2]. With the increase of confirmed cases, the novel coronavirus pneumonia (NCP) epidemic has been listed by the World Health Organization as a "public health emergency of international concern", and it has also attracted great attention from the governments of our country and other countries [3]. According to immunology, the most effective way to control the virus is to vaccinate. Therefore, all countries attach great importance to the research and development of vaccines. This article will explain the five successful vaccines, the current status of people's vaccination, and my own opinions about new crown testing.

## 2. Progress in the Research of Five Vaccines

### 2.1. Inactivated Vaccines

They refer to vaccines that are purified by inactivating infectious intact viruses by heating, radiation, or chemical treatment, so that they lose their pathogenic ability but retain their antigenicity. Common inactivated vaccines include rabies vaccine, inactivated hepatitis A vaccine, and inactivated polio vaccine. The advantage of inactivated vaccine is that the production technology is relatively mature and the safety is relatively high; its disadvantage is that it usually activates humoral immunity, and the immunogenicity of single-dose vaccination is weak. The immune effect will gradually weaken with the extension of the vaccination time, and it is necessary to increase the number of doses to maintain the immune effect [2]. On December 30, 2020, the state approved the conditional listing of the world's first inactivated COVID-19 vaccine produced by Sinopharm Group. The results of the Phase III clinical trial of the vaccine showed that its safety is good. The main adverse reactions are local pain and local induration, which are similar to those of ordinary inactivated vaccines. The allergic reaction is about two parts per million; effectiveness. In terms of effectiveness, after two doses of vaccination, the recipients produced high-titer antibodies, and the neutralizing antibody positive conversion

rate was 99.52%, and the protective effect against new coronary pneumonia reached 79.34% [4].

### 2.2. Live Attenuated Vaccines

They refer to vaccines made from attenuated strains with greatly reduced pathogenicity through continuous subculture of wild strains in the laboratory. Similar live attenuated vaccines include BCG, live attenuated polio vaccine, and live hepatitis A vaccine. The advantage of live attenuated vaccines is that they are similar to the natural state of the virus, they have a good immune effect. Secondly, the production cost is relatively low, and it is easy to mass produce. However, the shortcomings of live attenuated vaccines are also obvious: First, the development cycle is long, and long-term cultivation is often required to obtain the ideal strain; second, the residual virulence of the virus is difficult to evaluate, and virulence may be reversed. The new coronavirus attenuated vaccine jointly developed by the United States and India has entered phase I clinical trials in December 2020 [2].

### 2.3. Adenovirus Vector Vaccine

It refers to a vaccine formed by inserting virus antigen genes into a non-toxic adenovirus vector. Adenovirus vectors are divided into two types: replication-defective and replication-competent. At present, the commonly used one is replication-defective. The replication-deficient type retains the complete structure and infectivity of the adenovirus, but loses the ability to replicate itself, making it safer [2]. The new coronavirus vector vaccines developed in the United States, China, Russia, and the United Kingdom have all entered phase III clinical trials. The results of phase II clinical trials of my country's new crown adenovirus vector vaccine showed no serious adverse reactions, and phase III clinical trials have been carried out in Chile, Mexico, Argentina and other countries [5]. No serious adverse reactions have been found in the Phase III clinical trials of the new crown adenovirus vector vaccine in Russia and the United Kingdom, and it has been urgently approved for market use [6].

### 2.4. Recombinant Protein Vaccine

It is to construct the target antigen gene of the virus on a vector, and then transform the gene expression vector into recipient cells (such as bacteria, yeast or animal cells), and uses the cell protein expression system to produce the antigen

protein, a vaccine made after purification. Common recombinant protein vaccines include hepatitis B vaccine, hepatitis E vaccine, and cervical cancer vaccine. Currently, two recombinant protein vaccines developed by China and the United States have entered phase III clinical trials. The results of phase I/II clinical trials of the vaccine developed in my country have shown good immunogenicity and tolerability. Common adverse reactions are redness and pain at the injection site, and no other serious adverse reactions; neutralization *in vivo* after 3 doses of vaccination. The antibody level is higher than the level of patients with new coronary pneumonia during the recovery period. The new crown recombinant protein vaccine developed in the United States is inoculated in two doses. The results of phase I/II clinical trials showed that subjects had no or slight adverse reactions [2, 7].

### 2.5. Nucleic Acid Vaccines

They are known as the "third-generation vaccines" following the whole virus vaccines and recombinant subunit vaccines, including DNA vaccines and mRNA vaccines. They are a new generation of vaccine research and development technology with great potential [8].

## 3. Existing Detection Methods for Novel Coronavirus

In the early days of the virus, everyone did not know its transmission mechanism, but fortunately, Academician Zhong Nanshan discovered that the virus can be transmitted from person to person through aerosol in time. From this point of view, people will be infected with the virus inadvertently. Therefore, for the safety of the people and the stability of the society, the detection of the new crown virus is a very important task. At present, the 2019-nCoV detection methods mainly include virus isolation and identification, nucleic acid testing, and protein testing.

Virus isolation, culture, and identification according to Koch's law are important assays to identify novel coronavirus infections, which can determine the species of virus and provide a basis for clinical research and vaccine development. However, it is extremely demanding on technical conditions and personnel quality, and is not suitable for clinical rapid detection. Nucleic acid detection methods through amplified virus specific fragment detection, it has been written into the protocol for the diagnosis and treatment of new coronavirus pneumonia. It is suitable for rapid on-site detection. Protein detection methods, mainly including viral antigen detection and antibody detection, are utilizing the principle of antigen antibody specific binding, while combining other technologies to achieve stable, convenient, and rapid detection, suitable for large-scale screening and disease course monitoring [9].

## 4. Prospects for New Methods of Detection

Electrochemiluminescence biosensor is a detection technique that combines electrochemiluminescence technology with biosensor, which causes physicochemical qualitative changes at the biological contact interface by bioconjugation reaction between viral antigen and its specifically bound antibody molecules to form a complex. With the advantages of high sensitivity, reproducibility, wide linear range and low background signal, the ECL biosensor

provides rapid and efficient detection in environmental and medical fields [10]. Therefore, on the basis of the above-mentioned principle of protein detection, an attempt was made to combine the electro chemiluminescent sensor technology, perhaps to achieve a new and rapid method for the diagnosis of new coronaviruses. At present, this technique has been used in the detection of drug-resistant bacteria MRSA, whether it can be used in the detection of viruses needs further experimental study.

## 5. Conclusion

The virus is terrible, but as long as we start with prevention (vaccination), testing, and treatment, we can live in stability and society can develop sustainably. In addition, the research and development of the new coronavirus vaccine has gradually matured, and it is not difficult to find that advanced technologies have played a large role in it, such as the application of nanotechnology. Nanoparticles can be loaded with a wide range of antigenic moieties (by physical entrapment or chemical conjugation), and a correct antigenic display makes it a highly relevant alternate in vaccinology when compared to conventional approaches. In addition to safeguarding the native structure of the antigen, nanoparticles also improve the delivery and presentation of antigens to the antigen-presenting cells (APCs). Finally, I hope that science and technology will continue to build new results in vaccine development, and the new crown will no longer be daunting.

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