



An Overview: the types of Covid-19 vaccines in Iraq

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المقالة: انواع لقاحات كوفيد_19 في العراق

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Received:

21/1/2022

Accepted:

7 /3 /2022

Published:

31/3/2022

ABSTRACT

Background:

SARS-CoV-2 is RNA virus belonging to the Coronaviridae family that causes COVID-19. This newly sequenced virus seems to have originated in China and spread throughout world rapidly, causing a pandemic. According to the WHO, as of August 27 it had killed more than 2, 34 million people. Vaccination against coronavirus disease 2019 (COVID-19) is an important part of the multifaceted public health response, and may be the best solution for ending the pandemic. In addition, the laboratories around the world are working hard to develop an efficient vaccine for this disease, which is crucial to reduce mortality and morbidity. Most vaccines are designed to stimulate the synthesis of neutralizing antibodies against coat protein. These antibodies block the human ACE-2 receptor, thus preventing the entry of virus. While many vaccine platforms have developed vaccines, each offers several advantages and disadvantages. To date, there are seven types of vaccine (Pfizer Vaccine, Moderna Vaccine, AstraZeneca Vaccine, Johnson & Johnson Vaccine, Sinofarm Vaccine, Sputnik-V Vaccine and Novavax Vaccine) which are used around the world. Pfizer and Biontech vaccines are the most widely used vaccines in 10 countries: Saudi Arabia, UAE, Qatar, Kuwait, Oman, Bahrain, Jordan, Lebanon, Tunisia and Iraq. The Pfizer vaccine is a molecule of mRNA, a "messenger" ribonucleic acid, that codes the spike protein on the surface of the coronavirus, which is used by the virus uses to attach to human cells. Once the vaccine enters the body, human cells produce antibodies against this protein to intercept viruses before they enter the cells and multiply, so that the immune system can recognize and attack the virus. Moderna vaccine; uses the same mechanism as the mRNA-based Pfizer vaccine, stimulating the generation of antibodies.

AstraZeneca vaccine came in second place with 9 countries: Saudi Arabia, UAE, Kuwait, Oman, Bahrain, Morocco and Egypt, in addition to Iraq. AstraZeneca vaccine containing a weakened copy of the adenovirus, the common cold virus. The scientists modified the virus so that it cannot reproduce in human cells. Then, added the genes that code for the spike protein found on the surface of the Corona virus. When the vaccine enters the body and reaches the cells, it delivers these spike protein genes, which are used to build the protein itself. The spike proteins triggers an immune response. Similar to the AstraZeneca vaccine, The Johnson & Johnson vaccine contains a weakened version of the common cold virus (adenovirus). Scientists modified the adenovirus genetically so that it could no longer infect human cells. Then, they added genes that code for

the coronavirus' spike protein. Once in the body, the vaccine trains the immune system to recognize the spike protein and targets the coronavirus to destroy it. The Chinese Sinopharm vaccine is used in five countries: the UAE, Bahrain, Jordan, Morocco and Egypt. In cooperation with the Beijing Institute of Biological Products, Sinopharm developed a vaccine from the inactive corona-virus, a modified version of the virus (SARS-CoV-2) that cannot reproduce. The Russian Sputnik vaccine was used in Bahrain, Tunisia and Algeria. The Sputnik-V vaccine is based on adenovirus vectors. Adenoviruses are among the most easy and simple viruses to modify, and therefore their spread as vectors has expanded. "Vectors" are carriers that can transport genetic material from one virus to another. The infectious adenovirus has its genetic material deleted, and a gene "coding" a protein from another virus, which, in the case of developing corona-virus infection, enters the body. This new added component helps the immune system respond and produce antibodies that protect it from infection. Novavax uses a different approach than other vaccines, in which proteins from the virus and chemicals are injected to stimulate the body's immune system. The vaccine is based on inserting a mutated gene into a virus called baculovirus, which was then allowed to infect insect cells. Subsequently, spike proteins from these cells were combined into nanoparticles that look like coronaviruses they are not. It has the ability to replicate and cause COVID-19. These nanoparticles within the vaccine trigger the immune system response, so that when it encounters the corona-virus it will be able to resist it.

Conclusion:

In Iraq used only three types of vaccines (Pfizer, Sinofarm and AstraZeneca Vaccine. All types of vaccines can be reduce the morbidity of Covid-19.

Key words:

Vaccination, COVID-19

الخلاصة

مقدمة:

SARS-CoV-2 هو فيروس RNA ينتمي إلى عائلة Coronaviridae التي تسبب COVID-19. يبدو أن هذا الفيروس المتسلسل حديثاً نشأ في الصين وانتشر في جميع أنحاء العالم بسرعة، مما تسبب في جائحة. وفقاً لمنظمة الصحة العالمية، حتى 27 أغسطس / آب، قتلت أكثر من 2334 مليون شخص، ويعد التطعيم ضد مرض فيروس كورونا 2019 (COVID-19) جزءاً مهماً من استجابة الصحة العامة متعددة الأوجه، وقد يكون أفضل حل لإنهاء جائحة. بالإضافة إلى ذلك، تعمل المعامل في جميع أنحاء العالم جاهدة لتطوير لقاح فعال لهذا المرض، وهو أمر حاسم للحد من الوفيات والمراضة. تم تصميم معظم اللقاحات لتحفيز تخليق الأجسام المضادة المعادلة ضد بروتين الغلاف. تحجب هذه الأجسام المضادة مستقبلات ACE-2 البشرية، وبالتالي تمنع دخول الفيروس. بينما طورت العديد من منصات اللقاحات لقاحات، فإن كل منها يقدم العديد من المزايا والعيوب. حتى الآن، هناك سبعة أنواع من اللقاح (لقاح فايزر، لقاح موديرنا، لقاح أسترازينيكا، لقاح جونسون وجونسون، لقاح سينوفارم، لقاح سبوتنيك-V و لقاح نوفافاكس) المستخدمة في جميع أنحاء العالم. لقاحات Pfizer و Biontech هي اللقاحات الأكثر استخداماً في 10 دول: المملكة العربية السعودية، الإمارات العربية المتحدة، قطر، الكويت، عمان، البحرين، الأردن، لبنان، تونس والعراق. لقاح فايزر هو جزيء من mRNA، وهو حمض الريبونوكليك "الرسول"، الذي يرمز إلى بروتين السنبلة الموجود على سطح الفيروس التاجي، والذي يستخدمه الفيروس للاتصال بالخلايا البشرية. بمجرد دخول اللقاح إلى الجسم، تنتج الخلايا البشرية أجساماً مضادة لهذا البروتين لاعتراض الفيروسات قبل دخولها الخلايا وتكاثر، حتى يتمكن الجهاز المناعي من التعرف على الفيروس ومهاجمته. لقاح موديرنا يستخدم نفس آلية لقاح فايزر القائم على mRNA، مما يحفز إنتاج الأجسام المضادة. جاء لقاح AstraZeneca في المرتبة الثانية مع 9 دول: السعودية والإمارات والكويت وعمان والبحرين والمغرب ومصر، بالإضافة إلى العراق. لقاح AstraZeneca الذي يحتوي على نسخة ضعيفة من الفيروس الغدي، وهو فيروس نزلات البرد. قام العلماء بتعديل الفيروس بحيث لا يستطيع التكاثر في الخلايا البشرية. ثم أضافت الجينات التي ترمز لبروتين السنبلة الموجود على سطح فيروس كورونا. عندما يدخل اللقاح الجسم ويصل إلى الخلايا، فإنه يسلم هذه الجينات البروتينية، والتي تستخدم لبناء البروتين نفسه. تؤدي البروتينات الشوكية إلى استجابة مناعية، على



غرار لقاح AstraZeneca، يحتوي لقاح Johnson & Johnson على نسخة ضعيفة من فيروس الزكام الشائع (الفيروس الغدي). قام العلماء بتعديل الفيروس الغدي وراثيًا بحيث لم يعد بإمكانه إصابة الخلايا البشرية. بعد ذلك، أضافوا الجينات التي ترمز إلى بروتين سبايك لفيروس كورونا. بمجرد دخول اللقاح إلى الجسم، يقوم اللقاح بتدريب جهاز المناعة على التعرف على بروتين السنبله ويستهدف الفيروس التاجي لتدميره، ويستخدم لقاح سينوفارم الصيني في خمس دول هي الإمارات والبحرين والأردن والمغرب ومصر، بالتعاون مع بكين. قام معهد المنتجات البيولوجية، Sinopharm بتطوير لقاح من فيروس كورونا غير النشط، وهو نسخة معدلة من الفيروس (SARS-CoV-2) لا يمكن أن تتكاثر. تم استخدام لقاح Sputnik الروسي في البحرين وتونس والجزائر، ويستند لقاح Sputnik-V على ناقلات الفيروس الغدي. تعد فيروسات Adenovirus من أسهل وأبسط الفيروسات التي يمكن تعديلها، وبالتالي اتسع انتشارها كناقل. "الناقل" هي ناقلات يمكنها نقل المواد الجينية من فيروس إلى آخر. يتم حذف المادة الوراثية للفيروس الغدي المعدي، ويقوم الجين "بترميز" بروتين من فيروس آخر، والذي يدخل الجسم في حالة الإصابة بعدوى فيروس كورونا. يساعد هذا المكون المضاف الجديد جهاز المناعة على الاستجابة وإنتاج الأجسام المضادة التي تحميه من العدوى، ويستخدم نوفافاكس طريقة مختلفة عن اللقاحات الأخرى، حيث يتم حقن البروتينات من الفيروس والمواد الكيميائية لتحفيز جهاز المناعة في الجسم. يعتمد اللقاح على إدخال جين متحور في فيروس يسمى baculovirus، والذي سُمح له بعد ذلك بإصابة خلايا الحشرات. بعد ذلك، تم دمج بروتينات سبايك من هذه الخلايا في جزيئات نانوية تبدو وكأنها فيروسات كورونا ليست كذلك. لديه القدرة على التكرار والتسبب في COVID-19. تؤدي هذه الجسيمات النانوية الموجودة داخل اللقاح إلى استجابة الجهاز المناعي، بحيث يتمكن من مقاومته عندما يواجه فيروس كورونا. تهدف هذه المقالة إلى شرح أنواع اللقاحات المستخدمة في العراق، وآلية عملها، ومزايا وعيوب كل منها.

الاستنتاجات:

في العراق، تم استخدام ثلاثة أنواع فقط من اللقاحات (لقاح فايزر وسينوفارم وأسترا زينيكا، ويمكن لجميع أنواع اللقاحات أن تقلل من الإصابة بمرض كوفيد -19.

الكلمات المفتاحية:

اللقاح، كوفيد_19

INTRODUCTION

The World Health Organization (WHO) has defined COVID-19 as disease caused by the novel coronavirus. It was first reported on December 31, 2019 in Wuhan, China. It is a virus of the positive stripe RNA type. Corona viruses first appeared in the mid-1960s. Coronaviridae a larger family of respiratory viruses to which COVID-19 belongs, infect both animals and humans [1].

COVID-19 affects the upper respiratory tract. The virus, due to its slow mutation, poses a challenge to treatment. It appears among 2-14 days of infection.[2] and the normal period of incubation is 5.2 days [3]. The average duration of death for this disease is 6-24 days depending on the patients' prevalent clinical conditions, health and age as well. common symptoms of infection with respiratory complications comprise dry cough, high fever, sneezing, , muscle aches ,sore throat and fatigue.

According to the World Health Organization, COVID-19 spread from an diseased to an diseased person upon contact, coughing, and sneezing droplets as the virus enters the



body through the eyes, nose, or mouth (CDC [4]. COVID-19 droplets, which land up to 1.8 meters away and live for more than 2 to 2 days. Traces of the virus have also been found on the feces of infected people, but no infection through faces has yet been confirmed. The virus can be prevented and controlled by a combination of measures, the most effective of which is to avoid touching the mouth, nose, and eyes (CDC) [4]. There are also many other measures such as avoiding close contact with infected people, cleaning and disinfecting surfaces, staying at home when infected, and maintaining good practices.

There is still no cure for COVID-19. Taking care of patients is the only cure. Experts believe that perhaps the best approach for treating COVID-19 is through appropriate prevention and management measures [2]. However, scientists from all over the world are working hard to find a cure for the disease or a better vaccine. Therefore, many research laboratories from everywhere in the world has invested many resources to develop and manufactures a vaccine that hopefully will help flatten the COVID-19 curve for the benefit of all of humanity.

The virus's genome encodes many non-structural proteins, containing nucleocapsid (N), membrane (M), envelope (E), and spike (S). 3 The majority of COVID-19 applicant vaccines aim to stimulate antibodies. Neutralization against this virus-specific protein thistle (S) thus, prevents human uptake by ACE2 receptors, thus preventing infection [5]. However, strategies using a entire virus - either inactivated or attenuated - convince a response against many viral antigens. Since the periodical of the genome sequence of sars-cov-2, on January 11, 2020, an attempt has been made to progress a vaccine upon the disease. Early on, medical reviews anticipated that it might take at the least a 12 months or maybe a year and a half of to get the sars-cov-2 vaccine accepted for use inside the united states.

The SARS-CoV-2vaccine ought to meet the following requirements:

it no longer handiest protects in opposition to severe ailment but additionally prevents infection inside the entire vaccinated populace, which include immunocompromised people, eliciting lengthy-term reminiscence immune responses after token vaccinations or supporter doses should the producer be able to boom making to yield billions of doses every year and feature the capability to create it handy for worldwide vaccination campaigns at an inexpensive fee and in a restrained time [6-8]. One of the first assets of investment was (CEPI), a worldwide non-earnings organization whose organization objectives to supply investment for vaccines to forestall epidemics emerging. Any other crucial injection of investment came from (BARDA), which has devoted numerous million dollars from BARDA to pinnacle its list of candidate vaccines against covid-19[9,10]. The EU Vaccine Program has a joint effort to procure vaccines for EU countries. This article by now employed contracts with six vaccine: Sanofi-GSK , Pfizer- BioNTech, AstraZeneca- Oxford University, Curevac, Johnson & Johnson and Moderna.



Vaccine with different strategies and platforms

1. Inactivated vaccines

The Chinese "Sinopharma" vaccine was inactivated vaccine . after few a long time of weakened cholera immunization was delivered, Pasteur and Smith presented a strategy of warming, chemical medications or gamma radiation (such as formalin, beta propiolactone) to deactivate pathogen antibodies with the point of treating serious negative impacts after living Weakened infection and pathogen administration [11 16]. Inactivated Pathogen antibodies utilize dead pathogens, in this way affirming more beneficial care than live constricted immunizations. Be that as it may, illuminate, chemically, or warm deactivated pathogens miss their capacity to immunize making this methodology less successful than constricting pathogen immunization. In like manner, inactivated antibodies frequently fall flat to provoke versatile cellular reactions and in this way require the expansion of particular adjuvants and compounds that act as resistant cell activators and immunomodulators.

2. Protein subunit vaccines

An instance is the yank novavax vaccine. It is miles one of the first types of the superior subunit. Vaccines purpose to take advantage of the early capability of protein antigens to initiate bacterial principal reactions and result in high affinity, homologous immunoglobulin. Sub-protein antibodies are created through the union of recombinant protein antigens or protein confinement and decontamination. The strategy disposes of the plausibility of in temprate unfavorable comesabout, but frequently increments the need of expanding booster measurement optimizing the adjuvant to procure more grounded and more noteworthy changeless immunization. Managed antigen is uptake by means of aide actuated antigen-providing cells (APCs) giving versatile safe cells. One of the most punctual illustrations of cellular antibody got to be an bacillus anthracis defensive antigen advanced within the early 1960s but maybe the foremost popular reaction to this methodology is the flu immunization subunit [17-19]. The explosion of genetic engineering discovered inside the remaining of the twentieth century brought about the potential to clone and ramp up antigen production in the laboratory. Such strategies allowed the manufacturing of massive quantities of hepatitis b floor antigen in yeast cells, an invention that brought about the manufacturing of the hepatitis b vaccine [20]. Every of these applicants are using one-of-a-kind immunogens, basically exceptional varieties of the whole spike protein or its receptor-binding domain (rbd), a place of the s protein that mediates viral binding to the ace2 receptor of goal host cells. Upon binding to the host cell ace2, the receptor undergoes the formation of an s protein infusion. A prolonged conformational alternative to a fusion conformation that allows fusion among the viral



particle and the host cellular membranes[21-24]. As a rule, the initialization is stabilized. Viral glycoproteins are usually more immunogenic, and are therefore present aiming for a more attractive vaccine [25,26].

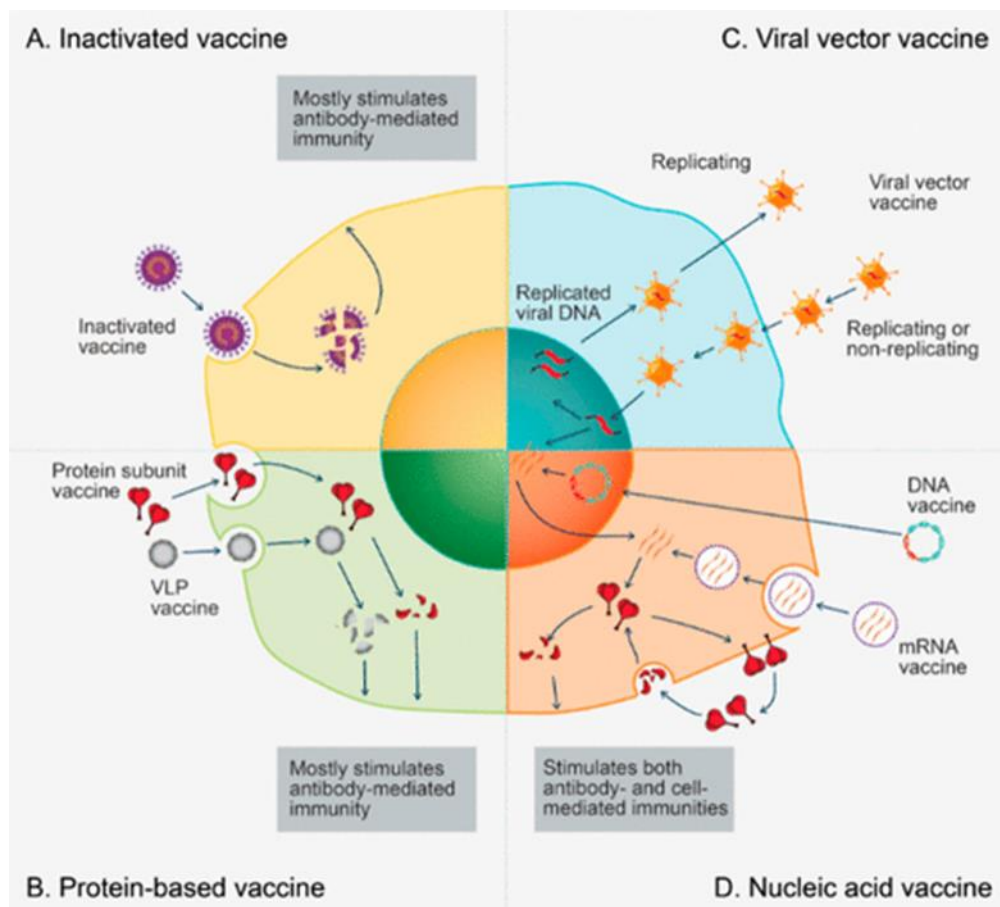
3. Viral-vectored vaccines

"AstraZeneca-Oxford" vaccine, the "Johnson & Johnson" vaccine, and the Russian Sputnik V vaccine, where viral vectors speak to one of the most recent created immunization methodologies. Different infections are changed to diminish destructiveness and non replication indeed as holding their capacity to sully human cells. Those are outlined to supply hereditary measurements of a pathogen to safe cells so that you just can particularize antigenic proteins and display them to lymphocytes. Adenovirus vectors, vesicular stomatitis and measles are usually employed for such plans which have been appeared to evoke strong resistant reactions. Hence, there are members of this institution which have issued endorsement. On the other hand, a recombinant vesicular stomatitis infection (rvsv) vector that comprises hereditary insights encoding a glycoprotein from ebola. This antibody is known as "rvsv-zebov" or ervebo issued endorsement in December 2019 [27]. On the other hand, heterotrophic adenovirus 26 (Ad26) and a vaccine-modified antibody coordinated against Zaire may be a strain of Ebola infection, commercially called Zabdeno and Mvabea ("Ad26.ZEBOV + MVA-BN-Filo"), promoting authorization by the European Solutions Organization (EMA).) for utilize by the European Commission on 1 July (2020) [28]. A notable complication with the use of viral vectors for vaccines is a pre-existing immunity to the vector that impairs the magnitude of the induced immune responses. Two broad spectrum vector combinations used to produce the SARS-CoV2 vaccine—the competent and the defective versions—are under clinical trials [29].

4. Nucleid acid vaccines (mRNA vaccines)

The pfizer-biontech and moderna vaccines, which can be primarily based on messenger RNA generation, a safe and powerful vaccine, wherein shipping of mRNA vaccines are similar to DNA vaccines, with the exception that the best mRNA must reach the endoplasmic or cytoplasmic reticulosomes to be interpreted into a protein. As a result, mRNA molecules encased in lipid nanoparticles (lnp) vectors that may efficaciously and effectively encapsulate DNA can enable tissue penetration, allowing genetic records to be shipped to host cells for antigen protein synthesis to begin. The production of immunological responses that follows is like to the introduction of DNA vaccines. mRNA molecules, on the other hand, are much extra wobbly than DNA ones. As a result, for long-term storage, mRNA vaccines typically require temperatures between -70°C and -20°C , complicating the logistics of distributing this type of vaccine[33]. Allowing a short-term storage (up to 6 months) of the temperatures to candidate mRNA vaccine between 2 and 6 degrees Celsius [34].

Below fig.1 shows the action of the four types of vaccines [35]



Acknowledgments:

I thank College of Nursing, University of Babylon, Iraq for the facilities provided for the completion of this work.

Conflict of interests.

There are non-conflicts of interest.

References

1. A. Demeco, N. Marotta, M. Barletta, I. Pino, C. Marinaro, A. Petraroli, L. Moggio and A. Ammendolia, "Rehabilitation of patients post-COVID-19 infection: a literature review", *Journal of International Medical Research*, vol.48, no. 8, 2020.
2. I. Ali, and O. M. L. Alharbi, "COVID-19: Disease, management, treatment, and social impact", *Science of the Total Environment*, vol.728, pp.138861, 2020. doi:10.1016/j.scitotenv.2020.138861
3. Q. Li, X. Guan, P. Wu, X. Wang, L. Zhou, Y. Tong, and Z. Feng, "Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia", *The New England Journal of Medicine*, vol.382, no.13, pp. 1199–1207, 2020. doi:10.1056/NEJMoa2001316
4. Center for Disease Control (CDC), "COVID-19 overview and infection prevention and control priorities in non-US healthcare settings", 2020.
5. InvivoGen, "Spotlight on COVID-19: vaccine development", InvivoGen, 2020.



6. AEP. LAS VACUNAS CONTRA EL SARS-COV-2 (COVID-19) BASADAS EN VECTORES DE ADENOVIRUS SON SEGURAS, BIEN TOLERADAS E INMUNÓGENA. AEP 2020.
7. S. Plotkin, History of vaccination. Proc. Natl Acad. Sci. USA 111, 12283–12287, 2014.
8. A. Dutta, et al. Sterilizing immunity to influenza virus infection requires local antigen-specific T cell response in the lungs, Sci. Rep, vol. 6, pp.32973,2016.
9. F. Gallais, et al. Intrafamilial Exposure to SARS-CoV-2 Associated with Cellular Immune Response without Seroconversion, France. Emerg Infect Dis. Vol.27, pp.113–121, 2021.
10. T. Sekine, et al. Robust T cell immunity in convalescent individuals with asymptomatic or mild COVID-19. Cell 183,pp. 158–168 ,2020.
11. A. Cadeddu, Pasteur et le choléra des poules: révision critique d'un récit historique. Hist. Philos. Life Sci. pp.87–104, 1985.
12. J. F. Enders, T. H. Weller and F. C. Robbins, "Cultivation of the Lansing strain of poliomyelitis virus in cultures of various human embryonic tissues", Science 109,pp. 85–87, 1949.
13. J. Ehreth, "The value of vaccination: a global perspective", Vaccine 21,pp. 4105–4117, 2003.
14. Y. Tao, et al. Surveillance of bat coronaviruses in Kenya identifies relatives of human coronaviruses NL63 and 229E and their recombination history, J. Virol. 91, e01953-16, 2017.
15. D. E. Salmon and T. Smith, "On a new method of producing immunity from contagious diseases", Am. Vet. Rev. 10, 63–69 ,1886.
16. V. Pliaka, Z. Kyriakopoulou and P. Markoulatos, "Risks associated with the use of live-attenuated vaccine poliovirus strains and the strategies for control and eradication of paralytic poliomyelitis", Expert Rev. Vaccines 11, pp.609–628 ,2012.
17. T. Cate, R. Couch, J. Kasel and H. Six, "Clinical trials of monovalent influenza A/New Jersey/76 virus vaccines in adults: reactogenicity, antibody response, and antibody Persistence", J. infect. Dis.,1977.
18. P. S. Brachman, et al. "Field evaluation of a human anthrax vaccine", Am. J. Public Health Nations Health 52, 632 ,1962.
19. M. Cox, R. Izikson, P. Post and L. Dunkle, "Safety, efficacy, and immunogenicity of Flublok in the prevention of seasonal influenza in adults", Ther. Adv. Vaccines ,2015.
20. P. Valenzuela, A. Medina, W. J. Rutter, G. Ammerer and B. D. Hall, "Synthesis and assembly of hepatitis B virus surface antigen particles in yeast", Nature 298,pp. 347–350 ,1982.
21. C. L. Hsieh, et al. Structure-based design of prefusion-stabilized SARS-CoV-2 spikes, Science 369, pp.1501–1505, 2020.
22. R. W. Sanders, et al. A next-generation cleaved, soluble HIV-1 Env Trimer, BG505 SOSIP.664 gp140, expresses multiple epitopes for broadly neutralizing but not non-neutralizing antibodies, PLOS Pathog. 9, e1003618 ,2013.
23. M. C. Crank, et al. A proof of concept for structure-based vaccine design targeting RSV in humans. Science 365,pp. 505–509, 2019.
24. J. Pallesen, et al. Immunogenicity and structures of a rationally designed prefusion MERS-CoV spike antigen. Proc. Natl Acad. Sci. USA 114, E7348 ,2017.
25. R. C. Rose, W. Bonnez, R. C. Reichman and R. L. Garcea, "Expression of human papillomavirus type 11 L1 protein in insect cells: in vivo and in vitro assembly of viruslike particles", J. Virol. 67, pp.1936–1944, 1993.
26. R. Kirnbauer, et al. Efficient self-assembly of human papillomavirus type 16 L1 and L1-L2 into virus-like particles, J. Virol. 67, pp.6929–6936,1993.
27. D. Czarska-Thorley, Zabdeno. European Medicines Agency (2020).
28. T. P. Monath, et al." rVSVΔG-ZEBOV-GP (also designated V920) recombinant vesicular stomatitis virus pseudotyped with Ebola Zaire Glycoprotein: Standardized template with key considerations for a risk/benefit assessment", Vaccin. X 1, 100009 ,2019.
29. D. Czarska-Thorley, Zabdeno. European Medicines Agency europa.eu/en/medicines/human/EPAR/zabdeno ,2020.
30. WHO. Draft landscape of COVID-19 candidate vaccines, 2021.



31. G. Dauphin and S. Zientara," West Nile virus: recent trends in diagnosis and vaccine development", *Vaccine* ,2007.
32. M. J. Atherton, J. S. Morris, M. R. McDermott and Lichty, "Cancer immunology and canine malignant melanoma: a comparative review", *Vet B. D. Immunol. Immunopathol.* 169,pp. 15–26 ,2016.
33. D. Hobernik and M. Bros," DNA Vaccines—How Far From Clinical Use?" *Int. J. Mol. Sci.* 19, pp.3605,2018.
34. N. Pardi, M. J. Hogan, F. W. Porter and D. Weissman," mRNA vaccines — a new era in vaccinology", *Nat. Rev. Drug Discov.* 17, pp.261–279, 2018.
35. L. Yingzhu, T. Rumiana, S. Jeffrey, L. Cynthia, W. Steven and Z.Qiongqiong "A Comprehensive Review of the Global Efforts on COVID-19 Vaccine Development", *ACS Cent. Sci.*, 7,pp. 512–533,2021.

مجلد 30، شماره 1، 2022

ISSN: 2312-8135 | Print ISSN: 1992-0652

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