World Health Assembly (WHA)

The use of vaccines in animal husbandry

Research Report

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"Out of this world"

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Introduction

Vaccinations against diseases are a vital part of animal husbandry, helping to protect livestock and boost agricultural output. The demand for animal products, such as meat, milk, and eggs, is growing worldwide, and the livestock sector is confronted with many difficulties, including disease outbreaks. These epidemics have the potential to endanger food security and cause financial losses. Immunisation campaigns provide a proactive means of preventing illness, decreasing the need for antibiotics, and lowering the dangers of zoonotic illnesses—diseases that can spread from animals to people.

Historically, infectious diseases such as foot-and-mouth disease, avian influenza, and bovine tuberculosis have had devastating impacts on livestock populations, necessitating comprehensive strategies to control and eradicate these threats. The implementation of vaccines has proven to be one of the most effective measures in this regard. By stimulating the immune response of animals, vaccines help in building resistance against specific pathogens, thereby reducing mortality rates and improving the overall health and productivity of herds and flocks.

Moreover, the adoption of vaccination protocols in animal husbandry aligns with the global One Health initiative, which recognizes the interconnectedness of human, animal, and environmental health. This holistic approach underscores the importance of preventing animal diseases not only to protect animal welfare but also to ensure human health and environmental sustainability.

Definition of Key Terms

Animal husbandry:

Controlled cultivation, management, and production of domestic animals, including improvement of the qualities considered desirable by humans by means of breeding. Animals are bred and raised for utility (e.g., food, fur), sport, pleasure, and research.[1]

Zoonotic diseases:

Zoonotic diseases are infections that are spread between people and animals. These infections are caused by germs, such as viruses, bacteria, parasites, and fungi. Some can be severe and life-threatening, such as rabies, and others may be milder and get better on their own.[2]

Smallpox variolation:

The intentional inoculation of an individual with smallpox material.[3]

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[1] Britannica. (2024, June 7). Animal husbandry | agriculture. Retrieved from Britannica: https://www.britannica.com/science/animal-husbandry

[2] Wisconsin Department of Health Services. (2024, March 25). Zoonitic Disieases. Retrieved from Wisconsin Department of Health Services: https://www.dhs.wisconsin.gov/disease/zoonotic.htm

[3] Louten, J. (2023). Poxviruses. Retrieved from Sciencedirect: https://www.sciencedirect.com/topics/immunology-and-

General Overview

History of vaccinations

The concept of vaccination dates back to ancient practices, with early forms of immunisation observed in China and India, where smallpox material was used to confer immunity through variolation. There are written accounts from the 15th century that describe smallpox inoculation being used in China and accounts from the 18th century from India that suggest this technique was being used hundreds of years prior.[4] However, there is some evidence that suggests that this practice was already being used as early as 200 BC.

The modern era of vaccines began with Edward Jenner's pioneering work in the late 18th century. In 1796, Jenner discovered that cowpox could protect against smallpox, a disease with high mortality rates[5]. He demonstrated this by inoculating an eight-year-old boy with cowpox, who then proved immune to smallpox. This landmark achievement laid the foundation for the field of vaccinology and eventually led to the global eradication of smallpox in 1980.

In the 19th and early 20th centuries we have witnessed significant advancements in vaccine development. Louis Pasteur's work in the 1880s on attenuated vaccines marked a major milestone[6]. Pasteur developed vaccines for anthrax and rabies, introducing the concept of weakened pathogens to stimulate immunity without causing the disease. This marked the beginning of vaccines in animal husbandry.

The mid-20th century marked the golden age of vaccine development. Jonas Salk and Albert Sabin's work on polio vaccines in the 1950s led to the near-eradication of polio worldwide. The development of measles, mumps, and rubella (MMR) vaccines in the 1960s further exemplified the progress in controlling infectious diseases. In this century, vaccines for diseases such as brucellosis and rabies were developed. These vaccines significantly reduced mortality and improved herd health.

In recent decades, molecular biology and genetic engineering advancements have revolutionised vaccine development. The introduction of recombinant DNA technology has led to the production of vaccines for hepatitis B, human papillomavirus (HPV), and more recently, the rapid development of mRNA vaccines for COVID-19. These innovations continue to push the boundaries of immunisation, offering hope for the control and eradication of numerous diseases in the future.

Zoonotic diseases

Zoonotic diseases are transmitted from animals to humans (or vice versa).[7] Some examples of zoonotic diseases are rabies, Ebola, and the coronavirus. With the domestication of animals, zoonotic diseases began appearing more frequently. Transmissions of these diseases can occur in any context when there is contact with or consumption of animals, animal products, or animal derivatives.[8]

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microbiology/variolation#:~:text=Variolation%2C%20the%20intentional%20inoculation%20of,the%20skin%20of%20an%20individual

[4] Davies, P. (n.d.). History of smallpox vaccination. Retrieved from World Health Organization (WHO): https://www.who.int/news-room/spotlight/history-of-vaccination/history-of-smallpox-vaccination

[5] WHO. (n.d.). A Brief History of Vaccination. Retrieved from World Health Organization (WHO): https://www.who.int/news-room/spotlight/history-of-vaccination/a-brief-history-of-vaccination

[6] Gillray, J. (n.d.). Smallpox vaccine. Retrieved from Wikipedia: https://en.wikipedia.org/wiki/Smallpox_vaccine

[7] Minnesota Department of Health. (2022, November 10). Zoonotic Diseases: Disease Transmitted from Animals to Humans - MN Dept. of Health. Retrieved from Minnesota Department of Health: https://www.health.state.mn.us/diseases/animal/zoo/index.html

[8] Wikipedia. (n.d.). Zoonosis. Retrieved from Wikipedia: https://en.wikipedia.org/wiki/Zoonosis

Recently, there has been a higher frequency of the appearance of new zoonotic diseases. A report from the United Nations Environment Programme and International Livestock Research Institute states that a large part of the causes of this rise are environmental causes like climate change, unsustainable agriculture, and exploitation of wildlife.[9] The report proposes a set of ten measures to stop this rise, like raising awareness and implementing stronger biosecurity measures.[10]

The most recent example of how drastically a zoonotic disease can change our lives is SARS-CoV-2, which is commonly known as the coronavirus. The outbreak of this virus most likely started on an animal market in Wuhan, China.[11] Here, the virus jumped from an animal to a human and afterwards it caused a worldwide pandemic.

The risk of another pandemic happening soon is big. The probability of another pandemic occurring within one's lifetime is roughly 17% and can even grow to 44% within the next couple of decades.[12] Professor Connolly, who coordinates the pandemic preparedness, said: "The most likely scenario for the next pandemic is a new strain of influenza like the H7N9 "bird flu" virus, or a newly identified virus such as another novel coronavirus."[13]

According to Connolly, the next pandemic could come from large intensive livestock farms. These farms can result in "spillover infections" from animals to people. For example, new types of avian influenza (also known as "bird flu") arise in wild birds every year. Intensive farming increases the risk of the infection of domestic birds by wild birds. Because the virus is highly contagious, the best solution to make sure the virus does not spread any further is to cull all the birds in the farm where the virus is detected.

This solution however isn't the best for both the farm and the environment. In the long term, we need a solution that prevents the virus from infecting domestic birds. Luckily, there are some vaccines for both humans and birds that prevent the virus from spreading.

One Health initiative

The One Health initiative wants to expand interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment. These collaborations include physicians, veterinarians, dentists, nurses and other scientific-health and environmentally related disciplines.[14] The initiative believes that human, animal and ecosystem health are linked and can only be improved together.

Distribution of vaccines

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[9] UNEP. (2020, February 29). Preventing the next pandemic - Zoonotic diseases and how to break the chain of transmission. Retrieved from United Nations Environmental Programme (UNEP): https://www.unep.org/resources/report/preventing-future-zoonotic-disease-outbreaks-protecting-environment-animals-and

[10] UNEP. (n.d.). Preventing the next pandemic – Zoonotic diseases and how to break the chain of transmission: Key Messages. Retrieved from United Nations Environmental Programme (UNEP): https://wedocs.unep.org/bitstream/handle/20.500.11822/32860/ZPKMEN.pdf?sequence=1&isAllowed=y

[11] NOS. (2022, July 26). Wetenschappers: corona ontstond op dierenmarkt in Wuhan. Retrieved from NOS: https://nos.nl/artikel/2438437-wetenschappers-corona-ontstond-op-dierenmarkt-in-wuhan

[12] Adam Williams, C. H. (2023). Outlook of pandemic preparedness in a post-COVID-19 world. Retrieved from Nature: https://www.nature.com/articles/s41541-023-00773-0#ref-CR17

[13] Smith, J. (2021, December 16). Q&A: Future pandemics are inevitable, but we can reduce the risk. Retrieved from Research and innovation: https://projects.research-and-innovation.ec.europa.eu/en/horizon-magazine/qa-future-pandemics-are-inevitable-we-can-reduce-risk

[14] One Health Initiative. (n.d.). One Health Initiative will unite human and veterinary medicine. Retrieved from One Health Initiative: https://onehealthinitiative.com/

Vaccines are not equally distributed in the world. Some areas in the world don't have enough resources to buy enough vaccines and in remote areas it can be difficult to store and transport the vaccines. The World Organisation for Animal Health (OIE) has set up vaccine banks for several diseases.[15] These banks allow the high-quality vaccines to get delivered fast and at a low price. Because the OIE arranges the delivery of the vaccines, countries can focus on other aspects of their national disease strategies, such as raising awareness, training vaccinators, or improving biosecurity measures.

Major Parties Involved

World Health Organisation (WHO)

Although the WHO primarily focuses on human health, it also plays a role in veterinary health. The WHO works closely with the World Organisation for Animal Health (OIE) and the Food and Agriculture Organization (FAO) to address zoonotic diseases and improve veterinary public health. The WHO also promotes the One Health concept.

World Organisation for Animal Health (OIE)

The OIE is an international organisation dedicated to improving animal health worldwide by setting standards, providing guidance, and coordinating efforts to control and eradicate animal diseases.[16] The OIE sets global standards for the safety and efficacy of vaccines. It promotes research and development of new vaccines, conducts training programs to build veterinary capacity, and facilitates rapid response to disease outbreaks through international cooperation. The OIE also maintains a database on animal diseases and vaccination strategies, helping countries implement effective vaccination policies and practices to protect livestock health and enhance global food security.

Food and Agriculture Organization (FAO)

The FAO is a United Nations agency dedicated to achieving food security, improving nutrition, and promoting sustainable agriculture worldwide.[17] It supports animal husbandry vaccination by coordinating global efforts to control and eradicate livestock diseases, providing technical assistance and guidelines for vaccine development and implementation. The FAO also facilitates research and development, capacity building, and training programs for veterinary professionals, ensuring effective vaccination strategies.

Timeline of Events

[15] World Organisation for Animal Health (OIE). (20, April 2022). Prevention is better than a cure: delivering quality vaccines to stop the spread of animal diseases. Retrieved from Wold Organisation for Animal Health (OIE): https://www.woah.org/en/article/prevention-is-better-than-a-cure-delivering-quality-vaccines-to-stop-the-spread-of-animal-diseases/

[16] Britannica. (2024, July 2). World Organisasion for Animal Health. Retrieved from Britannica: https://www.britannica.com/topic/World-Organisation-for-Animal-Health

[17] United Nations. (n.d.). FAO. Retrieved from United Nations: https://www.un.org/en/ccoi/fao-food-and-agriculture-organization-united-nations#:~:text=The%20Food%20and%20Agriculture%20Organization,and%20lead%20active%2C%20healthy%20lives.

200 BC	First evidence of people attempting smallpox inoculation
1796	Edward Jenner discovered cowpox can protect against smallpox
1980	Global eradication of smallpox
Late 2019	Covid-19 is discovered in Wuhan, China

Possible Solutions

Some measures could be taken to improve animal health and food safety. The first, and easiest, is spreading awareness for these vaccines and how these can help farmers. However, this measure doesn't always have the desired effect. Countries can also invest in interdisciplinary approaches such as the One Health perspective and strengthen the integration of environmental considerations in the WHO, FAO and OIE.[18] Another investment could be in scientific research on both vaccines and zoonotic diseases to prevent another global pandemic from happening.

Another solution would be to support the OIE programme that helps distribute vaccinations for farm animals. This programme doesn't only help with the distribution itself but also helps the farmers gain the required knowledge needed to vaccinate the farm animals.

Aside from the vaccines, there are another couple of measures that could be taken to prevent another pandemic from happening. The biggest one is to put regulations on large intensive livestock farms. These regulations could be anything from putting a maximum amount of animals per square metre to obliging vaccines from a certain number of animals.

[18] UNEP. (2020, February 29). Preventing the next pandemic - Zoonotic diseases and how to break the chain of transmission. Retrieved from United Nations Environmental Programme (UNEP): https://www.unep.org/resources/report/preventing-future-zoonotic-disease-outbreaks-protecting-environment-animals-and

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