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INTRODUCTION TO VETERINARY VACCINES: WORLDWIDE SCENARIO

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ABSTRACT

The history of veterinary vaccines can be divided into four distinct stages. The first stage was the discovery of variolation against smallpox and its eventual evolution into vaccination. The second stage was pioneered by the discoveries by Louis Pasteur and his colleagues, which paved the way for the early production of several successful vaccines against primarily bacterial diseases. The third stage, epitomised by the canine distemper vaccine development, was a process of advancement in these vaccines and resulted from a growing awareness about viruses and their behaviour. Eventually, the fourth stage is characterised by the experienced and suave use of vaccines, which led to the eradication of two major diseases, Smallpox and Rinderpest, and the near eradication of diseases such as Poliomyelitis.

KEYWORDS: Disease eradication, Livestock health management,Veterinary vaccines

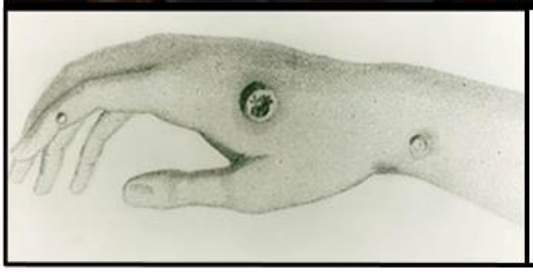
HISTORY OF SMALLPOX VACCINATION

VARIOLATION

In medieval Asia, medical practitioners started using the variolation technique, which is the intentional infection with smallpox. Dried smallpox scabs were deliberately blown into the nostrils of individuals who developed a mild version of smallpox. Upon recuperation, the individuals were immune to smallpox. Variolation was never a reliable and harmless procedure. There is a considerable risk of the patient dying from the procedure. Around 1-2% of the individuals variolated died due to the procedure. This is negligible when compared to 30% who succumbed when they developed smallpox naturally. Moreover, the mild form of the disease which the patient developed has the potential to spread, resulting in an epidemic. By 1700, India, Africa and the Ottoman Empire had adopted variolation to safeguard against smallpox. In contrast to Asians and Africans who were inoculated by blowing dried smallpox scabs into the nostrils, the Americans and Europeans were inclined to immunise through a puncture in the skin.

Variolation by inhalation practised in China

SOURCE:
https://www.labroots.com/trending/microbiology/4928/variolation-vaccination



Variolation done through puncture of the skin

SOURCE:
https://www.nlm.nih.gov/exhibition/smallpox/sp_variolation.html#:~:text=In%20Asia%2C%20practitioners%20developed%20the,individual%20was%20immune%20to%20smallpox.

THE ADVENT OF COWPOX VACCINATION FOR SMALLPOX BY EDWARD JENNER

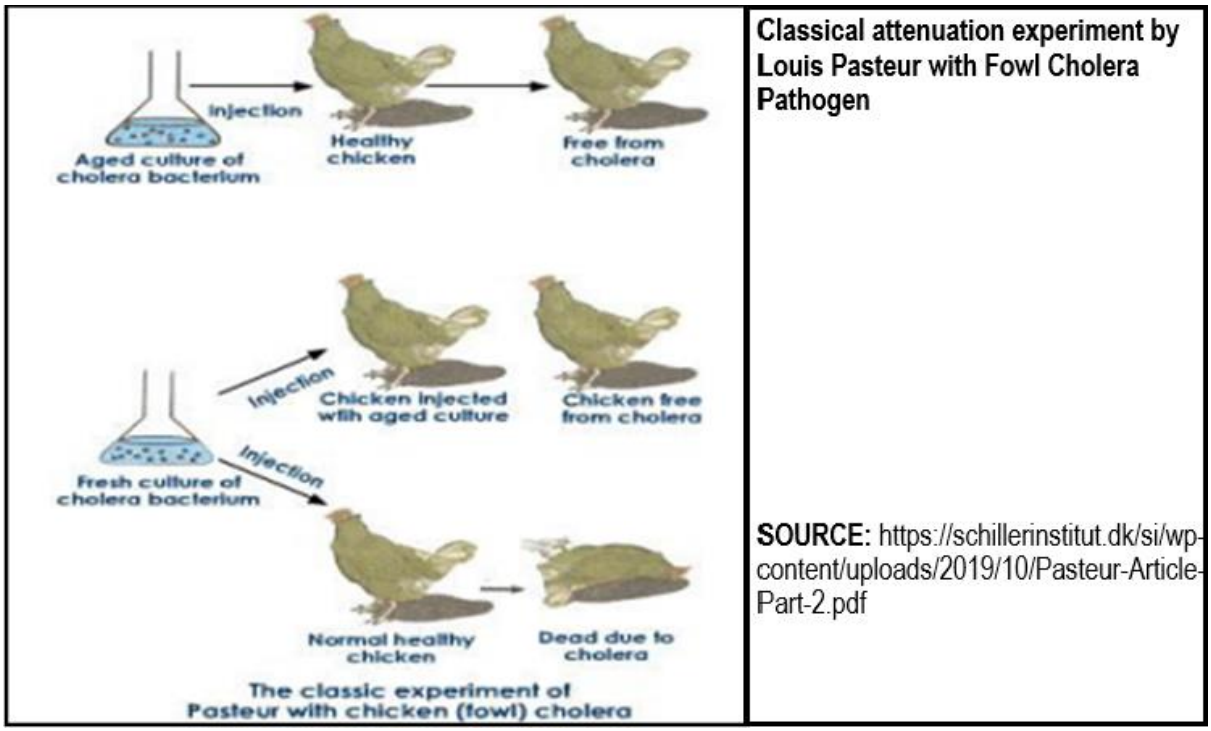
Edward Jenner, an English physician, observed in 1796 that milkmaids who had acquired cowpox were naturally protected from smallpox. Jenner presumed that prior exposure to cowpox could be utilised to safeguard against smallpox. To test his hypothesis, Dr. Jenner took samples from a cowpox sore on the hands of a milkmaid and inoculated them into the arm of James Phipps, an 8-year-old boy. After several months, Jenner exposed Phipps several times to variola virus, but Phipps never developed smallpox. Jenner declared in his dissertation, "On the Origin of the Vaccine Inoculation", that the elimination of smallpox, the most dreadful bane of the human species, must be the final result emanating from this practice.

Edward Jenner performing his first smallpox vaccination on James Phipps on 14th May, 1796

SOURCE:
https://museumandarchives.redcross.org.uk/objects/46915

CLASSICAL ATTENUATION EXPERIMENT BY LOUIS PASTEUR WITH FOWL CHOLERA PATHOGEN

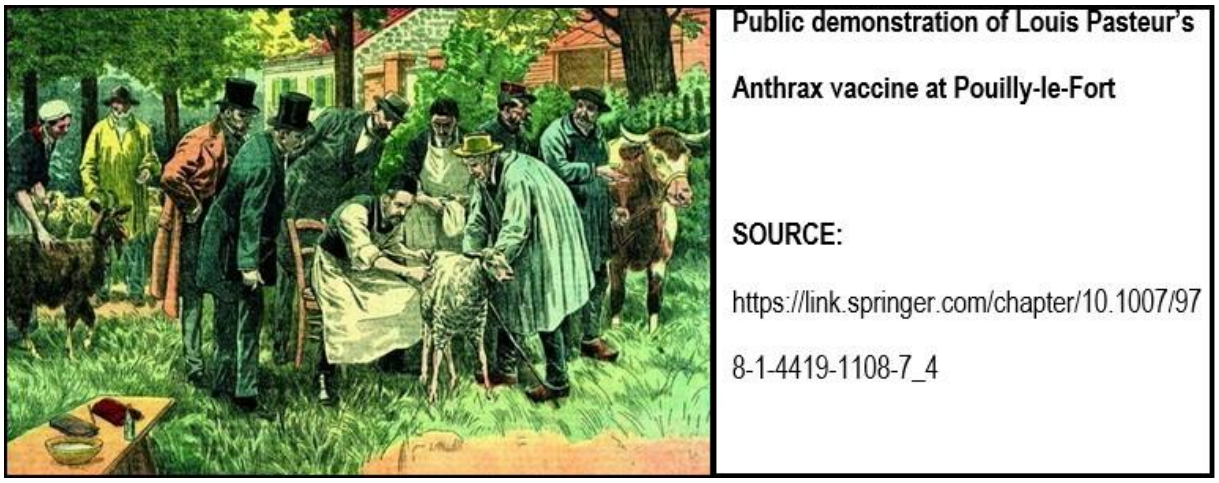
In 1879, Pasteur, planning for a holiday, instructed his assistant, Charles Chamberland, to inoculate the chickens with fresh bacterial (*Pasteurella multocida)* culture. Chamberland forgot and went on a holiday himself. Pasteur, returning a month later from holiday, found the flask of bacteria that had prepared before he had left, and decided to use it for inoculating the hen rather than discarding it. In one month, the microbes had become attenuated/ weakened, due to the aging process and exposure to oxygen. When Pasteur inoculated the aged bacterial culture into healthy chickens, they not only survived but developed robust immunity against the disease. Later, when Pasteur injected the freshly recovered hens with fresh bacterial culture that would normally have killed other chickens; the chicken in this experiment no longer developed any signs of infection. It became clear to Pasteur that the weakened bacteria had caused the chickens to become immune to the disease. Thus, the first laboratory-produced vaccine revolutionised the field of immunology.



ATTENUATED ANTHRAX VACCINE PRODUCTION BY LOUIS PASTEUR

After his success in attenuating Fowl Cholera pathogen, Louis Pasteur concentrated his efforts on attenuating *B. anthracis* so it could no longer cause disease. Pasteur grew the organism at an unusually high temperature of 108° F ("high-fever" temperature), where he could prevent the formation of spores and produce attenuated bacteria by infusing oxygen into the bacterial culture. This attenuation was then

transmitted to successive generations of bacteria cultivated at normal body temperature, and in early 1881, a vaccine was produced. On May 5, 1881, Pasteur put on a public demonstration of his anthrax vaccine at Pouilly-le-Fort, a small village near Paris, using two groups of animals. The vaccinated group comprising 24 sheep, 1 goat, and 6 cattle received two doses of the vaccine at a 15-day interval while the unvaccinated group received nothing., All the animals were challenged with a potent anthrax culture at 30 days after the 1st vaccine dose. All the vaccinated animals survived, while all the unvaccinated animals were dead or dying. The publicity given to this experiment made Pasteur famous and introduced the public to the potential of vaccines in combating infectious disease.



Public demonstration of Louis Pasteur's Anthrax vaccine at Pouilly-le-Fort

SOURCE:

https://link.springer.com/chapter/10.1007/978-1-4419-1108-7_4

ATTENUATED RABIES VACCINE PRODUCTION BY LOUIS PASTEUR

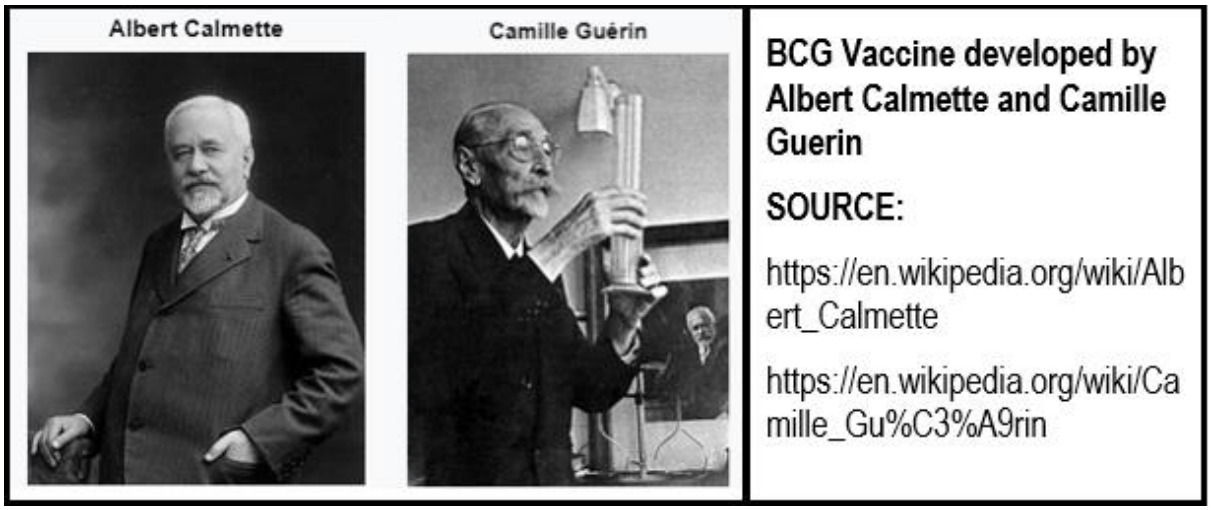
Pasteur's method of attenuation was rabies transmission from rabbit to rabbit (attenuation by lapinization) by intracranial inoculation for 15 passages until the shortest incubation period and the greatest degree of virulence have been attained. This lapinization technique, developed by Louis Pasteur, refers to viruses that have been adapted to develop in rabbits through serial transfers. This lapinized vaccine, developed by Louis Pasteur, became the blueprint for future veterinary vaccines such as the lapinized Classical Swine Fever vaccine.

Pasteur collected the spinal cord from deceased rabbits and kept it in tubes until the rabies virus virulence disappeared by the 15th day. Dogs were made immune to rabies by first inoculating with stale rabbit spinal cord specimens and later with fresh and virulent specimens.

After successfully protecting dogs from the disease, on July 6, 1885, Louis Pasteur injected the first of 14 daily doses of desiccated spinal cord suspensions from rabid rabbits by injecting increasingly virulent virus preparations until the fully active virus was injected into 9-year-old Joseph Meister, who had been severely bitten by rabid feral dogs. Pasteur became an international hero since Joseph Meister never developed any symptoms of rabies.

BACILLUS CALMETTE-GUÉRIN (BCG) VACCINE FOR PROTECTION AGAINST TUBERCULOSIS

BCG is an attenuated live vaccine prepared from *Mycobacterium bovis*, which is used to prevent tuberculosis. The vaccine was developed by Albert Calmette (French Immunologist) and Camille Guérin (French Veterinarian/Bacteriologist) and was first administered to human beings in 1921. BCG is the only vaccine against tuberculosis and an integral part of the routine newborn immunisation schedule. BCG vaccine also ensures safety against non-tuberculous mycobacterial infections like Buruli ulcer and leprosy



CONCLUSION

The eradication of smallpox in humans using cowpox vaccination by Edward Jenner, and protection of humanity against tuberculosis using BCG vaccine, which is an attenuated live vaccine prepared from *Mycobacterium bovis* demonstrate the intricate linkage between human and veterinary medicine. In fact, the eradication of smallpox in humans became the blueprint for the eradication of Rinderpest and

Contagious Bovine Pleuropneumonia (CBPP) in cattle, thereby underlining the fact that human and veterinary medicine can synergistically address public health challenges.

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