Edward Jenner

The Smallpox Vaccination.

George Barr
2008

Contents.

Plan.

I am going to investigate the life and work of Edward Jenner, primarily his work on the smallpox vaccine. There are several questions I would like to answer in this report. These are:

- What is smallpox?
- Who was Edward Jenner?
- How do vaccinations work?
- How did the W.H.O. bring about the end of smallpox?

Brief History of Smallpox.

What is smallpox? It has probably been one of the deadliest diseases that man has encountered. It is estimated 500 million people died from it in the 19th Century and 300 million in the 20th Century, with around a third of survivors being left blind. This disease is believed to have affected populations for thousands of years including causing the death of several Pharaohs.

Many natives in North and South America and Australia were affected by the disease when European travellers brought the disease with them. This was mainly due to the inability of new populations to cope with the new deadly disease. The disease usually takes 10 to 12 days to appear, initially as a fever and then the characteristic rash (see Figure 1) all over the body. The rash/lesions are painful to touch and quickly develop into the final stage, pus filled and highly infective. The disease is spread to others through the bursting of the pus filled lesions.

Figure 1 Progression of smallpox

They will then crust over, at this point most people think they are getting better when in fact they are at their most vulnerable, those infected are likely to suffer total immune system shock. Once all of the lesions have fallen off, the patient is no longer contagious and should recover. Even if it is survived, smallpox can often leave the victim disfigured by scarring at the lesion sites, if these sites are surrounding the ocular region loss of sight is likely.

The life and work of Edward Jenner.

Figure 2

Edward Jenner (17 May 1749 -26 January 1823)

Edward Jenner was born in 1749, in Berkeley Gloucestershire, and at the early age of 13 started an apprenticeship with a local medical practice near Bristol. He studied there until the age of 21, at which point he left for London and studied under one of the leading surgeons, John Hunter. At this stage, he already had a great interest in many areas, including Natural Science. Hunter died two years later, ending Jenner's apprenticeship, but his enthusiasm for Natural Science left a lasting impression on Jenner. He devoted many hours to in-depth study and classification of the new species that Captain Cook brought back from his first voyage

Jenner also spent some time refining his surgical techniques before returning to Berkeley to run his medical practice and surgery. This was unusual, as few people were skilled enough to enable both to be run from one doctor's practice.

Edward Jenner also joined and formed several medical societies that met to read and discuss medical papers. Jenner himself contributed several papers on Angina pectoris, Valvular diseases of the heart and Cowpox.

Another major piece of his work was a study into cuckoos and the development of the theory that a newly born cuckoo pushes the host eggs from the nest, not the adult cuckoo as many people thought at the time. This theory was confirmed in the 20th Century with the use of video recording equipment.

Jenner had heard during his apprenticeship that many of the cow girls who had suffered cow pox had natural immunity to smallpox and decided that there may be some link so he began to investigate further.

It was already widely known that survivors of smallpox were immune to re-infection and so it was safe for them to care for new sufferers of the disease. Jenner thought there might be some way of protecting against smallpox, by infecting someone with the cowpox virus, which is not fatal to humans. In 1796 Jenner decided to test his theory and found a dairymaid with fresh cowpox lesions. He took some pus from the lesions and infected a young boy with the disease. The boy had a fever for a few days and was indisposed, but by the next day the boy had recovered and felt fine. The next step was to test if the boy was now immune to the smallpox virus. The boy

was exposed to the smallpox virus but no disease was noted. At a later date, Jenner exposed the boy again to the disease with the same result. This proved that this method of using cowpox virus was successful at providing lasting protection against smallpox.

Prior to this, the only way to try to prevent smallpox was by variolation, which involved infecting a person with a small amount of Smallpox virus and hoping the person would not be too badly affected. The mortality rate for this procedure was about 30% which was the same as through normal exposure, this was therefore not a common practice by doctors.

Jenner brought his findings to the medical authorities once he had carried out more experiments and had more thorough findings and results to present. After extensive peer review, the findings were accepted and in 1840, after Jenner's death, the government banned variolation in favour of his method, this was to become known as vaccination and was freely provided. Jenner's pioneering method is the basis of all Public Health vaccination programmes today.

Modern vaccination and the eradication of smallpox.

It is now known how the vaccination process works, the basic theory behind it is that the body's immune system can recognise a disease previously encountered. It therefore, can create the antibodies that it requires to fight the virus more quickly, and generally the person will not even know that they have been exposed. Shown in the graph the second response is much faster and produces more antibodies.

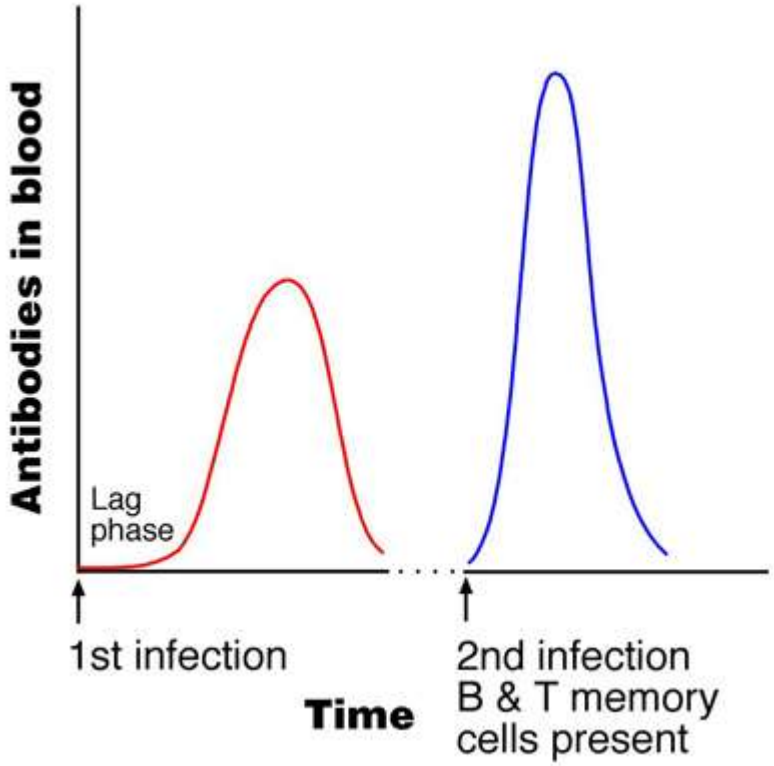

Figure 3 Effect of vaccination on antibody production

In 1967 the World Health Organisation decided to attempt eradication of smallpox, this was made possible by the development of a new way of producing and transporting the vaccine. The main features were the ability to produce large amounts of high quality vaccine throughout the world and maintain its efficacy by freeze drying. This allowed it to be easily stored and transported, previous versions of the smallpox vaccine were susceptible to contamination and had to be used within 48 hours of production.

The bifurcated needle was also another vital development in the fight against smallpox.

Figure 4 Smallpox vaccine and bifurcated needle

Development of a stable vaccine was only a small part of W.H.O.'s plan, the major problem was going to be the implementation of the vaccination process. Instead of just mass vaccination, a regime of monitoring and control allowed the teams to contain any outbreaks as they happened. There were several processes used to locate and monitor outbreaks, these included smallpox recognition cards and containment books which were developed by the field staff. These staff also had a much higher level of training to enable them to detect and counter outbreaks of smallpox, even in remote jungle villages.

After a decade of this intensified vaccination and containment process, the last case of smallpox was reported in Somalia in 1977. This heralded a huge victory over one of the most deadly diseases that has afflicted the human population.

Now the only stores of the virus are kept in vaults in the United States and Russia, that, however, is another story.

Conclusion.

I have chosen Edward Jenner as my hero for several reasons. These include his constant search for knowledge and new experiences, his dedication and effort to try and find a way of saving lives form smallpox and his courage to persevere with new processes that he had to develop. I admire his conviction that what he was doing was going to make a difference to people's lives. The feats he achieved during his lifetime have saved a huge number lives throughout the world, not just from smallpox, and will continue to do so for many years to come.

Evaluation.

There was useful information available about smallpox, what it is and how it affects people. There was very little data on death or survival rates which I could collate to form tables or graphs.

I found it very interesting researching and finding out about Edward Jenner, the person, his smallpox/vaccination process but also his theories concerning cuckoos. The cuckoo theory was particularly fascinating; I was unaware that such a pioneer in the field of medicine also contributed much to the study of Natural Science.

Valuable information was available to show how vaccinations help the immune system's response to fight viruses.

Many logistical problems had to be overcome to implement the vaccination programme that brought about the end of smallpox, along with many innovative developments in the vaccination itself. The medical community, W.H.O. and many governments worked together to achieve a common goal, the eradication of a single disease. They proved that the improbable was achievable; it makes me wonder how many more diseases could be eradicated with sufficient funding and the desire to do so.

References.

Wikipedia.

BBC Website.

World Health Organisation.

CDC.