

Smallpox vaccination: an early start of modern medicine in America

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ABSTRACT

Smallpox was eradicated by the World Health Organization in 1980. Before its eradication the disease had a mortality rate upwards of 50% and had a significant impact on society. During the American Revolutionary war, smallpox outbreaks were impeding the American war effort until 1777 when George Washington carried out a mass inoculation campaign in the Continental Army that reduced the mortality from smallpox to less than 2%. Inoculation was an early form of vaccination that used live virus from active pustules to induce a milder, but still sometimes deadly, case of disease. Washington has been credited with helping to ease the burden of smallpox on the Army which improved the odds of success against the British. When Edward Jenner's vaccine reached America it was more readily accepted by political and medical leaders due to the success of Washington's inoculation campaign. The Founding Fathers argued that smallpox vaccination was the greatest discovery in modern medicine and they were likely correct that it helped to usher in the modern era of vaccinology.

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Infectious diseases remain the leading cause of death in the developing world. In the United States, heart disease has surpassed infectious diseases, but this change has only occurred in the last century [1]. In early America, as in the modern day low-income countries, the greatest threats to life were diarrheal and respiratory illnesses, but in the 18th century they had the added threat of the now eradicated smallpox. When the smallpox vaccine was first introduced to America in 1800 by Benjamin Waterhouse, a friend of the British discoverer of the vaccine Edward Jenner, it was welcomed by the Founding Fathers [2]. They hoped it would finally put to rest the dreaded disease that had ravaged the Continental Army during the Revolutionary war. The Founders argued that smallpox vaccination was the greatest discovery in modern medicine and they were likely correct that it helped to usher in the modern era of vaccinology [3].

Before the introduction of smallpox vaccination by British physician Edward Jenner, western medicine was in a veritable dark ages, helpless against nearly all diseases that afflicted man. Thomas Jefferson had such little faith in the practice of medicine that in 1799 (a year before the introduction of the vaccine to America) he wrote, 'the state of medicine is worse than that of total ignorance' [4]. There was no germ theory to guide the understanding of the spread of infectious diseases and physicians had very little training or tools at their disposal. Most treatments involved either blood-letting or ingesting toxic materials such as mercury or antimony. Jefferson

compared the theories and practices of medicine to the 'fashions and fancies of caps and gowns,' always 'yielding in turn to the next caprice' [4]. Jefferson's frustration at the failings of medicine likely stemmed partly from the devastation from disease, most prominently from smallpox, dysentery and typhoid fever [5], that his fellow revolutionaries faced during the War from 1775–1781.

The Revolutionaries were fighting diseases such as smallpox as much, if not more, than they were fighting the British in their effort to gain independence. John Adams wrote to his wife Abigail in 1777 that 'for every soldier killed in battle, disease killed ten' [6]. This ratio of battle deaths to disease deaths was substantiated in other historical documents. Historians estimate that soldiers died from disease at a rate of 180 per 1000 per year with a total mortality over the seven years of conflict of at least 63,000 deaths from disease and 7000 deaths from direct military conflict [5].

Of all the diseases crippling the Continental Army, smallpox was one of the greatest threats because in non-immune hosts it had a mortality ranging from 10 to 60%. These numbers were fairly consistent from the 18th century until the eradication by the World Health Organization in 1980 [7,8]. While 18th century writers were often prone to hyperbole, such mortality rates are likely, since one of the most recent smallpox outbreaks in 1960 Madras, India saw a mortality of 43% [9].

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George Washington and other Founders recognized the severity of smallpox and its threat to their independence and took all measures at their disposal to contain the spread of disease. In 1777 Washington ordered the inoculation of all men in the Continental Army against smallpox. He feared that ‘no precaution can prevent [smallpox] from running through the whole of our Army,’ and he felt that ‘necessity not only authorizes but seems to require the measure [inoculation], for should the disorder infect the Army in the natural way and rage with its usual virulence we should have more to dread from it than from the Sword of the Enemy’ [10].

The practice of inoculation at the time carried much greater risks than the most dangerous vaccine today. The process involved taking the pus from an active smallpox lesion and inoculating it under the skin of a healthy patient [11]. The goal was to induce a milder case of disease and contemporary sources all suggest it did reduce mortality from 10–60% down to 1–2%. Despite the relative safety compared to naturally acquired smallpox, it still carried risks, in addition to death, of disseminated smallpox leading to outbreaks in the community and transmission of other blood-borne diseases such as syphilis [12].

Washington’s mass inoculation effort coupled with strict quarantine, while certainly risky, was credited with minimizing the mortality from disease and bolstering the morale of the troops by offering them a defense against the pox. Dr. Benjamin Rush, Surgeon General to the Continental Army and signer of the Declaration of Independence, stated in 1781: ‘the small-pox which once proved equally fatal to thousands, has been checked in its career, and in a great degree subdued by the practice of inoculation’ [5].

In 1798, Edward Jenner realized that cowpox, a harmless relative of smallpox, offered protection against smallpox and developed the first vaccination. In 1800 when Boston physician Benjamin Waterhouse introduced the cowpox vaccine to America, the success of Washington’s inoculation campaign of 1777 encouraged Americans to accept Jenner’s safer version [12]. Thomas Jefferson, the harsh critic of modern medicine in 1799, would now, as the third President of the United States, praise Jenner and Waterhouse for their contributions to modern society. He promised to introduce the vaccination to his estate at Monticello and to the American public because ‘it will be a great service indeed rendered to human nature to strike off the catalogue of its evils so great a one as the small-pox.’ Of all the medical discoveries, Jefferson knew ‘of no one discovery in medicine equally valuable’ [3].

In an age when there was much disagreement among physicians, the effectiveness of vaccination brought together the medical establishment in support of a common truth. The Philadelphia Dispensary released a statement of 50 physicians, including Benjamin Rush,

in 1803 that compared contracting smallpox to ‘attempting to cross a large and rapid stream by swimming, when one in six perish,’ whereas vaccination was equivalent to ‘passing over a safe bridge.’ They wrote that it was their duty ‘publicly to declare our opinion that [vaccination] is a certain prevention of the small-pox [and] therefore recommend it to general use’ [13].

The method of vaccination quickly gained the favor of the medical and political establishments and in 1813 President Madison signed ‘An Act to Encourage Vaccination’ that created the United States Vaccine Agency and required ‘the postal service to carry mail containing smallpox vaccine materials free of charge’ [14]. While it would take over 150 years to finally eradicate smallpox worldwide, the early American experience intertwining medicine and public health with military and government organizations laid the groundwork for subsequent disease eradication efforts in the United States and abroad.

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