

## Letter to the Editor

### Smallpox: leaving its mark on public health

Sir,

Smallpox was one of the most lethal human pathogens in history.<sup>1</sup> It originated around 10,000 years before common era (BCE) in North-eastern Africa, and spread world-wide through human migration and increasing population densities with periodic epidemics throughout the world.<sup>2</sup> By the middle of the 18<sup>th</sup> century, around one million Europeans each year were contracting the disease with approximately one third of adults and 90 percent of infants succumbing to it.<sup>3,4</sup> The mortality rate in the immune-naïve populations of the Aztecs and the Incas were as high as 90%.<sup>5</sup> Survivors were left with disfiguring scars and one third were blinded. After the bubonic plague, it was the most feared disease.<sup>4</sup> It affected the outcome of many wars, conquests and the development of many civilisations.<sup>6,7</sup>

Knowledge of the disease and response to it by early civilisations developed largely independently – from superstitious and erroneous beliefs, to isolation and finally to inoculation. Goddesses in China and India were attributed to the infection of, and protection from, the disease.<sup>8</sup> In medieval Europe, quack treatments and beliefs prevailed.<sup>9</sup> The transmission of smallpox was known to be increased with prolonged and close contact with others and that outbreaks could result if it was introduced into a new population.<sup>2,9</sup> It was also known that smallpox was introduced into the Americas in the 16<sup>th</sup> and 17<sup>th</sup> centuries by human movement from Europe and Africa, which aided in the conquering of these continents. Knowledge of its spread and devastating effects on populations also saw its use in warfare.<sup>10</sup>

Evidence of containment or isolation of individuals infected with smallpox date back to the 12<sup>th</sup> century BCE.<sup>11</sup> In England, infected individuals were restricted by local authorities to stay within their households, markets were closed and pest houses (originally used for plague epidemics) were used during smallpox outbreaks.<sup>1</sup> Another preventative measure centred around inducing immunity in individuals artificially. It was known, from as early as the 5<sup>th</sup> century BCE, that people previously infected with smallpox were immune from re-infection.<sup>12</sup> By the 16<sup>th</sup> century, artificial immunity through inoculation was performed in China and India. This involved introducing smallpox matter from an infected individual into a non-infected individual. By the early 18<sup>th</sup> century, these methods were known in England, but this preventative procedure was met with resistance by the royal society. This may have been reasonable however, as

the risks of inoculation included contracting smallpox, contracting other infectious diseases (such as tuberculosis and syphilis), and death. It was only after the risks and benefits of inoculation were quantified that it became a common and acceptable method of prevention in England. This was shown in a study that used comparative statistics (possibly for the first time) to evaluate a medical procedure.<sup>13</sup> Further acceptance came after the Royal Family effectively endorsed the procedure by inoculating two daughters of the Prince of Wales.<sup>3</sup>

In England, isolation and inoculation were implemented and paid for at a local level by individual parishes. The impetus for this was most likely financial as an outbreak in a community would result in loss of income and taxes, and parishes were required by law to provide for and support the poor. From the middle of the 18<sup>th</sup> century inoculation of whole communities was being performed by these local parishes. In the early 19<sup>th</sup> century a central governing body was established to outlaw inoculation after a safer and more effective vaccination had been developed. By the middle of the 19<sup>th</sup> century, smallpox had become a relatively minor cause of death.<sup>1</sup>

Given the success of the public health measures in reducing the spread of smallpox (and the actual eradication of the disease in the 20<sup>th</sup> century), the history of smallpox serves as a good example of the evolution of disease knowledge and response by societies. Comparing the smallpox epidemic with the HIV/AIDS epidemic reveals many similarities and highlights lessons learned and progress made. HIV/AIDS was initially met with a lot of fear and superstition but research and education minimised this.<sup>14</sup> Access to treatment by the poor was initially constrained by the interests of government and private organisations, but modelling and global agreements saw these treatments accessible worldwide by the poor only years after they were developed.<sup>15,16</sup> It took centuries from discovery to widespread use of inoculation for smallpox, whereas now, treatments are formally evaluated and can be fast-tracked.<sup>17</sup> Today, the current treatment and prophylaxis for HIV prevents transmission to low levels, raising the possibility that it too may be eradicated one day.<sup>18</sup>

The history of the smallpox pandemic demonstrates that public health measures have been used by societies for millennia and that public health is a natural consequence of human civilisation. It also shows that the public health measures used in the past are fundamentally the same as today, and our current public health responses have

grown from these foundations. As a result, the time from identification of a major infective disease to the control of the disease at a global level has reduced from thousands of years to decades.

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