Cuckoos, cows and a country doctor: The pioneering work of a rural health professional in the development of public health

Vicki Saunders *MPH* and David N. Durrheim *DrPH, MBChB*

Introduction

The work of Edward Jenner may not be well known outside of medical and infectious diseases circles and yet his contribution to public health changed the world and altered the course of history. A 'simple' country doctor, he is best known for his work on proving and popularising inoculation with cowpox as an effective and safer way to protect people against smallpox. His work led to the development of smallpox vaccination and eventually to public health's greatest triumph, the announcement by the WHO in 1979 that smallpox had been eradicated. As an early public health pioneer, Jenner demonstrated how powerful the hypothetico-deductive scientific method could be, particularly during a period in which medical knowledge and technological ability were limited. The contribution of Jenner to public health, his work, his life and the struggle to convince his critics provides important lessons for today's rural health professionals.

The scourge of smallpox

In 1979 the World Health Organisation (WHO) announced that smallpox had been eradicated. This declaration marked the greatest single achievement in the history of communicable disease control and Public Health, "*the discipline concerned with knowledge about the health of the populations and organised efforts to protect community health*" (Henderson, 1994; Coreil et al., 2001).

Smallpox is an ancient disease that may have originated in early North African agricultural settlements around 10,000BC. There is obvious evidence of smallpox scarring on the well-preserved mummy of Ramses V who died in 1,157 BC (Barquet & Domingo, 1997). Smallpox pandemics shaped the course of history, with the collapse of at least three empires attributed to the impact of smallpox (Zinsser, 1935). The epidemic of 180 AD killed between four and seven million people and triggered the demise of the Roman Empire, while introduction of smallpox into the New World by Spanish and Portuguese invaders resulted in the collapse of the Aztec and Inca Empires (Zinsser, 1935). In 1518, when the Spanish arrived in Mexico, there were 25 million inhabitants but within a hundred years the population was reduced to only 1.6 million principally as a result of smallpox.

Smallpox affected poor and wealthy, paupers and royalty alike. Influential ruling European families were prominent victims and during the first half of the 18th century an English queen, Austrian emperor, Spanish king, Russian tsar, Swedish queen and French king all succumbed to smallpox (Hopkins, 1983).

The disease has a high case fatality rate, exceeding 20% and during the 18th century, it is estimated that a quarter of the European population was killed, blinded or permanently scarred and disfigured by smallpox (Hopkins, 1983). The horror that smallpox held for individuals and society is eloquently captured by the historian Macauley, "Smallpox was always present, filling the churchyard with corpses, tormenting with constant fear all whom it had not yet stricken, leaving on those whose lives it spared the hideous traces of its power, turning the babe into a changeling at which the mother shuddered, and making the eyes and cheeks of the betrothed maiden objects of horror to the lover" (Macauley, 1800).

Epidemics were traditionally met with fervent prayer, fasting, panic and isolation of those with obvious dermatological manifestations (Bloch, 1993). Inoculation (variolation) of material from lesions of patients with mild disease into the nose or skin was practiced from ancient times in Asia, Africa and China, as it was recognized that this provided protection against smallpox. Lady Montagu, the wife of the British Consul to Turkey, introduced skin inoculation into Western Europe in 1721 (Miller, 1954). She had personally been scarred by smallpox and when she encountered variolation in Constantinople she insisted on having her five-year old son inoculated. She became a great protagonist of this procedure in England.

Unfortunately two to three percent of variolated persons developed full-blown smallpox and died (Parish, 1965). Others became the source of new epidemics or developed other illnesses as a result of inoculation with contaminated material.

Medical science in the 18th century

The 18th century was a period of enormous change in medical practice. The philosophy of materialism, that diseases could result from physiological dysfunction and a belief that "truth" could be discovered by investigations into the chemical and material structure of the body, became increasingly popular (Loudon, 1997). The burgeoning practice of post-mortems resulted in expanded anatomical and pathological knowledge and influenced disease categorisation. Doctors training became increasingly institutionalised and hospital-based, and there was a rapid growth in the number of formally educated and certified practitioners, with attendant development of professional bodies and increasing use of printed media to communicate medical knowledge.

This period, often referred to as "the Enlightenment", was characterised by intense intellectual debate and a belief that the world could be changed "through the gospel of Reason" (Loudon, 1997). This contrasted with the prevailing ignorance and superstition of the politico-religious establishment, and folk traditions.

Theories about smallpox causality were also undergoing change, with a shift from a belief that smallpox arose from innate seeds present in all humans or from unfavourable environmental conditions, to a view that smallpox was a specific disease that could be attributed to a specific material cause (Hopkins, 1983).

A vicar's son and medical student

Edward Jenner was born on 17 May 1749 in the small market town of Berkeley in Gloucestershire, the youngest of six children of the local vicar and his wife (Fisk, 1959). At 13 years of age he was apprenticed to a country surgeon and in 1770 he travelled to London where he began his formal medical education at St George's Hospital. Here his teacher was Dr John Hunter, a leading surgeon and a pioneer in critical assessment of the basis of medical practice.

John Hunter had a profound influence on Jenner's life. Not only did he insist that the young physician ensure that his medical practices were based on evidence but he fostered Jenner's great love of nature, encouraging him to assist Joseph Banks with classifying the botanical material collected by James Cook during his first expedition. Jenner's performance was exceptional and he was invited to join Cook's second expedition as a botanist (Bailey, 1996). He however decided to return and establish a rural general practice in Berkeley during 1772.

Hunter continued to mentor Jenner, predominantly by written correspondence, inspiring his experimentation and writings in natural history and medicine throughout his life. His general approach is aptly captured in a response to a Jenner hypothesis about hedgehog body temperature during hibernation; "I think your solution is just; but why not try the experiment" (Royal College of Surgeons of London, 1976).

The country doctor and natural scientist

From all accounts Edward Jenner was a well respected, kind and friendly country doctor, and as is often the case with rural health professionals he was involved in all aspects of local community life (Saunders, 1982). His poetic ability and passion for playing the flute and violin playing made him very popular. He married Catherine Kingscote in 1788 and they had three children.

His aptitude for raising and addressing diverse scientific questions was legendary, ranging from making the original association between angina pectoris and changes in coronary arteries at autopsy to determining the value of blood as manure, on the request of Sir Joseph Banks. However, it was his observations on the natural history of the cuckoo, published on the urging of John Hunter in 1788 that led to his election as a Fellow of the Royal Society, the highest scientific honour of his day. Jenner's study of cuckoo migratory patterns revealed that they remained in England for only 11 weeks, while their young required 15 weeks to achieve independence. His observations of cuckoos' unusual behavior of laying their eggs in the nests of hedge sparrows with the subsequent ejection of host sparrows' eggs or nestlings by the young cuckoos on hatching by means of depressions on their backs, that disappeared by the 12th day of life, were extraordinarily accurate.

A brilliant mind

Jenner was an astute observer and listener, traits that should characterise all successful rural health workers. In 1778 a milkmaid purportedly told Jenner that she would not contract smallpox because she had cowpox (Barquet & Domingo, 1997). This was common folk wisdom in dairy farming areas with a widespread belief that cowpox, a disease manifesting as lesion on cow udders that was occasionally contracted by humans particularly dairymaids, conferred immunity against smallpox. Jenner began studying this phenomenon and noted that people who reported previous cowpox lesions appeared protected during local outbreaks of smallpox. He decided to formerly test whether inoculation with cowpox was effective, believing that it would be safer than variolation since cowpox in humans appeared to be benign. Thus on 14 May 1796 he extracted fluid from the cowpox pustule on the hand of Sarah Nelmes, a dairymaid, and inoculated eight-year-old James Phipps through two half-inch incisions on his arm with the fluid (Bloch, 1993). The boy developed local vesicles and a mild fever from which he soon recovered. On 1 July 1796 Jenner inoculated James with smallpox material and the inoculation did not take. He repeated a smallpox inoculation again a few months later without effect.

In June 1798 he published this discovery, at his own expense, in a 75-page book, "*An Inquiry into the Causes and Effects of the Variolae Vaccinae, a Disease, discovered in some of the Western Counties of England, particularly Gloucestershire, and known by the name of Cow Pox*." He presented evidence that cowpox material could be transferred through four generations and provide protection against challenge by variolation; "These experiments afforded me much satisfaction, they proved that the matter in passing from one human subject to another, through five gradations, lost none of its original properties" (Bailey, 1996). He went further, hypothesising that the origin of cowpox was inflammation on horses' heels, called "grease" by farriers, that was introduced into dairies by people caring for horses. Milking of cows then resulted in udder infection and subsequent spread of infection onto the hands of dairymaids. Despite scientific dismissal of the grease theory, recently there has been renewed interest that vaccinia virus may well have originated from a now extinct equine virus (Bailey, 1996).

Jenner's careful observation allowed him to differentiate a milder condition on cow udders from "true cowpox" (Baxby, 1999). The former only rarely spread to dairymaids' hands and did not provide immunity against smallpox. When he published "*Further Observations on the Variolae Vaccinae*" in 1799 he had determined that vaccination failure might occur if material was taken from too old a lesion or when "grease" from a horse was directly inoculated. He also demonstrated that cowpox matter dried on a quill or piece of glass remained effective for vaccination for up to three months.

By 1800, when he published "*A Continuation of the facts and observations relative to the Variolae Vaccinae or Cow Pox*", more than 5,000 people had been successfully vaccinated and Jenner had established that the small minority who developed a generalised rash following vaccination had probably received material contaminated with smallpox virus.

The struggle to gain acceptance

Jenner's conclusive work on the efficacy and safety of cowpox vaccination in preventing smallpox, did not receive universal acclaim. When he attempted to present his findings to the Royal Society, that had elected him a Fellow for his work on cuckoos, he was scorned as his research was "in variance with established knowledge, and is incredible" and was warned to "…not promulgate such a wild idea if he valued his reputation" (Bailey, 1996). The medical fraternity was polarised. There was strong opposition from those practitioners whose income from variolation was threatened by the new discovery, while an Honorary Doctor of Medicine degree was awarded to Jenner by Oxford University.

Community opinion was also divided, with opposition from certain religious leaders decrying the "bestial" cowpox material and rumours spreading of vaccinees sprouting horns. However hundreds of grateful recipients queued for free vaccination outside "The Temple of Vaccinia", the bungalow built in Jenner's garden for this purpose by Reverend Ferriman. Within two years of his publication of the "Inquiry", 100,000 people had been vaccinated in Europe and a decade later cowpox vaccine was widely used throughout Europe, the Middle East, the Americas, India, China and Australia (Porter, 1999).

The British Parliament was indecisive initially. Despite granting Jenner £10,000 to establish a society to promote vaccination in 1892, when a bronze statue of Jenner was erected on Trafalgar Square in 1858, Parliament took exception; "Cowpox was a very good thing in its proper place, but it has no place among the naval and military heroes of the country", and so it was removed (Anon, 1858a).

The greatest accolades came from other historical giants. Louis Pasteur paid Jenner a wonderful tribute in an 1891 address to the International Medical Congress in London when he extended the term "vaccination" to other immunisation agents, "as a homage to the merit of and to the immense services rendered by one of the greatest of Englishmen, your Jenner" (Mellanby, 1949). Napoleon Bonaparte had the highest regard for Jenner and vaccination. When Jenner wrote to request the release of an imprisoned British officer, Napoleon's response was, 'Anything Jenner wants shall be granted. He has been my most faithful servant in the European campaigns.' Napoleon had all his troops vaccinated in 1805 and all French civilians a year later. Sir Christopher Wren said of Jenner, in memoriam after he died of a stroke on 26 January 1823, "His glory shines in every fresh and healthy face…his monument is not in one cathedral but in every home" (Anon, 1858b).

Lessons for rural health professionals

Although it is clear that Jenner did not discover vaccination, the work of this rural general practitioner in establishing its scientific merit and popularising its application laid the foundations for public health's greatest triumph. He clearly grasped the greater potential of vaccination, writing "... it now becomes too manifest to admit of controversy, that the annihilation of the smallpox, the most dreadful scourge of the human species, must be the final result of this practice" (Jenner, 1801).

There are important lessons that today's rural health professionals can glean from Jenner's colourful life. At a time when medical knowledge and technology was limited, Jenner demonstrated how powerful the hypothetico-deductive scientific method could be (Hopkins, 1983). This approach of carefully making observations, organising these observations into a hypothesis, testing the hypothesis, modifying it to make predictions based on the modified hypothesis and then testing those predictions, is what continues to shape the majority of advances in rural public health.

An important characteristic of Jenner's contribution to smallpox eradication was his perseverance despite considerable opposition to his ideas. In advocating the expansion of vaccination, he showed "the wisdom of one well-versed in the disposition of men and the knowledge of such modes of conviction as are most acceptable to the human mind" (Saunders, 1982). Thus, while only a "simple" country doctor with little social standing, he was politically astute and able to effectively mobilize support amongst influential allies, a skill unfortunately despised by many rural public health practitioners which may explain why many novel and potentially useful public health measures are never introduced.

The encouragement, advice and coaching provided by a good mentor, in Jenner's case John Hunter, despite distance should inspire the present generation of rural health practitioners to seek inspirational mentors, possibly amongst university academics, like Jenner.

Rural health workers should not despise traditional wisdom but be prepared to learn from their patients and objectively evaluate potentially valuable alternate approaches. The answer to many intractable public health conundrums may already be within our grasp, if we are prepared to listen, observe, experiment and demonstrate great resolve to implement our findings.

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