Temperature charts from Bombay

Harry YJ Wu, MD, DPhil
Medical Ethics and Humanities Unit, Li Ka Shing Faculty of Medicine, The University of Hong Kong
Invited author, Education and Research Committee, Hong Kong Museum of Medical Sciences Society

The temperature chart, sometimes referred to as fever chart, represented a turning point in the progress of medicine from superstition to science. In the days before advances in anatomical, physiological and pathological knowledge, medical practitioners tried numerous methods to understand the function of the body and the causes of disease, especially infectious disease. A powerful tool in its day, the temperature chart led researchers to the germ theory. Its significance in clinical practice was epitomised in the lines in TS Eliot's poem, *East Coker*,

> "The sharp compassion of the healer's art
> Resolving the enigma of the fever chart."

The French Revolution stimulated enlightenment in the 18th century; materialism in medicine followed that would provide the infrastructure of empirical reasoning and rational dialogue among academics, governments, and society.[1] Stethoscopes and case records at state-owned hospitals, as well as temperature charts, all helped to make disease profiles more identifiable and distinguishable. These innovations originated in the so-called Parisian school of medicine that started using new diagnostic instruments and methods to study disease in the 19th century. Among these, temperature charts were an important tool for clinicians, as they could reveal the characteristics of different fevers, including enteric fever, Malta fever (brucellosis), rat-bite fever, cholera, malaria, and dengue fever. Their use in research led to the acceptance of the germ theory in the closing decades of the 19th century, their value to project clinical observations on diseases with graphical methods being, in Patrick Manson's words, "universally admitted". "They facilitated the recording, and still more the comprehension and comparison, of the facts in the clinical tableau."[2] Clearly, the chart provided a valuable common language, not only for scientific correspondence but also in public health reports.

There are three temperature charts of plague patients in the collection of the Hong Kong Museum of Medical Sciences, along with a letter, dated 9 April 1897, from Nusservanji H Chosky, an Indian doctor in Bombay, the capital city of the Indian state of Maharashtra nowadays known as Mumbai. Chosky was originally a Medical Officer of the Maratha Hospital but later appointed Assistant Health Officer in charge of plague operations.[3] The letter was addressed to James Lowson, Acting Medical Superintendent at the Government Civil Hospital of Hong Kong. The letter describes the use of Alexandre Yersin's anti-plague serum in three patients diagnosed with bubonic plague at the Jain Hospital with different outcomes; one 36-year-old Hindu man went into remission (Fig a) but two other teenagers, one Christian (Fig b) and the other from the Jain religious community, died within 2 days of admission.

Bombay, a cosmopolitan emporium of manufactured goods, could not exempt itself from the invasion of bubonic plague in the late summer of 1896, two years after the outbreak in Hong Kong. Although the disease's transmission remains under debate, these infected cities directly and indirectly proved the significance to public health of inter-city mobility and trading.[4] While colonial port cities became nodes in the infrastructure of modernity, they also became foci of infectious diseases. The plague arrived in Bombay in the late summer of 1896. It was suspected that the railway system, while transforming Bombay by stimulating better urban planning, housing conditions and drainage systems, unfortunately accelerated the spread of the disease, an idea that had not been applied to the outbreak in Hong Kong.[5] Although it is unclear why Chosky wrote to Lowson, their correspondence reveals how scientists networked with each other in their response to the third global plague pandemic. After suffering from the epidemic for 2 years, Hong Kong could provide useful experience for health professionals in India. After reviewing the fever patterns shown on the temperature charts, Chosky wondered his patients in Bombay responded differently to Yersin's serum compared with those in China (Hong Kong). The serum was jointly developed by Yersin and another Pasteur school bacteriologist, Emile Roux, and is referred to as Yersin-Roux serum in most historical accounts. These documents not only reveal that international scientific networking had already started in Asia, beyond the reach of the Europe-centred International Sanitary Conferences, but that large-scale clinical trials had already been conducted, despite the underdeveloped methodology of the day.

In Bombay, scientific activity on bubonic plague was preceded by the 1894 discovery of *Yersinia pestis* in Hong Kong, where research teams from the Koch and Pasteur Institutes competed

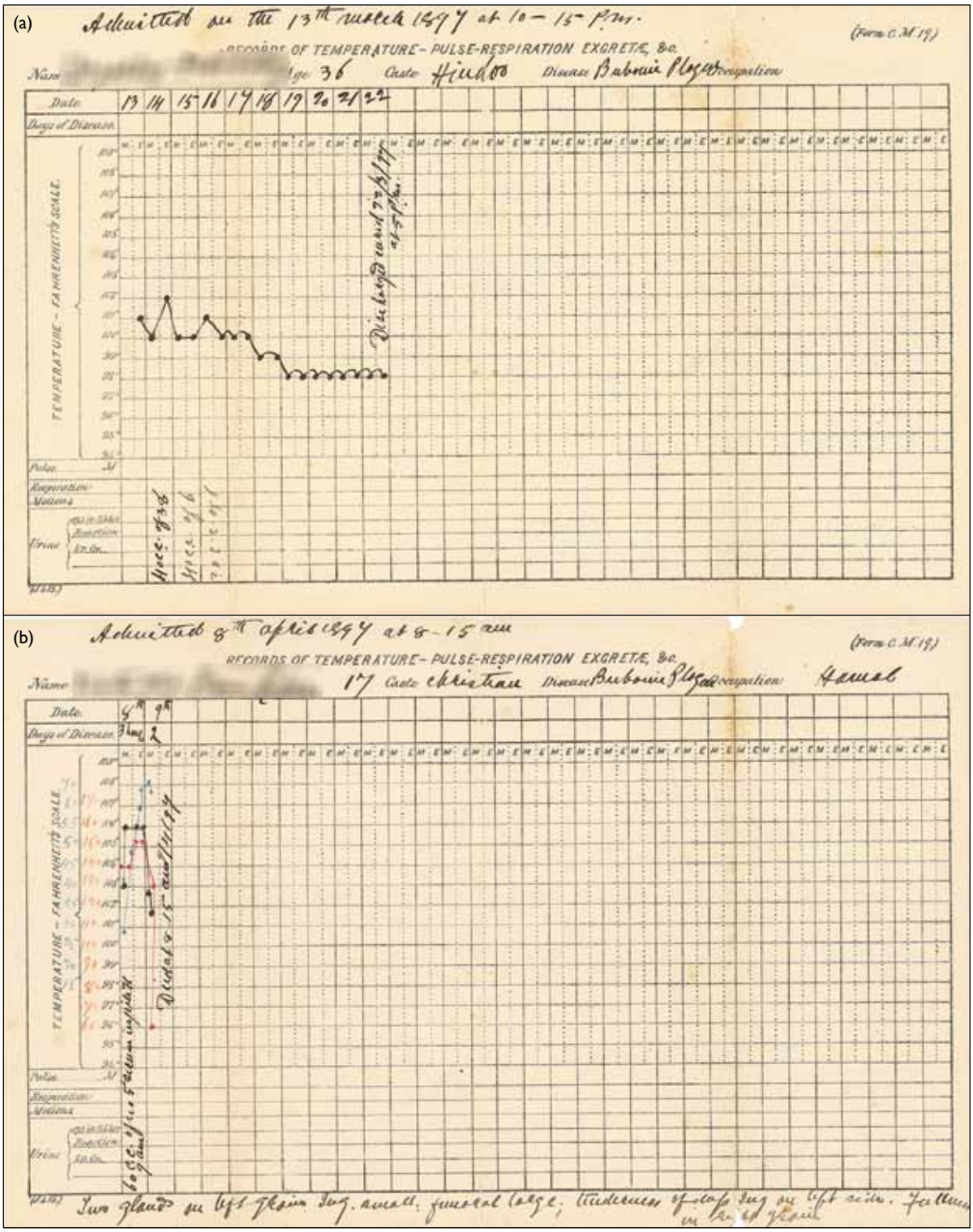

FIG. The temperature charts of two of the patients treated by Dr NH Chosky in Bombay in 1897; the patient in (a) recovered following three injections of plague antiserum, and the patient in (b) died without showing a response to the antiserum

The charts were donated to the Hong Kong Museum of Medical Sciences in 1996 by Mrs Ashburner, granddaughter of Dr James Lowson

head-to-head. Although personally favouring Shibasaburo Kitasato's work over that of Alexandre Yersin, who arrived 3 days later, James Lowson did not allow the undercurrent of rivalry to prevent him from networking with all the scientists to achieve an effective response[6] (an anecdote is described of how James Lowson passed Yersin's bacteria samples to the Japanese[7]). The plague in Hong Kong had stimulated the 'golden age of bacteriology' as Hong Kong became the hub for not only the study of pathology

of bacterial infection but also vaccine development. In less than 2 years, Bombay had also become the test bed and marketplace for various competing vaccines. In September, the Government of India asked the notable bacteriologist Waldemar M Haffkine to establish the Plague Research Laboratory where he set up experiments to study the infection routes of bubonic plague and also produced a curative serum using the Yersin method, although he later claimed that it was useless.[8] Inspired by Hong Kong's work on the infectivity of pigs, that of other livestock was studied during the Bombay outbreak. In addition, the transmission of bubonic plague via insects, eg fleas, was also investigated by different research teams in India.[3] Regarding the preventive work, the vaccines and serums (called "prophylactic fluid" at the time) that were developed in the Plague Research Laboratory and other workshops were tested in hospitals, orphanages, and jails; even slums became living laboratories. In these experiments, the most important means by which to study the outcome of inoculation was the taking and recording of the subjects' temperatures.[9]

Chosky's temperature charts are unique. As Assistant Health Officer, he not only conducted experiments on patients he recruited but also provided samples for other scientists. Most notably, he inoculated plague patients with eight vaccines developed by different scientists worldwide. Chosky confirmed Haffkine's observation that the Yersin-Roux serum was not fully effective. Having tested all eight vaccines, he eventually endorsed the plague serum developed by A Lustig, then Professor of Pathology at the Royal University of Florence. Notably, in Chosky's experiments, the subjects of the clinical trials were all native Indians and, for the first time, so was the trial leader. Although other trials were criticised for being racially discriminative, the knowledge that the leader was one of their own meant that his inoculation plans were much more acceptable to his compatriots. The addressee of the letter, James Lowson, later also stayed in India for a short period before returning to Scotland in 1933.

In many clinical settings, although our knowledge of pathology has progressed to cellular and molecular levels, the temperature chart remains relevant and in use, particularly in hospitals, to record disease progress. Public health still benefits. Members of the public caught up in the outbreak of severe acute respiratory syndrome during 2002 to 2004 in Hong Kong were taught that good self-health management should include a charted record of body temperature. Today, this may be regarded as a minor diagnostic tool, but a century ago, when scientific beliefs and levels of trust among scientists, governments and society varied enormously, the value of the chart was far greater than we can imagine.

Acknowledgement

The author acknowledges Prof Pratik Chakrabarti's help in deciphering Nusservanji H Chosky's signature.

References

1. Barnett R. The sick rose: disease and the art of medical illustration. London: Distributed Art Publishers; 2014.
2. Manson P. A malaria chart. Br Med J 1894;2:1252-4.
3. Verjbitski DT, Bannerman WB, Kápadiâ RT. Reports on plague investigations in India. J Hyg (Lond) 1908;2:161-308.
4. Harrison M. Contagion: how commerce has spread disease. New Haven, CT: Yale University Press; 2012.
5. Peckham R. Epidemics in modern Asia. Cambridge: Cambridge University Press; 2016.
6. Solomon T. Hong Kong, 1894: the role of James A Lowson in the controversial discovery of the plague bacillus. Lancet 1997;350:59-62.
7. Deville P. Plague and cholera. London: Little, Brown Book Group; 2014.
8. Chakrabarti P. Bacteriology in British India: Laboratory medicine and the tropics. Rochester: Rochester University Press; 2012.
9. Hume E. A study of one hundred inoculations against plague. Public Health Rep 1904;19:1477-83.