

Historical note

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A brief history of the clinical thermometer

Of the many tools and instruments regarded as essential to the clinical examination, none has had such widespread application as the clinical thermometer. In the time of Hippocrates, only the hand was used to detect the heat or cold of the human body, although fever and chills were known as signs of morbid processes. In Alexandrine medicine, the pulse was observed as an index of disease, superseding the crude assessment of temperature. In the Middle Ages, the four humours were assigned the qualities of hot, cold, dry and moist, and thus fever again acquired importance.

Galileo in 1592 devised a crude temperature-measuring instrument, but it had no scale and therefore no numerical readings; further, it was affected by atmospheric pressure. A large step forward was achieved by Santorio (Sanctorio Sanctorius) who invented a mouth thermometer.

Santorio (1561–1636) was an Italian physiologist, professor at Padua. He made quantitative experiments in temperature, respiration, and weight, and measured 'insensible perspiration' that laid the foundation for the study of metabolism. He wrote *De statica medicina* (1614; tr. 5th ed. 1737). He described his inventions in 1625.¹ Sanctorio Sanctorius produced several designs, but all were cumbersome and required a long time to measure the oral temperature. To this day, the time to get an accurate, stable reading remains difficult. Glass thermometers must remain in contact with sublingual tissue for 8 min. Rectal temperature takes 5 min, axillary temperatures up to 11 min.

In 1665, Christiaan Huygens added a scale extending from the freezing point to the boiling point of water, the original centigrade system. Gabriel Daniel Fahrenheit based his new scale on a mixture of ice and ammonium chloride as the lower point. He found mercury more useful than water, as it expanded and contracted more rapidly.

However, the thermometer was not in generally use until Hermann Boerhaave (1668–1738), with his students Gerard L.B. Van Swieten (1700–72),

founder of the Viennese School of Medicine, Anton De Haen (1704–76), and separately George Martine,² started to use the thermometer at the bedside. De Haen studied diurnal changes in normal subjects and observed changes in temperature with shivering or fever, and he noted the acceleration of the pulse when temperature was raised. He found that temperature was a valuable indication of the progress of an illness. But his contemporaries were unimpressed, and the thermometer was not widely used.

In 1742, the Swedish astronomer Anders Celsius reintroduced the centigrade scale into practice, but despite improvements in design of the thermometer, its use remained largely neglected until the late 19th century.

In 1868, Carl Wunderlich³ published temperature recordings from over 1 million readings in over 25 000 patients made with a foot-long thermometer used in the axilla. He established a range of normal temperature from 36.3 to 37.5 °C. Temperatures outside this range suggested disease. The size of thermometers remained a major disadvantage. Aitkin in 1852 made a mercury instrument with a narrower tube sited above a bulb reservoir; this ensured that the mercury did not drop back after the reading had been taken. It was left to Thomas Clifford Allbutt (1836–1925) to design in 1866 a conveniently portable 6-inch clinical thermometer,⁴ able to record a temperature in 5 min. It replaced a foot-long model, which required 20 minutes to determine a patient's temperature. The measurement of temperature soon became an inescapable routine.

For 28 years, Allbutt practised in Leeds, performing invaluable clinical studies, mainly of arterial and nervous disorders. In 1871, he published a monograph outlining the use of the ophthalmoscope. From 1892 until the end of his career, he was Regius Professor of Physics in the University of Cambridge. He was also a noted medical historian. He published *Diseases of the Arteries, Including Angina Pectoris* (1915) and a text on Greek

Medicine in Rome (1921). He produced a classic textbook *Systems of Medicine*, in eight volumes (1896–99), and the excellent *Notes on the composition of scientific papers*, 1904. He was knighted in 1907.

Recent advances in thermometer design include digital, electronic direct and predictive, infra-red ear thermometers, and dot-matrix or phase-change thermometers. But none is wholly free of problems.

J.M.S. Pearce
Emeritus Consultant Neurologist
Anlaby

References

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