

Boylston AW, Williams AE (2008). Zabdiel Boylston's evaluation of inoculation against smallpox.



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Variolation, known in the 18th century as inoculation, was introduced almost simultaneously in Boston and London in the early 1720s ([Huth 2006](#)). A furious debate followed. Among the issues were the religious implications of interfering with divine providence, and the legality of spreading a potentially fatal infection; and whether the disease induced really was smallpox, and whether it was safer than natural smallpox, and induced immunity. Thomas Nettleton, a Yorkshire physician and inoculator, suggested in a letter sent in 1722 to James Jurin, secretary of the Royal Society that the best way to answer the safety and efficacy question was to make a comparison between the mortality of smallpox and the mortality among those inoculated ([Nettleton 1724](#); [Boylston 2008](#)). He submitted 3405 cases of natural smallpox of which 636 died, whereas there had been no deaths among the sixty patients he had inoculated.

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Jurin took up the suggestion and advertised for information from anyone with experience of natural smallpox or variolation (Miller 1957, p 116). To simplify the investigation and avoid arguments about subjective issues such as the severity of an individual case he only recorded death or survival. His correspondents revealed that the operation was practised throughout England and that the operators ranged from fully licensed physicians to surgeons, apothecaries and lay women (Royal Society Classified Papers). Jurin published annual summaries of his correspondence between 1724 and 1727 (Jurin 1723; [1724](#); 1725; 1726; 1727).

However there was another source of information: the Royal Society had received several accounts suggesting that large numbers of people had been variolated in Boston. These ranged from enthusiastic promotion by Cotton Mather (1722) to condemnation of the practice by William Douglass (1722). With the involvement of Sir Hans Sloane, president of the Royal College of Physicians and vice-president of the Royal Society, and a "certain exalted figure", (probably Caroline of Ansbach, Princess of Wales, an early patron of inoculation), Jurin persuaded Zabdiel Boylston, the Boston variolator, to come to London, where he published a book giving the details of his experience of inoculation ([Boylston 1726](#)). In July 1726, Boylston presented his volume to a meeting of the Royal Society chaired by Sir Isaac Newton, then president, and at about the same time, Jurin published his accumulated data (Jurin 1726). Together they give a picture of inoculation in its earliest application.

TABLE. Fatality of Natural and Inoculated Smallpox

BOSTON ^a	ENGLAND ^b	
	died	survived
natural smallpox	844	4915
inoculated smallpox	6	276

a. relative risk natural vs inoculated smallpox: 6.9 (range 3.2–15) p <.0011
b. relative risk natural vs inoculated smallpox: 8.0 (range 4.7-13.6) p <.0011
c. relative risk inoculated in Boston vs England: 1.02 (range 0.4–2.6) p >.9

The Table shows the data presented by Boylston (1726 p 39-40) and Jurin (1726 p 55-58), analysed using a simple chi-square analysis. The mortality among inoculees was similar on the two sides of the Atlantic, but natural smallpox was associated with a higher death rate than inoculation in both places, the relative increase in the rate being 8 in Boston and 6.9 in England. This apparently similar effectiveness was present despite differences in the operators and the exact method of inoculation.

This very early use of mathematical evidence in favour of inoculated smallpox over the natural disease influenced the adoption of variolation both in England and in the colonies. In 1731 David Hartley, now remembered as the father of psychology (Hartley 1749), used these figures to argue for general inoculation in the town of Bury St. Edmunds because it would save about 600 lives (Hartley 1723). In 1730, when smallpox reappeared in Boston, Boylston republished his book and several of the town's doctors, including William Douglass, his old nemesis, now offered variolation to their patients (Boylston 1730).

The published evidence was taken so seriously that opponents of variolation tried to argue that the figures were biased (Warren 1733; Miller 1957, p 170). They complained that inoculators regularly excluded pregnant women and those in ill health, and that they were treating a healthier population than those who suffered the natural disease. The title of Boylston's book – *An historical account of the smallpox inoculated in New England upon all sorts of persons, whites, blacks, and of all ages and constitution*'- may represent a reply to these criticisms. Inoculation's efficacy and relative safety compared with natural disease was accepted both in England and in the North American colonies. It was used in Philadelphia in 1735 and Charleston, South Carolina in 1738 when epidemic smallpox appeared. By the middle of the 18th century John Adams and Thomas Jefferson had been inoculated and the Royal College of Physicians had endorsed the practice as safe and beneficial (Miller 1957 169-70; Baumgarner 1994 p 9 and 19).

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