



EXPLORING EPIDEMIOLOGY

#4: From Experimentation to Prevention

In the first installments of our “Exploring Epidemiology” series, we met Hippocrates, who connected careful observation to diagnosing diseases; explored how medieval Europe built public health systems in the shadow of the Black Death by counting the dead, quarantining the sick, and isolating people exposed to disease; and learned how John Graunt transformed decades of London’s death records into the first population-level analysis of disease. But what if diseases could be prevented in the first place? An 18th-century Scottish naval surgeon demonstrated that it could, through observation and controlled experimentation.

A Sailor’s Plague

In 1740, a British naval expedition set out with nearly 2,000 men and returned with fewer than 500 — a loss mostly due to disease rather than combat.

In the mid-18th century, ships were routinely making long voyages out to sea, where a disease, known as scurvy, was killing British sailors faster than any enemy fleet was. While the symptoms were known — fatigue, sore and bleeding gums, loosening teeth, and joint pain — its cause was not. As demonstrated in the above story, the disease often led to death.

Theories about the cause of scurvy ranged from the salt in preserved meats and dried biscuits (sailors’ primary food sources at the time) to hard labor or something in the damp sea air. The miasma theory, the belief that disease arose from “bad air,” a concept traced back to Hippocrates, still shaped medical thinking. Physicians and commanders simply accepted scurvy as an unavoidable cost of long voyages.

James Lind’s Twelve

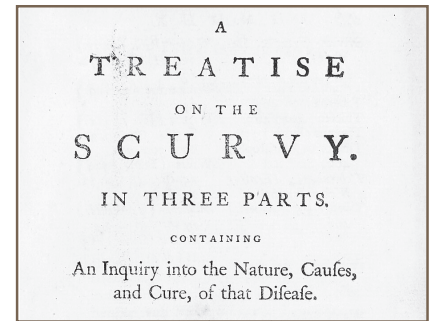
James Lind was born in Edinburgh, Scotland, in 1716. At 15, he was apprenticed to a local physician, and in 1739, he joined the Royal Navy as a surgeon’s mate. He served aboard ships in the Mediterranean, off the coast of West Africa, and in the West Indies, watching healthy men deteriorate before his eyes.

On May 20, 1747, aboard the HMS Salisbury, Lind saw an opportunity to compare scurvy treatments under controlled conditions. He selected twelve sailors who were suffering from scurvy, choosing men whose conditions were as comparable as he could find, and whose diets and living quarters he could keep constant. He divided them into six pairs and assigned each pair a different treatment, all of which were, at the time, proposed as remedies for scurvy. The six treatments — one for each pair — included:

- A quart of cider consumed daily
- 25 drops of elixir vitriol (dilute sulfuric acid) administered three times a day
- Two spoonfuls of vinegar given three times a day
- Half a pint of seawater consumed daily
- Two oranges and one lemon eaten each day
- A paste of garlic, mustard seed, and dried radish root applied three times a day

After just six days, the results were unmistakable. The two sailors receiving citrus fruit had recovered well enough to return to duty. The pair given cider showed slight improvement. The other four pairs showed no improvement at all. Lind had not only identified a treatment but also demonstrated what we now call a “controlled experiment.” By holding every other variable constant and changing only the treatment each group received, he could draw a conclusion that simple observation could not: citrus fruit aided recovery.

Lind published his findings in *A Treatise of the Scurvy* in 1753, in which he introduced the core logic of a controlled clinical trial. This is the same framework that would become the gold standard for testing medical interventions, from antibiotics to vaccines.



Title page, *A Treatise on the Scurvy*, 2nd edition Lind, J. Published: 1757 Credit: Wellcome Library, London. <http://wellcomeimages.org>

Gap Between Evidence and Policy

Lind’s findings were well received by the scientific community, but they were not quickly put into practice. The Royal Navy did not begin issuing a standing order requiring lemon juice for sailors until 1795. This came more than 40 years after Lind’s *Treatise* was published, and a full year after Lind died. The reasons had little to do with the quality of his evidence. Cost, logistical challenges, institutional skepticism, and the slow movement of new ideas through large bureaucratic systems all played a role.

Even after the policy was adopted, the use of lime juice, which was cheaper but less effective than lemon juice, allowed scurvy to persist longer than it should have. It wasn’t until 1932, nearly 200 years after Lind’s trial, that scientists identified the missing nutrient as vitamin C.

The gap between Lind’s discovery and its adoption mirrors what epidemiologists still grapple with today. Evidence alone isn’t sufficient; translating findings into practice requires political will, public trust, infrastructure and time.

In Sum

Until James Lind’s controlled trial, much of public health had been reactive: counting the dead, quarantining the sick, and separating the exposed. Lind may not have set out to transform medicine, but what he pioneered aboard the HMS Salisbury in 1747 remains the foundation of how we test whether interventions work today.

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Think about it

1. Why was it important to keep the conditions as similar as possible across the six pairs of sailors?
2. Lind showed that citrus cured scurvy, but scientists didn’t know that scurvy was caused by vitamin C deficiency until much later. What is the advantage of knowing why something works?
3. Lind’s experiment only contained 12 subjects, two in each group. What are the risks of drawing conclusions from such a small group?