

Florence Nightingale

Many are familiar with the story of British hospital reformer **Florence Nightingale** (May 12, 1820 – August 13, 1910), known affectionately by the wounded British soldiers of the Crimean War as “The Lady with the Lamp.” Fewer may know of her contributions to mathematics.

Although the story of a single nurse, fighting medical, political and bureaucratic indifference in her campaign to reform nursing and hospital care is perhaps more dramatic; it is her talents for organization and use of statistical arguments that eventually carried the day. It has

been reported incorrectly that Nightingale was the first to use diagrams for presenting statistical data. Rather, she was the first to use them to persuade those in authority that change was necessary so as to improve medical and surgical conditions and practices.



Florence Nightingale, the second daughter of wealthy landowner William Nightingale and his wife Fanny, was named for the city in Italy where she was born. In 1840, Florence’s aunt tried to arrange mathematics lessons for her niece, but Fanny resisted, insisting that ladies did not need math. Nightingale begged to be allowed to make a more formal study of mathematics rather than “doing worsted work and practicing for quadrilles.” Her father encouraged his daughter to study history, languages, philosophy and classical literature. Although he had a great interest in mathematics, he initially sided with his wife about the appropriateness of a female studying mathematics. Only after numerous emotional battles with her parents was Nightingale permitted to have a mathematical tutor, one of whom was James Joseph Sylvester, not yet the renowned mathematician he would become later in the century.

When she was seventeen, Nightingale announced that she heard a heavenly voice. God informed her of his plans for her to care for the sick, but convincing her family to allow her to accept God's command was another matter. Nightingale wished to find personal fulfillment, which would allow her to use her intelligence and energy. She became obsessed with a desire to help the ill, but young women of her station were not expected to pursue careers of any kind and particularly not in the helping professions. At the time, public hospitals existed solely for those too poor to afford a private physician who made house calls, where relatives and servants cared for the patient. Hospitals were dirty, smelly, overcrowded places, full of disease, where the destitute went to die. Nursing was not considered respectable work for decent women. English nurses were untrained, uneducated, and rightly or wrongly accused of being promiscuous drunkards. They cooked for the sick and sometimes bathed them but did little to tend to their patients' illness or help them heal.

Nightingale spent the years 1837 to 1839 on the continent where she completed her education. On her return to England, she was presented to British society and soon became the reigning debutante with many suitors. She rejected them all. She never married, choosing to pursue her life's ministry of social action, which she described as "mankind creating Mankind." It took five years to convince her family to support her ambition. In the interim, she managed to visit hospitals in London, Edinburgh, Dublin, and Paris. She demonstrated her scholarly bent and mathematical curiosity by amassing extensive data on every aspect of hospital conditions and nursing methods. She organized her findings, analyzed them and compiled statistics, formulating her ideas about health care that one day would revolutionize it.

Finally at age 30, Nightingale was allowed to train to become a nurse. She studied at the Institute of Saint Vincent de Paul in Alexandria, Egypt, and at the Institute for Protestant Deaconesses at Kaiserwerth, Germany. After graduating with honors from the latter she was appointed the unpaid superintendent of the "Hospital for Invalid Gentlewomen in Distressed Circumstances" in London.

Using the statistical information she had gathered and compiled, she streamlined the physical facility and improved both the nursing care and the administration of the institution. Within two years she was recognized as England's foremost authority on hospitals.

In March 1854 the Crimean War began in the Ukraine, matching the English and French against the Russians. Nightingale and the nation were shocked and outraged by the reports of war correspondents of the shameful conditions endured by the sick and wounded British soldiers. She arranged with the British Secretary of War to head up a contingent of 38 nurses to be sent to the British hospital at Scutari (now a part of Istanbul). She found the conditions even worse than she had suspected. Many British soldiers – including those who had been injured in the famous “Charge of the Light Brigade” - fought for their lives in hospital beds without any medical help. Their chances of survival were slight even if their wounds were not serious. The smelly hospital was cold, dirty, and infested with rats and fleas. Patients were packed in wards and those who endured operations performed by the few overworked surgeons did so without anesthetics.

The military doctors were not interested in Nightingale's views on reforming hospitals. With few funds and little help from the military, she turned for assistance to the people back home. Her reports of how the British Army was treating wounded soldiers did the trick. She was given the authority to reorganize the hospital. She used her own money to pay for supplies and hire local laborers to clean the hospital. She imposed strict sanitary and nursing conditions with the result that by the spring of 1855 the number of soldiers who died either from their wounds or diseases was cut from 42% to 2.2%. She worked up to 20 hours a day. At night, carrying a lantern to light her way, she moved among the wounded to check on them. While on the tour of the frontlines, Nightingale became dangerously ill with Crimean fever (known today as chronic brucellosis) and although she survived, the illness and its excruciating symptoms plagued her for the rest of her life.

Upon her return to England, Nightingale was welcomed as a national heroine. The War gave her the opportunity to demonstrate how trained nurses, proper hygiene, and sufficient organization could transform healthcare. During her time at Scutari she collected data and systematized record-keeping practices. The British Government would not allow her to publish her most damning statistics, which showed that hospital conditions were the main cause of the death of the soldiers. A pioneer in the graphic method of presenting data, she dramatized the needless deaths caused by unsanitary conditions with “polar-area diagrams.” She designed these antecedents of modern pie charts, which she called “coxcombs of biostatistics of life and death.” In her original *Diagram of the Causes of Mortality in the Army in the East*, she statistically represented the number of British soldiers who died of various causes by wedges of proportional areas in a circular diagram [Figure 5.3]. It showed that most of the British soldiers who died during the war died of sickness rather than of wounds or other causes. Although other methods of persuasion had failed, her statistical approach convinced military authorities, Parliament, and Queen Victoria to carry out her proposed hospital reforms.

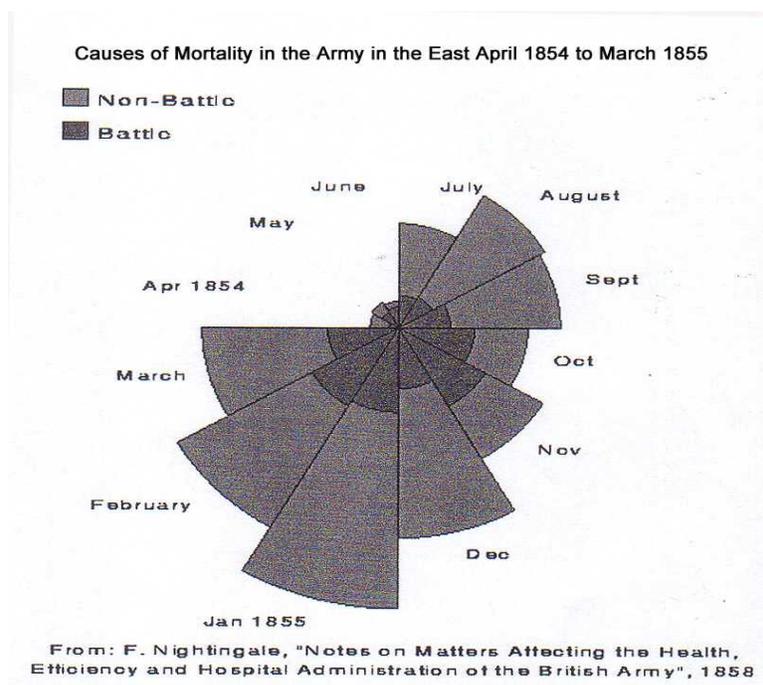


Figure 5.3

Nightingale helped promote what was then a revolutionary idea that social phenomena could be objectively measured and subjected to mathematical analysis. She was an innovator in the collection, tabulation, interpretation, and graphical display of descriptive statistics. Nightingale took her theological ideas from the work on probability and social behavior of the Belgian statistician Adolphe Quételet. She was certain that the patterns of behavior identified by Quételet were expressions of the “Laws of God,” which had been left by the Almighty Creator to be discovered and acted upon. Her goal was to use statistics to improve society. She developed a *Model Hospital Statistical Form* for medical facilities to collect and generate consistent data and statistics. Her work with medical statistics was so outstanding that in 1858 she was selected as a Fellow of the Royal Statistical Society of England and in 1874 became an honorary member of the American Statistical Association. Karl Pearson called Nightingale a “prophetess” in the development of applied statistics. By making observations, collecting data, and finding ways to represent statistics graphically, she found a way to make nursing and hospital management a science.

Later in life, Florence lost her sight and gradually her other faculties as well. She received honors from many countries, and in 1907 she became the first woman to receive the distinguished Order of Merit from the British government. She was only vaguely aware of the purpose of the ceremony that took place in her bedroom, but she knew she was being honored and protested, “Too kind, too kind.” Shortly afterwards she slipped into a coma and on August 13, 1910 she quietly died.

Quotation of the Day: “To understand God’s thoughts, we must study statistics, for these are the measure of His purpose.” – Florence Nightingale