

Florence Nightingale and Statistics: What She Did and What She Did Not

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Nightingale, as a social and public health reformer, needed statistics to make her case for change. She had learned how knowledge, meaning hard evidence, well-collected data, could make a difference, actually save lives. The Crimean War had a high death rate, in its hospitals and in the camps, from disease far more than wounds. Yet the rates of disease and death declined radically in the course of the war, to be no higher than for men the same age in an industrial city in England, Manchester.

What Nightingale did was crucial, but she is often credited with what she did not do. So:

What She Did Not

- Nightingale did not collect statistics, not during the Crimean War, or later. Yet two eminent American statisticians made such claims: ‘She was able to introduce an orderly plan of recording the principal sickness and mortality data of the military hospital establishments which came within the sphere of her influence’ (Kopf, 1916-17), and, ‘At Scutari, apart from the important sanitary reforms she instituted, she also systematized the chaotic record-keeping practices, until then even the number of deaths was not known with accuracy’ (Cohen, 1984). Indeed, she complained about the discrepancies in the mortality data from three different sources, even that data from the Adjutant-General, who was in charge of burials, reported more burials than the number of deaths in any of them.
- Nor did she (or anyone else) use statistics to get the Sanitary and Supply Commissions sent out, the organizations that made the changes that brought down the rates of disease and death.
- Nor can she be reasonably credited, either by bedside nursing, or walking through the wards at night with a lamp (both of which

she did) with success in bringing down the death rates. Good bedside nursing cannot make up for polluted air, water, overcrowding, poor nutrition, etc., contrary to the contention that ‘Nightingale’s vigorous use of these facts resulted in a series of reforms, which in turn reduced this terrible rate of mortality’ (Kopf, 1916-17).

- Nor did Nightingale ever claim that she and her nursing achieved any of the above, commonly stated in the secondary literature.
- Nor, when the death rates made their great decline, from 60%, did she ever attribute this to the provision of nursing. A French doctor, in a history of nursing, gave a reduction from 60% to 2.2%, thanks to Nightingale’s ‘ability to transform the hospitals from top to bottom’ (Hamilton and Regnault, 1901, 137). An American source made the reduction from 60% to 1%, ‘accomplished by her and her devoted band of nurses’ (Richards, 2014, 68).
- What Nightingale did state, in her “Introductory” to *Notes on Matters Affecting*, in a footnote, was that ‘it is not denied that a large part (10,053 men, or 60 percent per annum, perished in seven months, *from disease alone, upon an average strength of 28,939—this mortality exceeds that of the Great Plague.*’

She specified that this was not from the ‘unavoidable or necessary results of war’ (14:587). She used similar language in her evidence to the Royal Commission (14:897).

- On her famous polar area charts, she noted the arrival of the Sanitary Commission in March 1855, to show the decline, rather than the start of the nursing, in November 1854, (when death rates increased).

Nor, to examine the false negative claims, did Nightingale’s hospital have the *highest* death rates of the Crimean War, as asserted in *Florence Nightingale: Avenging Angel* and often repeated by (careless) authors. Small (1998) gave no numbers of deaths or rates for any hospital in making the claim!! The back dust cover depicts the famous polar area charts (Chart 1), but there is *no* discussion of the data they represent in the text. Further detailed refutations are available (McDonald 2014 and 2016).

Chart 1 Polar Area Charts

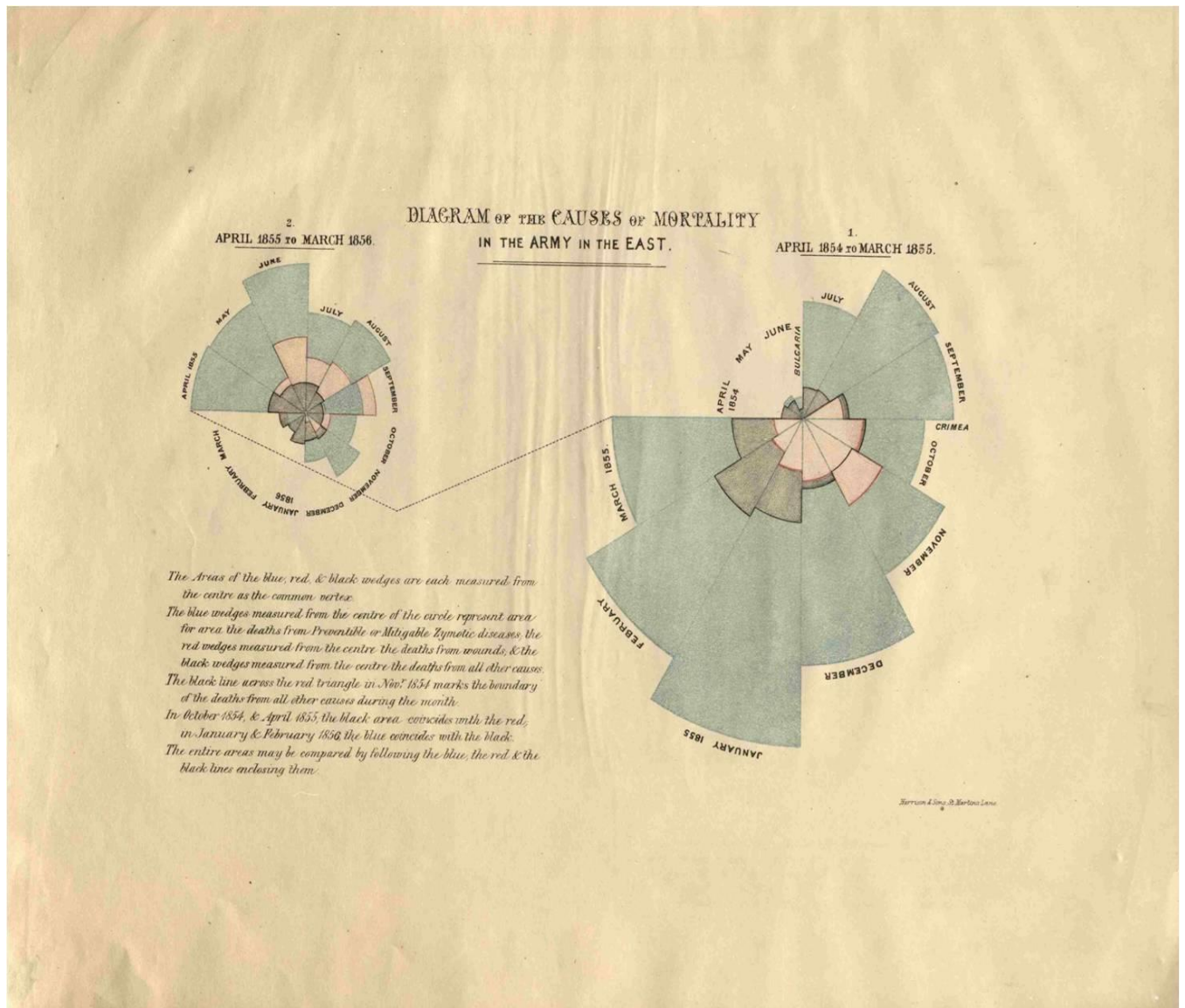


Chart 2 Mortality by Cause over Time

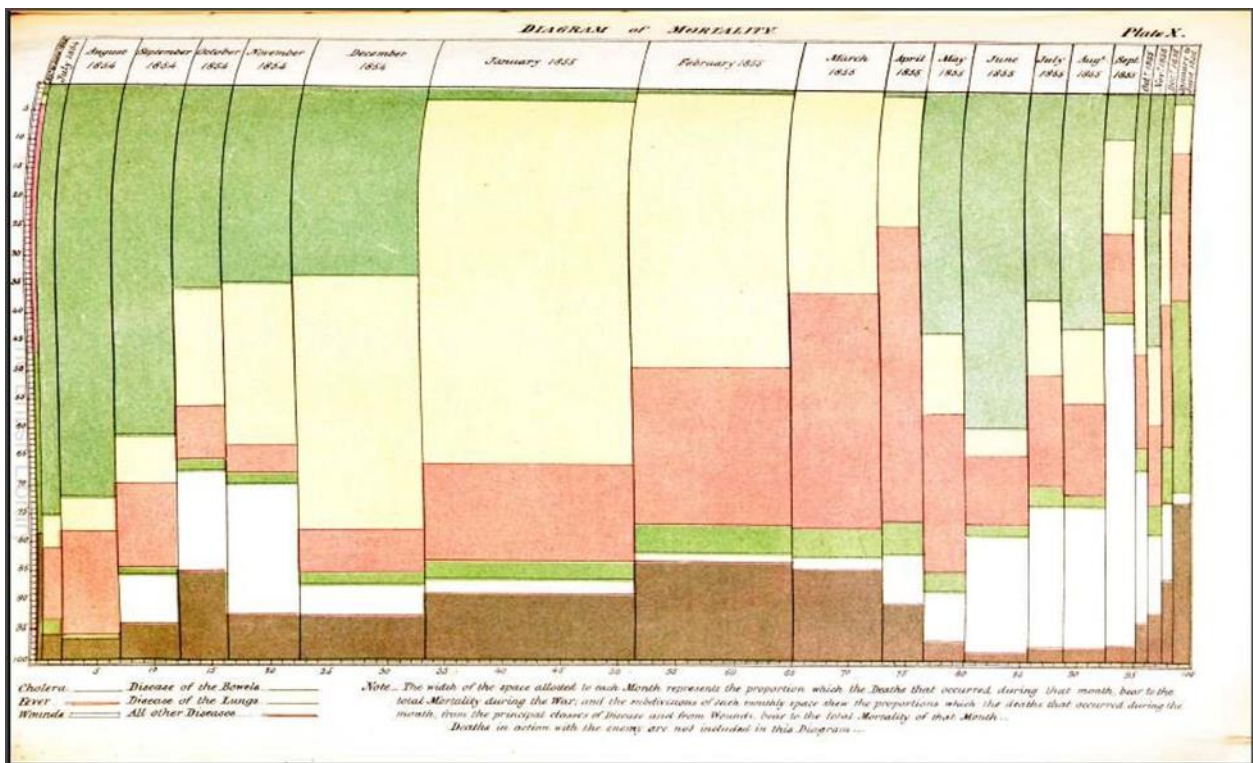


Chart 3 Mortality by Cause over Time

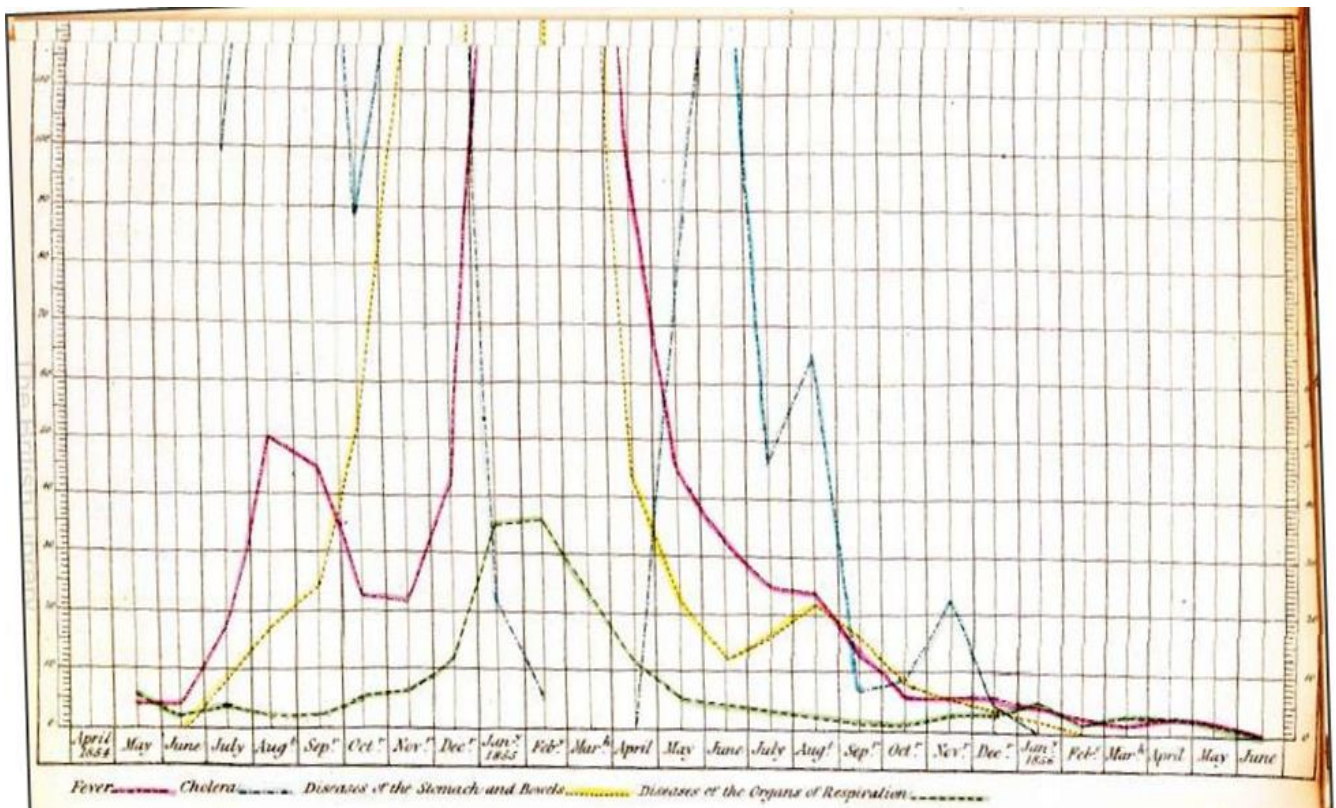
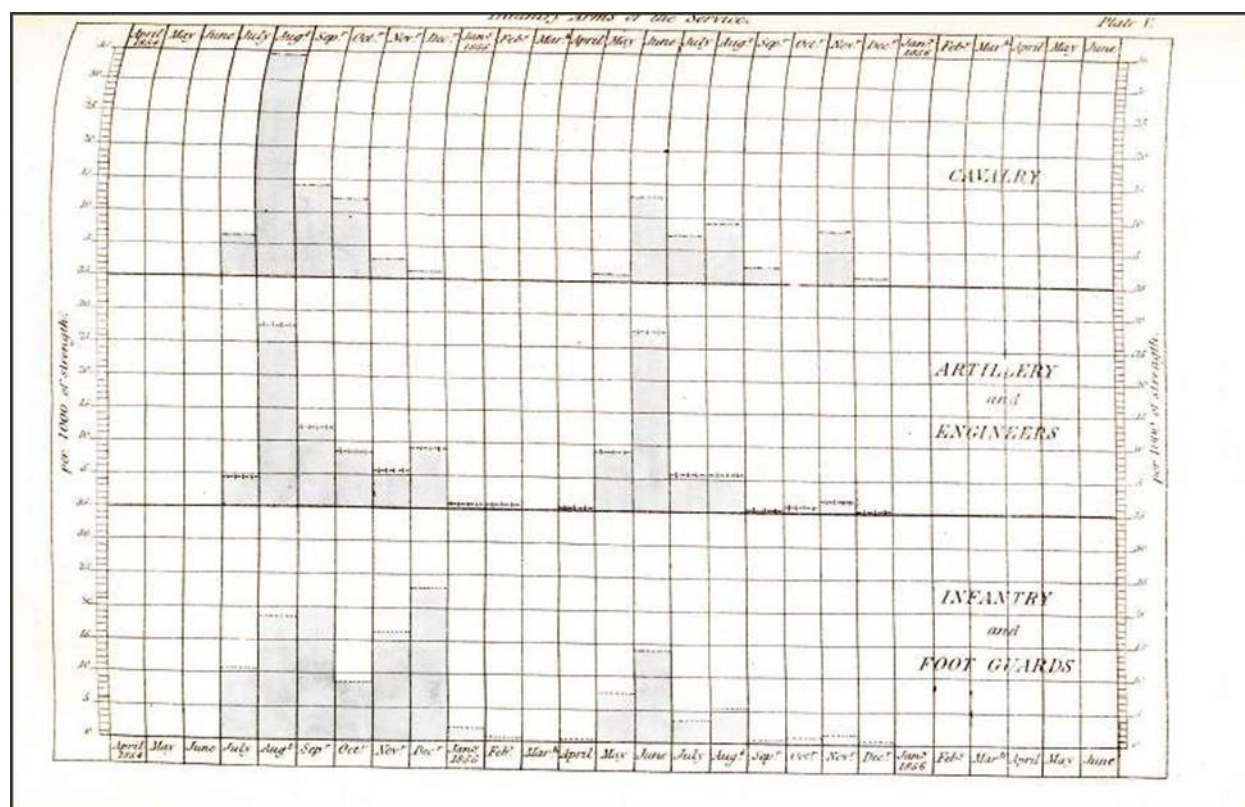


Chart 4 Mortality by Army Division over Time



What She Did Do

Post-war, Nightingale learned the lessons of the war, by careful data analysis, data collected by the Army Medical Department of the War Office and published, in two volumes, by its director-general, Andrew Smith, as *Medical and Surgical History of the British Army*, 1858.

Nightingale worked closely with Dr William Farr, superintendent of Statistics at the General Register office, and his staff. Farr was an expert and had published polar area charts before. What each did working together is not known. The result was better work than he had ever done before, but who did the equations? It is not clear how much mathematics Nightingale knew. She is known to have had instruction from a noted mathematician, James Joseph Sylvester (1814-97), but this seems to have taken place from April to mid-May, 1840 (noted in Woodham-smith, 1986, 37, and in the autobiography of a Crimean War colonel, Lefroy, 1895). There is nothing in her own hand describing the lessons or what she learned. Correspondence shows that she sent gifts

(game from her family) to Farr and an employee, Clode, in appreciation. In *A Contribution to the Sanitary History of the British Army*, she specified that certain tables were prepared by Farr and his office, from 'official documents' presented to Parliament (16:338).

Nightingale produced two major analyses post-Crimea:

- Matters affecting the Health, Efficiency and Hospital Administration of the British Army, Founded Chiefly on the Experience of the Late War, 1858, 853 pages, privately printed, a 'confidential report.' her insurance that the truth would come out if she died and nothing was done to make changes; she sent it, stressing its confidentiality, to more than 100 people.

This document has a complicated history. Her analysis had been printed as Notes on the Care and Treatment of Sick and Wounded and the Sanitary Requirements of the Army Generally, 567 pages, in 1857. Then the War Office then released a detailed document, with the names and dates of crucial correspondence, which showed who raised what problem and how long they were ignored. Nightingale added massively to her printed pages, interspersing whole new sections, with Roman numerals, between those already printed.

- Answers to Written Question (1858b), her answers to questions for the Royal Commission, so that she would not experience the indignity of speaking in public and being cross-examined). 89 questions, and some addenda, some short and succinct, some with tables (a total of 16).

Both documents are forward looking, to application, and both use comparative data with civilian populations and hospitals.

Nightingale looked to system change. There is some blame of individuals for failure to act, but by far the worst problems were failures in system, notably a failure in responsibility. One department would be in charge of ordering supplies, another for packing and sending them, and yet another for landing them. Supplies did not get where they were desperately needed, but everybody could blame somebody else, and did.

- She also produced a short report, 16 pages, with charts, giving highlights from the lengthier material, *A Contribution to the Sanitary History of the British Army*, 1859.

The official report

The Army Medical Department put out a two-volume official report, also in 1858. It, too, featured charts, but none of them like Nightingale's. One useful chart shows deaths by type of disease for such major categories as fever and bowel diseases, as well as wounds. It shows declines over time, but with no explanation as why (Nightingale's flagged the work of the Sanitary Commission). The official report included numerous charts of deaths by branch of the army (all rather similar) and enormous charts of meteorological conditions: temperature, barometric pressure, humidity.

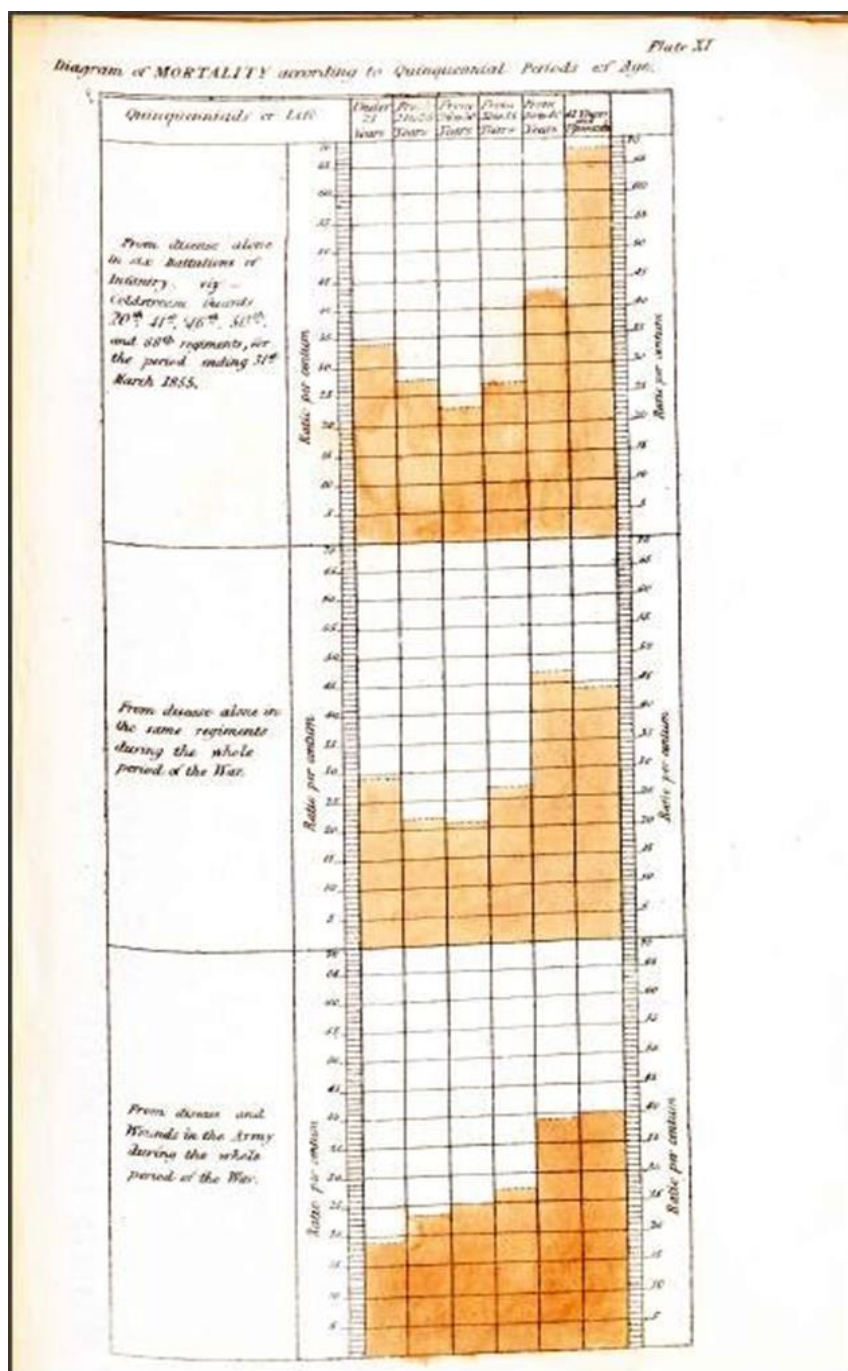


Chart 5 Mortality by Age Group

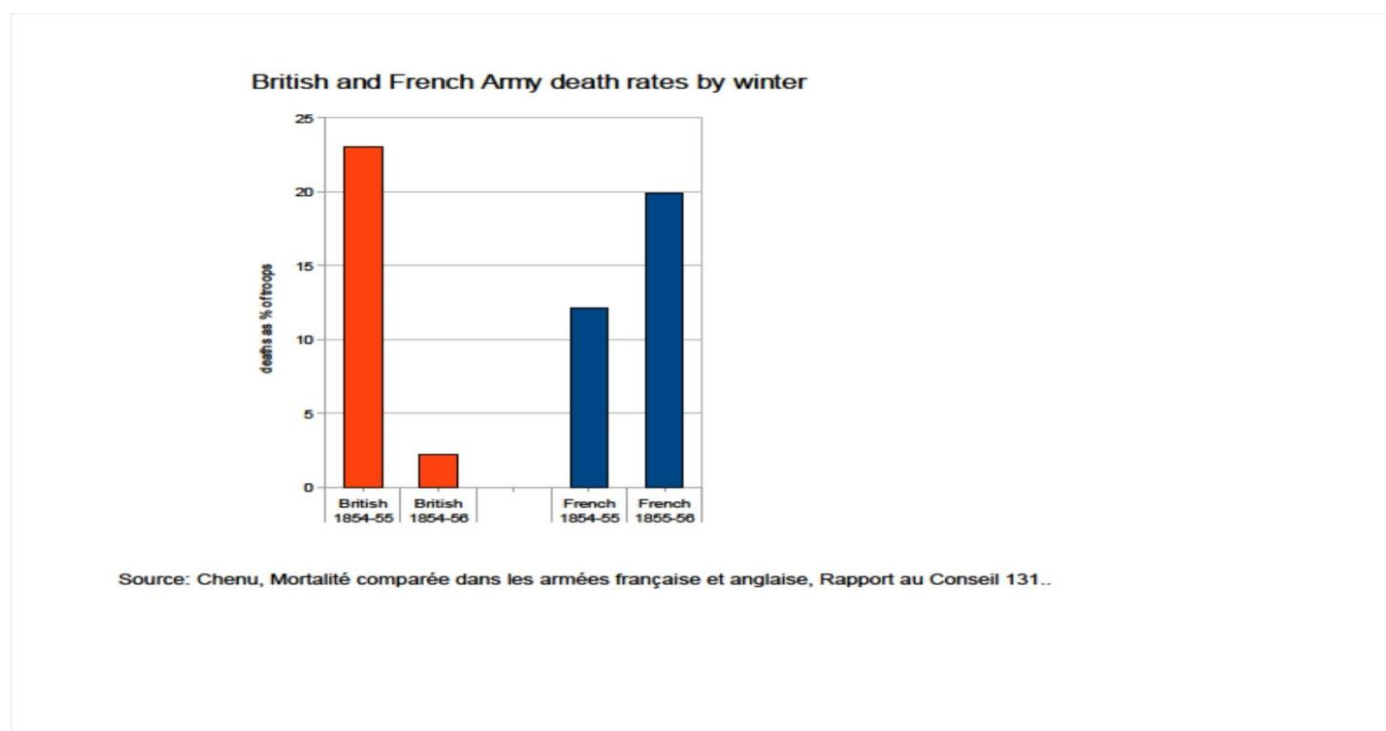
Causal knowledge

Nightingale and colleagues learned the cause-effect lessons of the high death rates of the Crimean War. It happened that only the British government instituted changes in running their camps and hospitals, by sending out *civilian* commissions, the Sanitary Commission, consisting of Dr John Sutherland, a pioneer public health expert, and Robert Rawlinson, a civil engineer; and the Supply Commission, consisting of Sir John McNeill, a doctor and old hand with the East India

Company, and Colonel Alexander Tulloch, an early military statistician. The former commission cleaned up the hospitals (sewers, drains, cemeteries, water supply), the latter the camps (housing, clothing, nutrition). Death rates declined radically.

The French Army made no such changes. Their death rates were lower in the first year of the war (the instigators, they were better prepared for it), but higher in the second year, although there was no actual fighting! In effect, there was a controlled experiment: the same war, same climate, same distance from home, yet radically different outcomes (Chart 6).

Chart 6 British and French Army Death Rates by Winter

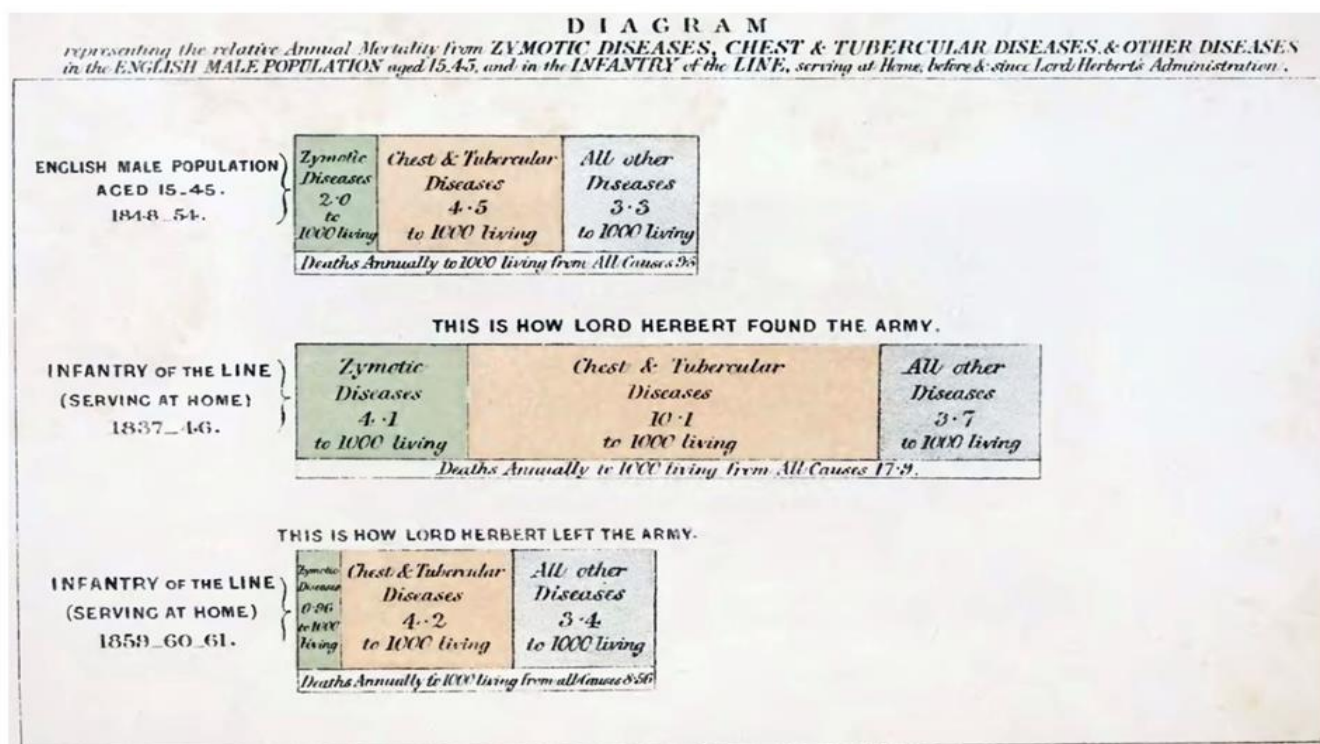


This is very evident to us now, but, since the French were late in publishing their official results (Chenu, 1865), no comparisons appear either in Nightingale's writing or in the Royal Commission Report. There was anecdotal evidence of the high number of French deaths, but no hard data at the time. We are indebted to Chenu for making the comparison showing British superiority in a second, shorter, report (1870). Le Fort (1868), a Crimean War doctor who later published on maternity death rates, gave credit to Nightingale and 'civil doctors' sent out by the British government, without any specific mention of either of the commissions sent.

Nightingale’s statistical tribute to Sidney Herbert

Nightingale’s tribute to her friend and great collaborator, appropriately, signaled his achievements, as seen by reduced death rates in the British Army post-Crimea. These occurred thanks to his applying the lessons learned from the war. She described Herbert as the first war minister who set himself the task of saving lives, that he took the trouble to learn the necessary material to do so. He himself chaired the four sub-commissions established after the tabling of the Royal Commission report to implement its major recommendations. Her short paper features three horizontal bar charts, the first giving baseline data: mortality rates of the relevant general, English, male population. Then comes the chart with rates for 1837-46, labelled ‘This is how Lord Herbert found the army,’ followed by data for 1859-61: ‘This is how Lord Herbert left the army.’ The great diminution of death rates is clear (Chart 7).

Chart 7 Death Rates Before, During and After the Crimean War



Nightingale made a similar point years later on the death of Dr Sutherland, that the value of his recommendations would be best understood ‘by a comparison of the vital statistics of the Army before the Crimean War and those of the present date’ (Times 1891).

Native Colonial Schools and Hospitals

One of Nightingale's earliest research projects post-Crimea was on mortality and illness in 'colonial schools and hospitals,' meaning for Indigenous people, in the Australian colonies, Ceylon (Sri Lanka), southern Africa and (pre-Confederation) Canada. Although the data were shoddy, there were enough to show that the rates of death and disease were twice what they should be. Further, 'By far the greater part of the mortality is the direct result of mitigable or preventable disease.' In the report on deaths in hospital, she concluded, with recognition of the poor quality of the data, 'the mortality statistics of these hospitals show a very high death rate upon the numbers treated' (Sanitary Statistics of Native Colonial Schools and Hospitals).

She carried on the research to produce papers on the disappearance of Indigenous people both for Australia and New Zealand (Note on the New Zealand Depopulation Question). She succeeded in getting Australian public opinion interested – newspapers gave her papers good coverage – but this did not lead to any action.

The physical and sexual abuse of Indigenous children in residential and day schools in Canada, with their loss of language and culture, has become a great issue in recent years. Nightingale's work was not on those aspects of abuse, but simply disease and death. She was the first person to make public the high rates of disease and death in residential and day schools in Canada. Incidentally, today's Canadians blame the Canadian government for the abuses, although the rates Nightingale reported date from the 1850s, for schools established in the 1830s, or decades before Canada became a country, in 1867.

Unfortunately, Nightingale was unsuccessful in getting the Colonial Office to continue to collect data, let alone make the necessary improvements. She turned her attention to India, where she was able to have more (albeit limited) impact.

Statistics on India

India was a major concern of Nightingale's for some 40 years. Again, statistics were needed to save lives. The Royal Commission on the Sanitary State of the Army in India, established in 1859, reported in 1863, was aimed at the health of the British Army there. However, it was argued that an army station could not be healthy if its surrounding area was not, hence there had to be a holistic approach.

Nightingale devised the questions sent to the army stations for the Royal Commission and analysed the returned data as Observations by Miss Nightingale on the Evidence contained in Stational Returns, 1863. That year also she began to publish short articles on India, with titles like 'How People May Live and Not Die in India' (9:183-94) and 'Life or Death in India,' 1873 (9:710-23). 'The People of India,' 1878, sounds nicer, but it opens with: 'We do not care for the people of India....Do we even care enough to know about their daily lives of lingering death from causes which we could so well remove? We have taken their lands,' after which she compared famine deaths with war deaths (9:778-810). A lengthy paper given to the East India Association in 1883 was entitled 'The Dumb Shall Speak and the Deaf Shall Hear, or The Ryot [peasant], the Zemindar [landlord] and the Government' (10:549-98).

Nightingale in fact did little on nursing in India, as more basic challenges kept emerging: dire poverty and famine.

The British government had inquiries conducted after famines, but did nothing about the base causes, the extreme poverty of Indian peasants, such that they had no margin when floods or drought occurred. Famines existed long before British rule in India, but British rule made them worse: higher numbers of deaths, fully documented in Late Victorian Holocausts: El Nino Famines and the Making of the Third World (Davis 2001).

Post-famine, Nightingale held, deaths had to be counted properly, to include deaths from disease as well as hunger itself—malnutrition makes people more vulnerable to disease. The British government, for obvious reasons, preferred to minimize the numbers.

Nightingale's estimate of famine deaths in 1876-1877 was 5 to 6 million, which was dismissed as 'a shriek.' The English representative on the Famine Commission made it 4 million, while the India Office had said 1¼ million. Gladstone's letter of reply to her on the matter acknowledged that her 'shriek' was 'a better expression of the truth than any other utterance' (letter 26 January 1879, cited in Cook 2:292).

In 1869, the Bengal Social Science Association made her an honorary member. Statistics, obviously, reflect the values and priorities of those collecting them. She clearly wanted input on policy matters from Indian nationals themselves, although decisions then were made overwhelmingly in London by British officials.

Nightingale worked closely with Surgeon-Major Evatt to obtain better data on the ordinary workings of health care in India. He sent her what he collected, pre-publication, and she commented, complimenting him when he made improvements, then called for more. She, for example, complained to him when, having told her he would provide ‘particulars of the *actual condition* of the nursing’ of European soldiers in India, he gave:

“no *facts*, as to the patients--what they want and *don't* have—what you have observed as to actual neglects, and the sufferings, slow recoveries, or *no* recoveries, and death caused by such total absence of nursing” (letter 8 February 1881, in 10:173-4).

The Contagious Diseases Acts

Nightingale fought against this anti-woman legislation, and probably delayed its passage for a couple of years, but the first Contagious Diseases Act was adopted in 1864. It permitted the inspection and compulsory treatment of suspected women prostitutes (never the men), a measure intended to reduce venereal disease in the army and navy. Later acts extended the scope of regulation, until their suspension, then repeal, in the 1880s. Nightingale’s role early on was a short paper, Note on the Supposed Protection Afforded against Venereal Disease by Recognizing Prostitution and Putting It under Police Regulation, 1862. For it, she produced data on rates of admission for venereal disease for different stations. She showed that there were lower rates of admission to hospital per 1000 at stations with no police protection (Bermudas, Sierra Leone, St Helena, Mauritius, Jamaica and Ceylon) than those with police protection (Malta Gibraltar and the Ionian islands) (8:431). Of course, data do not always persuade!

Nurse deaths

Nightingale was aware that hospitals were responsible for deaths of patients and staff. Her first table in *Notes on Hospitals* was of hospital death rates (patients) in 106 English hospitals, then various specific groupings. The next two tables were on nurse deaths , for 15 London hospitals, with deaths by age, rates compared with those of the wider female population, tables prepared by Dr Farr ((16:97-98). She wanted nurse deaths tracked, for nurses spent more time in hospitals than

doctors). The data she reported were ‘imperfect,’ so she created a form to collect better data (16:99).

Mortality in childbirth

Here’s a radical idea of Nightingale’s: there should be a zero death rate in childbirth (8:253). Giving birth is not a disease, so the only deaths that should occur should be those caused by an unrelated disease. Practically, however, deaths did occur, so that it would be useful to ascertain a ‘normal death rate’ for lying-in women (birthing mothers). This would then become a standard against which to compare rates in various institutions: lying-in (midwifery) hospitals, regular hospitals, workhouse infirmaries and home births.

Maternity death rates became an issue for Nightingale in 1867 when doctors at King’s College, London, threatened the closure of the midwifery ward opened in 1862 as a training school for midwifery nurses. There were no deaths in the partial first year, but they began in the next year, and rose. The ward and programme were ended in 1868. She was held up in doing the research by the Franco-Prussian War, 1870-71, and appropriate data were hard to find, so that it finally came out in 1871 as Introductory notes on lying-in institutions.

Nightingale set to collecting comparative data from obstetricians (then a new medical specialty), and from the Liverpool Workhouse Infirmary, from home births, and, thanks to publications, from European hospitals. The result was a thorough (for the time) setting out of a rich diversity of data, with Nightingale’s analysis. She was disappointed with the result and looked to a new edition being done, with better data. She hoped that Dr Sutherland would do one, but neither he nor she did.

A key lesson Nightingale learned from the research was that she could see no way of having a midwifery training institution, which required bringing birthing mothers together, without costing some lives. She never set up or assisted in establishing another midwifery ward, much as she was asked to.

The findings included lower death rates at workhouse infirmaries than elsewhere, this despite the poor health status of women giving birth in them (often prostitutes), a reversal of the usual relationship of declining deaths with rising status and income. With the knowledge Semmelweis acquired at the Vienna General Hospital in 1847-48, this can be

explained, but neither Nightingale nor Farr, nor any of her British contacts, knew of it — this despite the fact that short analyses of his findings were available in English, French and German in 1849 and 1850 (Routh, von Arneth, Simon). Then, in 1861, a German translation appeared of Semmelweis's full (written in Hungarian) book. The findings go against the grain: higher death rates with better training, an obvious point when it is realized that medical doctors did autopsies, midwives did not, except that Paris midwives, who were well trained (two full years) exceptionally, did, and had very high death rates. At Semmelweis's hospital there were two clinics, in effect a controlled experiment, one staffed by medical doctors and medical students, the other by midwives, assignment by time of entry, no choice by patient or doctor. The midwives' clinic had the lower death rates, a well-known fact. Semmelweis made the breakthrough by requiring doctors and medical students to wash their hands in a carbolic solution before entering a birthing ward after an autopsy (and later to wash after seeing any patient, not just after an autopsy).

What She Tried To Do, But Did Not Get Done

The Census

Nightingale understood the importance of population data, especially the Census. In 1860, she made numerous efforts to persuade officials to add two questions to the 1861 Census form: one on housing, the other on sickness. They were related, of course, since she considered that housing was what would later be called a major 'social determinant' of health. In her words: 'the connection between the *health* and the *dwelling*s of the population is one of the most important that exists' (letter 10 May 1860, 5:99-100). She called specifically to know how many people live in 'hovels,' and 'in stables, or in flats, or in cellars, or in *back-to back* houses, or in mansions' (letter 11 May 1860, 5:99-101). She was not successful in either quest, although some description of housing did get added late in the century.

Uniform Hospital Statistics

A project of 1859-61, Nightingale sought to reform routine hospital statistics so that, in effect, their success or failure would be noticeable, so that people could compare death rates per admissions by hospital, for different diseases/surgeries. Hospitals then published actual numbers and rates of death (they don't now). For this to work, the different hospitals would have to collect comparable data. She enlisted

the support of the distinguished surgeon, Sir James Paget, at St Bartholomew's Hospital, who succeeded in getting his hospital to revise their forms. She later told him Bart's statistics were the best.

Nightingale made the proposal at the International Statistical Congress, held in London in 1860 (5:83-89). However, this proved to be yet another project that did not produce long-term results, despite initial enthusiastic support at the congress by European delegates.

Nightingale, as well, sent Paget a detailed form to be used as a trial for new hospitals. Hospitals then were difficult to compare, as they differed greatly both in overall building size and dimensions and ward size. This form, which was probably never used, would have been a very useful document, collecting specifics on the nursing (numbers, jobs, and assistants' jobs, coverage of night duties (check on drunkenness?), if separate syphilitic wards (men nurses for?), dispenser in hospitals? pupils? expenses and hospital income, library? museum? chaplain? prayers? services? lending library for patients? spiritual instruction for patients? nurses? what for patients not Church of England? management (treasurer? surgeon? matron?) bandaging, dressings, administration of medicine, mistakes made in administering medicine? training? (5:75-79).

Questionnaire on Poor Law schools

Nightingale drafted a questionnaire in 1874 for Jane Senior, the first woman to be appointed a Poor Law inspector, hence the first woman to hold a British civil service post. The questions included, for each school, number of inmates, yearly admissions, early deaths, and causes of, yearly discharges (to service, friends or other), number of girls for every 5 years of age, number of orphans (father dead, mother or both parents), number of classes, with average attendance, duration, domestic training, number of teachers, and salaries, holidays (if any), examinations (if any), how school and training managed, assessment of girls as to cleanliness, clothing, bedding, general care, and your own summing up of moral state. There were more complicated questions that required discussion with officials: how girls were placed into service and what supervision they got, their situations afterwards, including 'horrid blot!' the number of failures where the girls return to the workhouse (13:641).

Probably nothing came of this project. Jane Senior died soon after and no further women were appointed to such a position for a long time, and no minister approached Nightingale for her assistance.

A Chair or Readership in Social Physics at Oxford University

Nightingale's last endeavour to get statistics used to their fullest, as opposed as collected, was her (unsuccessful) project to get a chair or readership in 'social physics,' the term of Belgian statistician L.A.J. Quetelet, at Oxford. Why there? Because it was the university that trained most Cabinet members, the Army, MPs and senior civil servants, many of whom had a university education and should be using social data for policy decisions. They were not, as she complained to her colleague Benjamin Jowett, master of Balliol College, for 'the enormous amount of statistics at this moment available at their disposal (or in their pigeonholes which means not at their disposal is almost entirely useless.' Why, those persons did not know how to use them. She and her fellow reformers did not seek 'a neat arithmetical sum; we want to know *what we are doing* in things which must be tested by results' (letter 3 January 1891, Add Mss 45785 f144, 5:110). This is 'outcomes research,' and still badly lacking (*ED: see previous article by Andy Street*).

The collection of quality of data

Good analysis requires reliable data, a serious challenge Nightingale faced beginning with the Crimean War mortality data: six different data sources, with competing death rates, even more burials than deaths. She learned the importance of obtaining reliable, accurate data. For her, statistics represented real people, in the Crimean War men killed needlessly. As she said in *A Contribution to the Sanitary History of the British Army*, 'It is impossible to reconcile the discrepancies in these various returns. One thing is quite certain, that hundreds of our brave soldiers perished, in regard to whom neither the when, the where, nor the how will ever be known' (16:344).

Conclusions

There is no doubt that the work done by Nightingale, with her team, saved lives, beyond count. This, however, was done post-Crimea, by careful research and just as careful following of an implementation plan. Nightingale developed a *modus operandi* that was effective,

however, not obviously in everything. What she and her team achieved was immense, and even the failures doubtless made it easier for later reforms to be accomplished. You don't win them all, and Nightingale's score, with its blots, is hugely impressive.

As we face so many different issues today, we might reflect on how Nightingale would have approached them. At the top of the list of challenges, there is climate change. She undoubtedly would have seen its importance for the number of lives (species, coastlines) at stake. She understood the connection between irrigation, forest cover and rainfall: 'We go on cutting down wood without replacing it...Tree planting would do much both to bring rainfall and to arrest floods' (Nightingale 1879, 10:293), and 'with tree planting properly carried out, there would be *equalized* rainfall' She noted also, for America, the effect of flooding on crop failure, hunger and famine. She could count and see trends. For her own work, she had to balance, as goals, where the greatest need was (the highest number of deaths), and where she had access (China had a higher population than India, but she had access in India, not China).

How would she deal with estimates on death rates from smoking (8 million plus a year, 7 million direct smokers, 1.2 million from second-hand smoke), with air pollution (mainly fossil fuel burning) at 7 million and rising? (WHO 2019).

On the newly emerged issue of vaping, we might wonder how she would confront the use of a completely made-up estimate, of 95% harm reduction, promoted by Public Health England. Without any data on long-term harm - for vaping is too new - yet it accepted the 95% 'guestimate,' and the claims of cigarette companies that that harm reduction is now their goal (Nutt, et al. 2014).

It does not appear that Nightingale was discouraged by the number of unsuccessful projects she undertook. She continued to take up new issues, or new lines on old issues, and sketch out questionnaires, or 'queries,' to pursue them. People, notably Edwin Chadwick, sent her proposals for research.

Her attitude near retirement reveals her to be no less committed to her reform projects than in her youth. Hospital reformer Sydney Holland (later Viscount Knutsford), who visited her in 1897, recorded her words: 'She warned me against ever being discouraged by the snubs of government officials: 'Keep what you know is right before you, and never

cease trying to get it. Aim high and people will follow you in the end....No, no, no one can be neutral in this life; you are either doing good or bad, and the very fact of not trying to do good is bad in itself (Holland, 154).

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