

Florence Nightingale: Statistics to Save Lives

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Abstract

This paper reviews Florence Nightingale's contribution to the use of statistics to save lives, beginning with the Crimean War (1854-56). It addresses accusations to the contrary, that her work resulted in lives lost, with primary source data in refutation. It also demolishes exaggerated claims *for* her, on the extent and speed of death rate reductions achieved, that she collected statistics to this end, and that she did the work virtually single-handedly.

Comparative French death rates during the war are cited which show how successful the British were with their sanitary reforms. Nightingale's significant collaboration with the leader of the Sanitary Commission is related. The two went on to numerous successful reforms post-Crimea. The creation of a Statistical Branch was a key part of the strategy.

Several unsuccessful attempts Nightingale made to improve statistics are noted, beginning with a rejected proposal to add questions on health to the 1861 Census. Next came the Colonial Office's failure to follow up on her research on excessive deaths in British colonial hospitals and schools, which raised the broader issue of declines in aboriginal numbers. Finally, she had to give up on an attempt to have applied statistics taught at Oxford University, for the benefit of future Cabinet ministers and senior administrators.

The paper argues that Nightingale's belief that statistics can be used to save lives still has merit, so long as the endeavour is taken seriously, with adequate attention to detail and complexity.

Keywords: mortality rates, Crimean War, army hospitals, policy decisions

1. Introduction

Florence Nightingale (1820-1910) is still known as the leading founder of the modern profession of nursing, the heroine of the Crimean War (1854-56), a hospital reformer, and, to historians of statistics, a major contributor to the discipline, especially for her ability to portray crucial mortality rates so vividly as to persuade authorities to act to reduce them. She was the first woman fellow of the Royal Statistical Society and an honorary member of the American Statistical Association. However, in recent years, she has come under attack, in print initially, then in BBC television films that were widely broadcast.

A newspaper story on the 2008 BBC film renamed the legendary "lady with the lamp" "The Liability with a Lamp." The story stated no less than that "Errors by Florence Nightingale killed thousands of troops in the Crimea," so that the "saintly nurse" was "in reality...the kiss of death to thousands of men in her care." (*Sunday Times*, 1 June 2001). In Britain this rendition of Nightingale has now become commonly accepted. In the United States and many other countries, benign neglect is more the case. Either way, the failure to see the significance of her work is obvious. Nightingale went on, after the Crimean War, to work with leading experts on public health, notably Dr John Sutherland, the head of the Sanitary Commission, to reform hospitals and health care. Their joint work led to improved nursing, safer hospitals and marked declines in death rates, all over the world.

2.1 Statistical Claims, with Missing or Faulty Data

The main source for the now much quoted negative conclusion on Nightingale's work--that she was responsible for the high death rates of the Crimean War--is a retired management consultant, Hugh Small, in *Florence Nightingale: Avenging Angel*, 1998, for which a book by an Australian medical historian, F. B. Smith, paved the way, *Florence Nightingale: Reputation and Power*, 1982. Both make extreme accusations, with copious endnotes in apparent support. Reviewers of both books complimented the authors for revealing the "truth" about the false heroine, without checking the accuracy of their sometimes far-fetched charges (McDonald, 2000).

Many historians--military, political, medical and nursing--fell for one or both of these books. No nursing organization nor senior nurse came to Nightingale's defence, and many nursing leaders joined in the fray. Statisticians did not, and indeed

there is a long history of their approving of Nightingale's work, back to her contemporaries Adolphe Quetelet, the great Belgian statistician, William Farr, then Britain's leading medical statistician, and T. Graham Balfour, reformer of army statistics and later president of the Royal Statistical Society. Late in the nineteenth century Karl Pearson was another Nightingale admirer, while in the twentieth century admirers include a Nobel laureate in Economics (Stone, 1997), a leading statisticians (Kopf, 1916-17) and the founder of the Department of the History of Science at Harvard University (Cohen, 1984).

Statistics will be seen to be key to the refutation of Small's arguments of culpability for the high death rates of the Crimean War. He made his point repeatedly, the core of which is that "bad hygiene...killed thousands of patients in her hospital," and when Nightingale discovered "what she believed to be the proof, she suffered a complete mental and physical collapse" (Small, 1998, 2).

A peculiar twist to this conclusion is Small's belief that Nightingale herself revealed the damning information in her own lengthy report (Nightingale, 1858). That work, he said, remains "to this day the only known source of evidence that her hospitals were more than twice as lethal as the hospitals in the Crimea" (Small, 1998, 185).

Several points have to be disentangled:

1. That the death rates were highest at Nightingale's hospital;
2. That she was responsible for the unhygienic conditions at it that caused the deaths;
3. That, after the war, when she learned these supposed facts, she blamed herself;
4. That she herself revealed the "fact" of the highest death rates being hers, i.e., that the data were not published elsewhere.

No reviewer or commentator on Small's book seems to have noticed the fatal flaw, that he published not so much as a single table or chart in support of his claim, nor did he realize that there are no separate data for "her" hospital. The official published death rates combine data from four to seven hospitals (Smith, 1858, vol. 2), a source Nightingale used. Small did not discuss the data; Smith does not appear in the Index or References, but the two-volume work is listed in the References in quotation marks, as if it were an anonymous article, classified by its title. It appears in the Index, now in italics, again by its title, not its author's name. The report has been available since 1858, was certainly used by the French statisticians, and is available now online as a UK Parliamentary Paper.

The "Scutari hospitals," note the plural, consisted of two very large hospitals, Nightingale's Barrack, her main hospital, then the largest hospital in the world; the General Hospital, the next largest; two smaller hospitals, the Palace and the Stable Hospitals, with a separate matron but under her overall jurisdiction; and two ships, the "Turkish Hulk" and the British *Bombay*, with no matron or nurses and not under Nightingale at all. The Stable Hospital and the two ships were promptly closed by the Sanitary Commission. For some time there was a seventh hospital, at Koulali (spelled Kulelli in Smith's report), under the superintendence of the Irish Sisters of Mercy, and not under Nightingale's general superintendence. The whole lot are referred to variously as the "Bosphorus" or "Scutari and Koulali hospitals."

Instead of reporting full tables, Small used round numbers and made "apples and oranges" comparisons, for example, contrasting the "12,000" sent from the "primitive regimental hospitals" in the Crimea to "Nightingale's hospital." He called this, "her hospital," "easily twice as lethal" (88-89). He failed to acknowledge that the 68 regimental hospitals transferred their most serious cases to the general hospitals, and that the regimental death rates varied from a low of 1.2% of admissions to a high of 12.9% (Nightingale, 1858a). Her data, reported in her evidence to the Royal Commission, were drawn from the official War Office report (Smith, 1858, discussed in McDonald, 2014). Scutari, at 11.9% deaths over admissions, ranks well below Koulali at 25.9, and even below Varna, Bulgaria, before the war started and where there were no women nurses at all. The hospitals with the lowest rates were not comparable: Renkioi, a new, purpose-built hut hospital with state-of-the-art toilet and washing facilities, and Monastery, a hut hospital on the heights of Balaclava, with fresh breezes blowing.

How could Nightingale have blamed herself for the "highest" death rate at her hospital when she was well aware where the highest rate was, and the reasons for it? (McDonald, 2014) In her lengthy report, she repeatedly called it "the worst of all the hospitals" (McDonald, 2010, 696, 738 and 882). Koulali's problems were documented by Dr Sutherland both in his evidence to the Royal Commission (on 17 July 1857) and in his own report as head of the Sanitary Commission. In the evidence, he stated that the deaths were highest at Koulali, "where the sanitary defects were even more serious" than at Scutari (U.K., 1857, 2:334). In the report itself he listed quantities of removed "filth," meaning feces and offensive material, which show Koulali to have been by far the worst hospital. Further, the report of the person who actually supervised the removal noted 202 cartloads from the two Scutari hospitals in the first week; for Koulali the measure was in tons (U.K., 1854-55).

2.2 Disaggregating Hospital Death Rates

Nightingale, in a short paper after the major reports came out, was able to disaggregate partially the Scutari and Koulali death rates. She reported that the highest death rates were at Koulali, for one month at 60% of the sick population, in fact a miscalculation neither Nightingale nor medical statistician William Farr caught; the correct percentage is 46.6, still the highest, while the percentage deaths of cases treated at Koulali was 52.0, again the highest of all the hospitals (Nightingale, 1859, 16, discussed in McDonald, 2014).

In her words:

At Koulali, the worst of all the hospitals, in February 1855 the mortality was 52 percent on all the cases treated in hospital during that month! At Scutari and Koulali, it was nearly 43 percent during February on the cases treated!

In other words, had the rate of mortality at Koulali continued, in two months the troops in hospital there would have been swept away, had that at Scutari and Koulali continued at what it was in February, in three months its hospital population would have been annihilated, that is, the mortality there was 415 percent annually on the sick population, at Koulali it was 608 percent annually (Nightingale, 1859, 143).

While Nightingale flagged the high death rates at Koulali, and did not have a high opinion of the matron and nurses there, at no time did she blame them for the excess mortality. They were no more responsible for the faulty toilets, sewers and drains, lack of ventilation and accumulation of dead animals in the water system than she was at her hospitals.

A major, early, history of the war related the fact of the high death rate at Koulali, although without precise figures, noting "that fated hospital at Koulali," with a "fearful mortality," that "pest-stricken hospital" (Kinglake, 1901, 7:362).

Small and his followers, so quick to lay blame on Nightingale, failed to examine the available data which accounted for the high death rates, the subject of Nightingale's own extensive analysis. She, with Sutherland and the sanitary reform doctors, highlighted sewers and drains, overcrowding and lack of ventilation, with roles also for the soldiers' poor health from poor nutrition and exposure to severe winter conditions.

As to point 2, on the unhygienic conditions in the hospitals, another reconfiguration of the death rate data is informative, in Table 1.

Table 1. Hospital Death Rates by Sanitary Condition and Nursing Responsibility

Hospital	% Deaths/Admissions	Sanitary Condition	Nursing
Koulali	25.9	worst, very serious defects	Irish Sisters of Mercy
Camp	18.8	half-buried huts, pernicious	Sardinian Sisters of Charity
Varna	13.1	cholera conditions	no women nurses
Scutari hospitals	11.9	2nd and 3rd worst, large	mainly Nightingale nurses
Abydos	10.1	not known	civilian nurses
Smyrna	8.2	not known	civilian nurses
Balacava	7.7	excellent stone, on heights	Nightingale nurses
Renkioi	3.8	model, new, pre-fab	civilian nurses
Castle	3.8	good, heights	Nightingale nurses
Monastery	3.1	hut, heights	Nightingale nurses

Note. Data from Nightingale (1859b, 25)

The highest rates are for the large general hospitals with serious sanitary defects. The three lowest rates for general hospitals are for those which came into operation only after the reforms of the Sanitary Commission had been made, two of which had the advantage of being hut hospitals, and one, Renkioi, was new and prefabricated. The very low Monastery Hospital rate is for a convalescent hospital, and not really comparable.

The Camp Hospital is an anomaly, with a high death rate, also a late period of operation. It consisted of huts, which Nightingale described as half-buried and defective. No such hospital is listed in the official War Office returns, but from discussion it is likely that of the Sardinian Army, and the dates fit. If so, it was not influenced by the work of the Sanitary and Supply Commissions.

Silver (2007), using the available official statistics, came to quite a different conclusion from Small, in a book on the new

hut hospital at Renkioi. He held that the hospitals should be compared only when they were both in operation, and showed that the differences for that period were not great, 4.7% deaths over admissions at Scutari (still a combined rate), compared with 3.76% at Renkioi, the hospital with the best sanitary conditions. Moreover, the Scutari rate included deaths from cholera when patients were admitted from the neighbouring village to the Barrack Hospital. Renkioi had no such epidemic and no other troops were quartered with them who might have introduced the disease. Silver concluded:

With treatment mainly symptomatic, and medical treatment so ineffective, a good diet and good nursing, by now available to both, gave the patient the best chance. Mortality at Scutari, including that due to cholera was 4.7%. If cholera is put aside the percentage of deaths from all causes at Scutari falls to 2.5%, even lower than the low rate at Renkioi (3.76%) and proof of the improvement at Scutari.

3. Comparisons with French Army Death Rates

While Small and his followers were pinning the blame for the high death rates of the British Army on Nightingale, they failed to look at a remarkable data set that might have set them straight: mortality in the French Army. The French were in advance of the British in military medicine generally, and, as the instigators of the war, were better prepared for it. That they had a much worse second year than the British was well known informally, but they did not publish comprehensive data until a full seven years after the British did. The French report was lengthy, 732 pages, and shows how much higher the French death rates were, 30.9% of the troops sent, than the British, at 22.7% (Chenu, 1865, 611 and 579).

Chenu (1870, 131) added some even more telling comparisons using death rates from the two winters. The British rates dropped from 23% of troops sent to a mere 2.5%, while the French rose from 11% deaths per troops the first winter to 20% in the second, and this when hostilities had ceased. The British and French in the Crimea were subject to the same weather conditions and the same susceptibility to epidemics, the very conditions for a controlled experiment. French doctors themselves credited the Sanitary Commission with the lower British rates.

4. A Broader Range of Comparative Hospital Death Rates

Table 2 shows the death rate for a greater range of types of hospital. The comparisons are not of like with like, especially those with London civil hospitals, which admit all ages and all medical conditions, while in army hospitals patients are all young, fit, men. Death rates of regimental hospitals have also been included, although these hospitals kept only the less serious cases, sending the more serious to the general hospitals. The table is intended only to serve as a final example of how wrong the contentions were of Small and his followers as to responsibility for the highest death rates.

Table 2. Death Rates in a Range of Hospitals

Hospital/Nation	Period	% Deaths/Admission	Nursing Responsibility
Koulali	Feb-Je1855	25.9%	Irish Sisters of Mercy
Camp	Ap55-Je56	18.8	Sardinian Sisters of Charity
Varna	Je54-Ja55	13.1	no women nurses
highest^ regimental	Je54-Je56	12.9	no women nurses
Scutari hospitals	Je54-Je56	11.9	mainly Nightingale nurses
UCH [@]	1861	10.7	All Saints (Anglican) nuns
Abydos	Se54-Se55	10.1	civilian nurses
London [@] average	1861	9.7	civilian nurses
Smyrna	Fe55-N56	8.2	civilian nurses
average^ regimental	Je54-Je56	8.1	no women nurses
Balaclava	Oc54-Je56	7.7	Nightingale nurses
Renkioi	Oc55-Je56	3.8	civilian nurses
Castle	Mar55-Je56	3.8	Nightingale nurses
Monastery	Jy55-Je56	3.1	Nightingale nurses

Note. British general hospitals (Nightingale 1859b), regimental hospitals (Smith 1858, vol. 1).

[@] Data for University College Hospital, London, the civil hospital with the highest death rate, and average for 13 London hospitals from the *Journal of the Statistical Society of London* **25,3** (September 1862, 384-385).

^ For the highest regimental death rate there was a tie between the First Royal Regiment First Battalion and the 63rd Regiment; the rate was calculated by subtracting deaths at general hospitals from the total number of regimental deaths reported; average for all the regimental hospitals (Smith 1858).

5.1 Assessment of Blame for the Death Rates: Nightingale or Others?

For point 3, that, after the war, when Nightingale learned the supposed “facts,” she blamed herself, there is an embarrassment of contradictory evidence in her detailed reports and correspondence for the rest of her life. A few examples will serve:

* In 1858, Nightingale referred to “Sir John Hall, k.c.b., principal medical officer of the Crimean Army” as one of the “two greatest criminals” she knew in the country, yet he was “unhung and out of jail” (letter, McDonald, 2014, 565). Also in 1858, she referred to the “calamities” of the hospitals of the East, naming Hall for the “sufferings which proceeded from the defects of his own department” (Nightingale, 1858b, 144).

* In 1861, Nightingale sent Crimean War materials to Dorothea Dix, head of nursing for the Union Army in the American Civil War, as “a short, not sweet, account of the sanitary evils of the Scutari hospitals...which might be useful” (McDonald, 2011, 598).

* In 1869, in a letter of advice on a Stockholm hospital, Nightingale asserted that she had herself “nursed a hospital in the Crimea [Castle Hospital]...consisting of wooden huts....The death rate in that hospital was *under* 3 percent; in the magnificent corridor hospitals of Scutari it was 20 percent on cases treated; and in one large hospital during one month more than half of all the cases died” (McDonald, 2012, 702). Koulali, not named, is clearly the culprit, and she never nursed in it nor was responsible for it, while she identified the hospital with the low rate as one where she herself had nursed.

Further examples have been noted elsewhere (McDonald, 2014). Her pride in the improvements made can also be seen in the three iconic polar area charts included in her longest report (Nightingale 1858) and her short, provocative paper (Nightingale 1859). Both mark the break in March 1855, when the commissions began to improve conditions.

5.2 Culpability for Deaths in Later Wars

In addition to the points discussed above regarding the Crimean War, Small considered that Nightingale and her fellow reformers helped “to promote the expansion of the role of war in society.” Some 100,000,000 lives, he said, were lost “over the next century and a half...as a direct but unexpected result of the well-meaning efforts of the army reformers” (Small 1998 175). Small adduced no evidence of any connection between reform work and a predilection to go to war. In fact, it was the French, as early as 1859, who next went to war, in the Second Italian War of Independence, yet France had no sanitary commission or army reformers.

In 1870, it was France who declared war against Prussia, launching a much greater war than for the Crimea, the Franco-Prussian War, which it lost. Britain, the country with the army sanitary reformers, took no part in it or any European war post-Crimea until World War I in 1914.

There was a great expansion of firepower and manpower in the American Civil War of 1861-65, in which more than 600,000 soldiers died. Yet neither the Union Army nor the Confederate Army had an official sanitary commission or sanitary reformers. Civilian volunteers in the North organized what they called, after the (official) British body, their Sanitary Commission, but it never had official status.

A medical historian concluded that the Red Cross societies, organized after the Italian wars of independence, encouraged military expansion and glorified sacrifices for war: “The leaders of most national societies enthusiastically prepared for whatever war service the army and the government wished them to perform” (Hutchison, 1996, 350). But Nightingale (and Sutherland) both opposed the early formation of the Red Cross, precisely because, in Nightingale’s words, it made war “cheap” (McDonald, 2011, 731). In other words, the army reformers Small blamed for expanding war were prominent in warning against the organization that did precisely that. Nightingale herself, during the Franco-Prussian War of 1870-71, began to consider social institutions for their tendency either to encourage or discourage war--democratic measures like freedom of press and opinion working against war, their lack promoting it.

6. Nightingale’s Significant Collaboration with Sutherland

In addition to the serious accusations dealt with above, there are mistakes of a lesser nature, which lead to missing pertinent points. Small mistakenly described John Sutherland as Nightingale’s doctor (Small 1998 180). He further said that Nightingale “obtained more or less permanent employment” for him “in military and civilian public health posts,” without mentioning one (134). She did not, but for years he worked on a contract, as a civilian employee of the War Office. The relationship between the two was of a highly functional, professional, collaboration, with Sutherland providing medical expertise and information gleaned from travel and War Office colleagues, deferring to her bolder vision and

aptitude for research and policy formulation. Each had a mission to save lives, with concerns both military and civilian. Small missed this entirely, as he missed the fact that Sutherland was Nightingale's initial source on the highest death rates being at Koulali.

Nightingale and Sutherland, with other leading doctors, engineers and statisticians made a formidable team that worked to reform hospitals, military and civil, and reduce death rates for decades after the Crimean War. The real story of that work, and the significant role statistics played in it, is of great interest and remains to be told.

7.1 The Other Extreme: Exaggerating Nightingale's Achievements

While so much recent literature is negative on Nightingale's work, an earlier literature which exaggerated her achievements continues to be cited. Zealous commentators then variously credit Nightingale and her nurses with bringing down the death rates, thanks to bedside patient care, not a claim Nightingale ever made. The death rates themselves are sometimes exaggerated. Three examples will be given here.

A prize-winning biography of Nightingale gave the "mortality of the Crimean disaster, 73 per cent in six months from diseases alone," a gross exaggeration. It was fair enough in blaming "the system which controlled the health administration of the British Army" for what were high death rates (Woodham-Smith 258). The 73%, no source given, is likely a mistaken quotation from Nightingale, when she made a dramatic example of the death rate of eight regiments at the front, from a total of 68 regiments, over a six month period (Nightingale 1858a in McDonald 2010, 469). She even named the regiments, while Woodham-Smith's version seems to apply it to the whole army.

An American book on community health nursing put the 73% into a range, 42-73%, specifying a decline to 2% in six months (the decline is accurate, but it took longer to achieve). It credited Nightingale's "radical and well-documented interventions based on sound public health principles," which were, it said, the result of "careful, scientific epidemiological research." (Lundy and Janes, *Community health nursing*, 80). Yet Nightingale's research only began after her return to London post-war.

A speech by a leading surgeon and Nightingale collector, at an event in New York, also exaggerated Nightingale's role in reducing the death rates. Hugh Auchincloss had the correct decline, from 420 per 1000 to 22 per 1000, although again with too short a period, three months. While he cited her publications and correctly had her understanding the core relations between "dirt and disease," he then added, incorrectly: "Above all, she checked all her efforts by statistics, with a scientific caution far ahead of her time." One can agree with him that she could be known as "The Lady with the Slide Rule," (Winslow. 1846, 331) but must realize that she did all her research post-Crimea, with the help of medical experts, War Office reports and the assistance of William Farr and clerks at the General Register Office.

7.2 The 60% Mistake: Death Rates Exceeding the Great Plague of London

Nightingale herself was responsible for one exaggerated death rate, although with no accompanying claim of credit for reducing it. The 60% error regarding Koulali noted above, for one month, now seems to have been the source for a 60% general death rate, of "troops," not just one hospital, for seven months, not the worst month. This first appeared in her evidence to the Royal Commission: "We had, in the first seven months of the Crimean campaign, a mortality among the troops at the rate of 60 percent per annum from disease alone, a rate of mortality which exceeds that of the Great Plague in the population of London, and a higher ratio than the mortality in cholera to the attacks" (U.K., 1858, Appendix, paragraph 9996, in McDonald, 2010, 897). In her lengthy report, she called the "enormous" mortality of the Peninsular War against Napoleon a "small matter" compared to the 60% "of the whole force," from October 1854 to May 1855 in the Crimea (Nightingale, 1858a, in McDonald, 2010, 584).

The 60% rate then was quoted by a major American statistician, who then credited "her vigorous use of statistics" to reduce it. After correctly noting the lack of uniformity in reporting on deaths, he cited her "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, 389). However, she had no control over the collection of data in any hospital, but used the official data, available only after the war for her research. Cohen repeated the 60% error, with the "Great Plague of London" reference (1984). His later work on Nightingale correctly flags the work of the Sanitary Commission, but with the same 60% error (Cohen, 2006, 164).

Other authors have tied the mortality reduction from 60% to the provision of nursing. A French doctor, in a book on the 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). Numerous nursing books make nursing care the crucial change, although without the 60% exaggeration.

An American nursing history, published in fifteen editions, had the correct reductions in mortality, but shortened the process and attributed the success to Nightingale: "In two months she had transformed the hospital into an efficiently

managed institution. In six months she had reduced the death rate to 2 percent (Dolan, 1968, 216).

An article on safety in health care credited Nightingale with both sanitary reforms and record keeping that she could never have undertaken: “She recorded the outcomes of care. The death rate among the patients was worst in February 1855 at 42.7% of all soldiers admitted. After her sanitary reforms, which started on 17 March 1855, the death rate fell to 2.2% by June 1855. She showed a causal link between the sanitary reforms and this dramatic fall in mortality“ (Neuhauser, 2003, 317). The drop in mortality is accurate, but it was the Sanitary Commission that started work in March, 1855; Nightingale had arrived in November and done what she could, short of the rebuilding of infrastructure that only engineers with a sizable work force could have. Showing the link between sanitary reform and the fall in mortality was her work--done in the two years following the war.

7.3 Implications of Errors for Policy Making

Numerous other books and articles give exaggerated statistics and credit Nightingale and her nurses, or Nightingale alone, for reducing the death rates. While this is superficially flattering, it also shows that Nightingale was not taken seriously. She never claimed that patient care made the difference, but the cleaning up of the sewers and drains, better ventilation, clean bedding and clothing and improved nutrition. The difference is fundamental: Nightingale believed that good research could help to save lives, by leading to an understanding of causal laws. It is doubtful that the best bedside care in the world could save lives if the water is polluted and bedclothes unwashed, laden with vermin and feces. The “Lady with the Slide Rule” was also the person who got laundries and kitchens going, and purchased essential supplies when they were missing. The devil is in the details. Not only is a laundry essential, the water must be hot enough to kill pathogens.

8. Conclusions

Statistics can save lives, but only if the lessons are correctly learned and adequate changes made, which must then be monitored. Nightingale was a firm believer in the possibility of unintended consequences, a lesson she learned from Quetelet. Her research methods still make good sense for the social and health sciences, especially for those who seek to apply research results to make changes in the real world.

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