

William Farr: Founder of Modern Concepts of Surveillance

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Considerable confusion surrounds the use of the term surveillance in the context of public health but the principles underlying all uses are as old as epidemiology itself. William Farr has contributed more than anyone else to the development of these principles and to the demonstration of their value in practice on a large scale. This paper re-examines the basic tenets which guided him and the methods and techniques which he developed in the hope of reviving insights and resetting standards that modern epidemiologists might, with benefit, strive to emulate.

The meaning of the term surveillance in public health practice has been in a rapid stage of evolution during the past twenty-five years. Considerable confusion now surrounds its use but the basic principles underlying all uses are as old as epidemiology itself. No one has contributed as much as William Farr to the development of these principles and to the demonstration of their value in actual practice on a large scale (1, 2).

Therefore, it is perhaps worthwhile to pause a moment and re-examine the basic tenets which guided him and the methods and procedures which he developed. Such a study may revive insights that have become clouded and reset standards that modern epidemiologists may strive to emulate. The present paper is an attempt to do this.

EVOLUTION OF THE MODERN CONCEPT

Until 1950 *surveillance*, as used in the public health setting, defined the specific but limited function of watching contacts of certain serious diseases such as plague, smallpox, typhus and syphilis. The obvious purpose was to detect first symptoms so that prompt isolation could be instituted. In concept, this involved maintaining a responsible alertness and seeing that appropriate action was taken on indication. It was a more sophisticated and democratic function than the restrictive practice of quarantine.

Beginning in 1950 in the United States the term *surveillance* was applied to specific diseases rather

than to single individuals (3, 4). The methodology included systematic collection of relevant data and their constant evaluation and dissemination to all who needed to know. The obvious purpose was to improve the control of disease. The underlying concept originating with Farr was the faith that with well-informed officials supported by an understanding public, corrective measures will be taken.

The early results of this programme were conspicuously successful (3, 4). Malaria was found to have disappeared spontaneously as an endemic disease and the major mosquito control programme became redundant. Smallpox similarly was non-existent. Of several hundred reports each year none could be verified. The surveillance of poliomyelitis beginning in 1955 clarified the problem of cases arising from inoculation of inadequately inactivated vaccine (The Cutter Incident) and then served to guide the national effort to control the disease over the ensuing decade. Similarly, in 1957 the surveillance programme guided the national effort to limit the damage from the pandemic of Asian Influenza.

During the past 14 years surveillance has been applied in the USA not only to all communicable diseases of national importance but to the systematic study of all manner of non-infectious diseases including leukaemia, congenital defects, drug reactions, nutritional problems and a wide variety of environmental and occupational hazards.

Internationally, the term was adopted officially in Czechoslovakia early in the 1960s (5), and in 1968 was broadly endorsed by the World Health

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Organization where it was the subject of the technical discussions at the 21st World Health Assembly (6). With increasing popularity the term has been given greatly expanded meaning in the nosology of the WHO Malaria Eradication Programme. Surveillance has been extended to embrace active measures of control; namely, chemotherapy of patients and insecticiding of premises (7). In the Smallpox Eradication Programme surveillance has become synonymous with containment including active vaccination of large numbers of people (8). Recently Doll (9) has equated surveillance with 'monitoring and audit' and applied the term to the evaluation of medical care services including the reporting of a large number of carefully planned research studies. It almost seems that surveillance is now extending into the field of medical care beyond the usually accepted limits of epidemiology itself. This trend is not only etymologically incorrect but also clouds the meaning of a useful and rather specific descriptive term.

FARR'S CONTRIBUTION TO SURVEILLANCE METHODOLOGY

Farr's contributions have been quite comprehensively condensed in a memorial volume published in 1885 (1) but until recently this was not readily accessible (2). It would be repetitious to cover the full scope of Farr's contribution as a demographer, an actuarial scientist, an epidemic theorist, a social reformer and a humanitarian (2, 10). Rather, this paper will stress his role as an actively practising epidemiologist and urge that future use of the term surveillance be limited to the practices and concepts so vividly illustrated by Farr's career.

When the General Register Office was established in England and Wales in 1838 William Farr was appointed compiler of statistical abstracts and later Superintendent of the Statistical Department, a position he held until his retirement in 1880. He thus was in a position from the start not only to influence, indeed, to determine the character and quality of the data collected on births, deaths and marriages but also to control their analysis. In this role he remained free of the administrative chores of designating over 2,000 registration districts and supervising the designation of local registrars. Undoubtedly a key to Farr's success was the 'entente cordiale' which marked the long continued official relationships between him and his Registrar General, Major George Graham (10). He immediately directed his attention to a new

system of nosology, finding all existing ones wanting. He states in the First Annual Report:

'Nomenclature is of as much importance in this department of inquiry as weights and measures in the physical sciences and should be settled without delay.'

The classification which he established was broadly based on three groupings: epidemic, sporadic and external (violent) causes. He combined many then prevalent separate diagnoses into logical classes using both aetiological and anatomical associations. His classification influenced the development of vital statistics throughout the world and is still visible in the modern International List.

He was acutely aware of the necessity of matching his registered 'numerator data' with appropriate census 'denominator data'. Although he had no official position in the conduct of the 1841 census he is credited with influencing the authorities to include a complete enumeration of the ages of the people which had been omitted from the previous census of 1831 (10). He was an Assistant Commissioner of the censuses of 1851, 1861 and 1871 and essentially wrote the Census Reports of these years including the calculation of definitive life tables. Thus, from early in his career he gained complete access to and substantial control of the basic sources of epidemiological and demographic information for England and Wales. He proceeded to exploit these with consummate imagination and talent and by means of weekly, quarterly, annual, decennial and special reports he brought to official and public attention the results of his keen analyses. Unique as a civil servant he did not cleave to the neutrality that his office could have afforded. He presented his analyses with objectivity but then stated his own interpretations forcefully and argued fearlessly for his recommended changes regardless of what vested interests might be involved.

He was not constrained to his official reports but regularly contributed papers to the *Lancet*, read papers at national and international professional conferences and even resorted to the public press when he felt the conditions necessitated. For example in a letter to the *Daily News* during the cattle plague in London in 1866, he courageously predicted a rapid termination of the epidemic countering a prediction of doom by a prominent member of Parliament (11).

His underlying dedication to the importance of carefully analysing and continually reporting his studies of mortality rates and of the benefits that will arise permeates all of his writings. For example,

in his letter to the Registrar General appended to the First Report (dated 18 May, 1838–1839, page 89), Farr shows that annual death rates of different communities differ from a low of 20 to a high of 40 per thousand. In the less salubrious areas—

‘. . . half the life is passed in infancy, sickness and dependent helplessness . . . in exhibiting the high mortality, the diseases by which it is occasioned and the exciting causes of disease, the abstracts of the registers will prove that while a part of the sickness is inevitable and a part may be expected to disappear by progressive social amelioration a considerable proportion may be suppressed by the general adoption of hygienic measures.’

He goes on to affirm that it should be possible to reduce annual deaths by 30,000. He thus immediately allied himself with Chadwick and the advocates of social and hygienic reform of his day.

In the Second Annual Report, page 70, Farr expands on his sense of obligation as custodian of these vital records—

‘. . . the facts of the appendix are published in sufficient detail to be available in the study of special causes. The physicians all over the country will find at their disposal the materials for investigating the various forms of fatal disease in their own neighbourhood and the means of comparing them with diseases of other localities. The intelligence and sagacity of all the members of the medical profession will thus be brought to bear in the facts of the report and it may be confidently anticipated that in the lapse of time innumerable results will be elicited of the highest interest to the medical service and humanity.’

Edwin Chadwick, Florence Nightingale and John Snow are but three great leaders that owe an immeasurable debt to Farr.

Farr in no sense felt limited to the official data that he was responsible for collecting. He was an omnivorous reader of current and historical references. In his official reports he quoted extensively from any source that he deemed pertinent. Thus, in the Fifth Annual Report dated 14 August 1843, he focused on Oliver Wendell Holmes’s paper ‘On the Contagiousness of Puerperal Fever’ that had been published in Boston in April of the same year. He quoted at length from a Mr. Robert Storrs, Surgeon of Doncaster, who reaffirmed Holmes’s conclusions from his own experience. Furthermore, Farr reinforced Storrs’ recommenda-

tions that after attending a patient with erysipelas an obstetrician should pay strict attention to ‘ablutions of the hands, and a total change of raiment’ before treating a pregnant woman.

Influenza 1847

In the main body of the Tenth Annual Report for the year 1847 appears a vivid narrative account of an influenza epidemic. Although the three page report is printed over the signature of the Registrar General, the often flowery prose, the rigorous marshalling of statistical data, and the unqualified confidence of conclusion are unmistakably Farr.

Table I can be reconstructed from the narrative. Mortality was stable during late October and the first few weeks of November and thus provided a first approximation for expectancy or ‘mortality for the season’. In late November there was a sharp increase in total deaths and in deaths ascribed to influenza, to bronchitis, to pneumonia and to asthma. This increase peaked in early December but elevated mortality continued through the rest of the year and on into January although the later data were apparently deemed inappropriate in an 1847 Annual Report.

The epidemic was most fatal to adults and the aged, mortality being increased during the peak weeks by 104 and 247 per cent, respectively. The mortality largely spared the 4 to 25 age group. Thus the age-specific mortality was ‘U’ and not ‘W’ shaped, as in the 1918 pandemic. There were only slight differences in mortality by sex but marked ones by geographical area. Using a broader basis for expectancy, namely, a seven year average of the total mortality during the last six weeks of the year, the annual rate in Lewisham, a healthy district, was increased from 17 to 27. Similar rates in St. Georges in the East, an unhealthy district, was increased from 29 to 73. The excess mortality was therefore more than four times higher in the latter district than in the former.

Farr uses this epidemic to chide physicians mildly on their narrow views pointing out that sharp increases were observed not only in influenza itself but in bronchitis, pneumonia and asthma and many other non-respiratory causes, he states:

‘. . . there is a strong disposition among some English practitioners not only to localize disease but to see nothing but the local disease. Hence, although it is certain that the high mortality on record was the immediate result of the epidemic of influenza, the deaths referred to that cause are only 1,157.’

TABLE I
*Influenza epidemic, London, 1847**

Week ending	Total deaths	Influenza	Bronchitis	Pneumonia	Asthma
30 October	934	1	36	62	12
6 November	1,052	2	49	68	12
13 November	1,098	4	58	79	12
20 November	1,086	4	61	95	12
27 November	1,677	36	196	170	77
4 December	2,454	198	343	306	86
11 December	2,416	374	299	294	78
18 December	1,946	270	234	189	52
25 December	1,247	142	107	131	14
1 January	1,599	127	138	148	26
Totals					
24 October–27 November	4,181	11	204	304	48
28 November–1 January	11,339	1,147	1,317	1,238	333
Average					
24 October–27 November	1,045.3	2.7	54	76	12
Excess					
28 November–1 January	5,067.5	1,131	1,011	782	261

Total excess respiratory deaths = 3,185.

Total excess non-respiratory deaths = 1,882.5.

* Reconstructed from Tenth Annual Report of the Registrar General.

Farr had no trouble ascribing the total excess mortality from all causes to the epidemic even though this still presents problems to some clinicians and epidemiologists in recent times. Epidemics continue to be described with emphasis placed on deaths ascribed to 'influenza' even though these may comprise 20 per cent or less of the total impact on mortality of an epidemic.

In this rather simple abbreviated report included in the routine annual statements in the 1847 message of the Registrar General, Farr developed in detail the methodology of excess respiratory and total mortality which has been widely used in modern times to identify and quantitate influenza epidemics. Few large epidemics in modern times have been described as precisely.

Cholera

Farr's role in the studies of cholera in the 1848–49, 1853–54, 1866–67 epidemics epitomizes the contribution that surveillance makes in controlling disease. The story has been thoroughly and repeatedly recounted so that only highlights need mention.

During the pandemic of 1848–49 Farr organized an intensive study of the cholera returns throughout

England and Wales and he issued a fully documented voluminous special report. The introduction to this report reveals his motivation. In emphasizing the 'calamity of 52,293 registered fatalities' he points out:

'... in following cholera through its fatal way however the inquirer meets with some grounds of consolation. He sees places on every side which the epidemic passed over leaving the inhabitants in the serene enjoyment of health and complete immunity and the hope is perhaps not fallacious that an examination of the results of the second may be the means of mitigating if not preventing a third invasion. For whatever may be the immediate cause of cholera it will appear evident that in England it is only seriously fatal under certain known physical conditions which admit to a great extent of remedy.'

Farr's particular interest at that time was seeking epidemiological verification for the miasmatic theory then so widely popular. His approach was to measure mortality rates by elevation above sea level assuming that emanations from the heavily polluted river would be progressively diluted by

altitude. He found some remarkably consistent relationships which must have seemed very persuasive to those who believed in miasms.

He did not, however, ignore water which was widely assumed to be in some vague way unhygienic. Actually in the late autumn of 1848 when only a small premonitory wave of cholera had appeared in London, Farr published in the weekly returns a table showing mortality by areas of London according to their water supplies. Those most contaminated with sewage from the River Thames experienced the highest mortality. He called on the water companies to accelerate improvements they were then planning. It would indeed be interesting to know the origin of this table. Was it possibly instigated by Farr's association with John Snow, who was then developing his highly specific ideas about the importance of water, or was it merely a logical table to construct because of the general interest in water supplies as part of the great sanitary awakening? At any rate from that time on extensive tables showing current mortality rates by water supply appeared in Farr's publications.

Cholera disappeared in 1850 but reinvaded England in the autumn of 1853, again in a relatively small epidemic of less than 1,000 deaths. Farr again analysed mortality rates by water sheds in London and showed that an area where the water supply had been partially improved the rate was partially lowered in comparison with adjoining areas where the supply still was wholly contaminated. On the basis of this rather thin amount of evidence, Farr confidently predicted a severe epidemic for the following summer and again publicly urged the water companies to 'accelerate their progress' in 'an extraordinary emergency'.

Cholera did indeed return with severity in 1854. John Snow completed his definitive studies both of the Broad Street Pump Outbreak and the massive epidemic in South London with considerable logistic help from Farr. It is noteworthy that in a weekly return of 14 October 1854, Snow's preliminary findings for the first six weeks of the epidemic in South London, from 28 August to 7 October, were published for the world to see. Farr lived in no ivory tower. His weekly return was no archive for stale data but with his facile pen became a literate weapon for effecting change.

Cholera returned to London in its last outbreak in 1866. This time Farr took a prompt and aggressive position, tracing the outbreak to contaminated water from the River Lea, naming the

responsible officials, and holding his ground over severe criticism and through many official boards of review.

DISCUSSION

The above vignettes of Farr's active practice of epidemiology characterize a rather specific public health function which in recent times has been termed surveillance. Farr concentrated his efforts on collecting the relevant facts, on assembling and evaluating them, and on reporting them to responsible health authorities as well as the general public. He made only judicious sorties into the field of research. He chose to limit his efforts to the data coming under his jurisdiction with occasional supplemental questionnaires such as surveys of water companies in London regarding their sources of supply and requesting local registrars in the subdistricts of South London to determine the exact water supply in the homes of fatal cases of cholera during the 1854 outbreak. Although he kept fully informed on the rapidly developing fields of medicine and public health and probably stimulated a number of research studies, he did not consider it to be his role to mount or direct research studies outside the realm of registered mortality and the census.

Likewise he limited his actions regarding control measures to the forceful presentation of the epidemiological facts with his own unequivocal conclusions and specific recommendations. He recognized that responsibility for enforcing control measures belong to the official health authority and involved complex administrative budgetary and political problems which he was ill equipped to solve. To Farr this surveillance function made him an active participant in the dynamic health movements of his times. It was more active and rewarding than the relatively passive functions of monitoring or auditing but it was limited and avoided the entanglements that might well have deviated him from his basic responsibility.

Modern epidemiologists in active practice of their profession would do well to emulate the precedents set by William Farr.

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