"*On Prognosis*" by William Farr (British Medical Almanack 1838; Supplement 199–216) Part 1 (pages 199–208)

Typed and edited by Gerry Bernard Hill

Introductory note by Alfredo Morabia

The publication of "*On prognosis"* in the series on the history of epidemiological methods was a suggestion of Gerry B. Hill. It is published here in two parts. The main reason was that the paper's size was too long to fit in a single issue. We tried however to keep together the sections that could not be separated. For example, the whole discussion on the "force of mortality" appears in part II. We have reproduced the footnotes at the bottom of the page, as they appeared in the original document. The figures had to be reproduced. The photocopies of the original document were too poor to be reproduced as such. Each part will appear along with editorials and commentaries by Gerry B. Hill, Bud Gertsman, Jan Vandenbroucke and John Eyler. The publication of "*On prognosis*" belong to our series on the history of epidemiological methods because it is a precious testimony of the birth of epidemiological concepts (risk-vs-rates) and of statistical analytic methods (linear regression) in the first half of the 19th century. As stressed in the editorials and commentaries, these concepts and methods will be progressively formalized and taught in the following decades.

"On Prognosis" by William Farr

Prognosis, from *πρω*, before, and *γνωσιζ*, (*γνοω* know), knowledge, is literally translated by foreknowledge. Foretelling presupposes fore-knowledge; and prognosis is employed, in medicine, to designate the art of fore-seeing and foretelling the course and issue of diseases. It implies that vital phenomena succeed each other in a determined order; and that when one of a series is observed the existence of others may be inferred. The fundamental problem in medical prognosis is, from a given group of morbid phenomena, to determine the phenomena that will follow or that have preceded, and their mutual relations. The etymology restricts the application of prognosis to the future, but the idea of futurity is accessory. Hippocrates, in the second sentence of Prognostics, speaks of *predicting* "things present, things *past*, and things to come;" so that prognosis, in the etymological sense, is but a part of the subject. So important, however, is a knowledge of the future; so much more precious the power of foreseeing the events unaccomplished and controllable, than of telling things past and irremediable, that the emphatic term prognosis may still be employed, with the qualification that it shall include the science of the laws of succession of all morbid phenomena, whether regarded as past, present, or future.

Every medical man should be well versed in prognosis. It will enable him to take into consideration the subsequent phases of the malady, and rescue him from the system of expediency, where every symptom is treated as an isolated fact, and, according to the urgency of immediate circumstances, without regard to the subsequent states through which the patient must inevitably pass; while diseases often require to be treated, in the early stages, for phenomena not developed, and only acquiring intensity at a future period. This is the case with phthisis, the exanthemata, and fevers. An accurate prognosis in such cases gives the physician the advantages a general possesses, well informed beforehand of the enemy's forces, plans of battle, and order of attack. Hippocrates does not forget to enumerate one advantage of prognosis, which savours of the Greek cunning, the father of medicine sometimes discloses in turning the prejudices of his patients to account. "By telling," he remarks, "the past, present, future, and recalling things the patient forgets, you gain his confidence, he places full reliance on your skill, and dares commit himself into your hands unreservedly. To cure all the sick is impossible; to predict which patients will die, which will recover, will screen the practitioner from blame." This is founded on a well-ascertained prejudice. Great credit is

Soz.- Präventivmed. 48 (2003) 219–224
0303-8408/03/040219–06
DOI 10.1007/s00038-003-3004-8
© Birkhäuser Verlag, Basel, 2003

often gained by predicting the death of a patient where the bystanders perceive no danger. Nothing more forcibly impresses the minds of the common people; who have always treated their historians with calm indifference, their prophets with admiration and worship. It is, nevertheless, rare that the physician has to perform this mournful function, and to prophesy death. There is almost always a chance, and generally a strong probability of recovery. Nine times in ten he is the messenger of glad tidings; and it is seldom that he cannot point out some dawn of hope – some streak of light – when the horizon is darkest.

The reduction of the phenomena of disease to simple laws, susceptible of calculation, offers the same attraction as other fields of investigation; but its intimate connexion with human interests and sufferings gives it stronger claims on attention. To lessen the danger and duration of disease is the main object of medical science; this is the public function intrusted to the medical profession; but the laws of disease, the degree of danger, the extent and duration of morbid processes, must be determined before the relative value of remedial agents can be ascertained. Prognosis, then, naturally precedes Therapeutics in the order of study, and is preceded by Diagnosis. Many pretend to treat disease successfully with a very imperfect knowledge of prognosis; and to predict the death of patients without an accurate knowledge of the seat or nature of maladies. Nurses and empirics, with and without licences, are examples of these short-hand intellects.

In prognosis patients may be considered in two lights: in collective masses, when general results can be predicted with certainty; or separately, when the question becomes one of probability. If 7000 of 10000 cases of fever terminate fatally, it may be predicted that the same proportion will die in another series of cases; and experience has proved that the prediction will be verified, or so nearly verified as to leave no room for cavil or scepticism. The recovery or death of one of the cases is a mere matter of probability. Here, as Celsus has said, *medicina ars conjecturalis est*; but not in the shallow sense some persons imagine, that everything is at random in individual cases; for if medicine be guessing, it is at least the *Art of guessing*. The rate of mortality determined for 10000 cases applies, as a general standard, to each patient ; and the probability of death is 0.07, of recovery 0.93; the probability that the fever patient will recover is 93 to 7, raised or lowered by particular circumstances. This distinction applies to the prediction of all organic changes: collectively they can be predicted, where data exist, with certainty; individually their probability can be determined.

Prognosis may be extended to every kind of morbid phenomena; but, practically, it can only be applied, at present, to events of decided importance. The following are examples of several kinds of prognosis. Recovery may be predicted in cholera, fever, confluent small-pox, pneumonia, all acute diseases; for the general chances of recovery (at least under the age of 40) are equal to the chances of dying in these diseases; and generally as 2, 3, 4, and even 14 to 1. Death may be predicted in rupture of the intestine, phthisis, lumbar abscess. The probability of other diseases being developed in the course of the first may be determined: thus, local inflammations supervene in chronic diseases and fevers; perforation of the ileum occurs a certain number of times in the latter stages of typhus, of the pleura in pulmonary phthisis, and nearly always proves fatal. Haemoptysis is generally followed by phthisis; the pulmonary symptoms of phthisis by ulceration of Peyer's glands. Tubercular cachexia is the forerunner of phthisis (Clark). Dyspnoea from infancy, and clear sounding projections upon the chest, and over the clavicle, imply the existence of emphysema; whence may be predicted paroxysms of asthma, dilatation of the heart, oedema. Sometimes the recurrence of the same disease may be prognosticated; of epilepsy, insanity, apoplexy, catarrh, rheumatism, intermittent fever. The same method is applicable to these and other cases of the same kind; and to the whole facts included in the prognosis.

In prognosis (1) the patient may be considered, (2) the circumstances in which he is placed, and (3) the disease. The age, sex, temperament, habits, strength, intellect, passions, fall under the first head.

a. The patient

Age. It had long been observed that the rate of mortality is high in infancy, that it declines to the age of puberty, then increases, and in old age proceeds with increasing rapidity. Mr. Edmonds discovered the law regulating the mortality of the general population at all ages; he found that the mortality increased from puberty 3 per cent every year[1] up to 50–60; and 8 per cent afterwards annually up to the end of life. Dr. Southwood Smith gave in his excellent book the *Philosophy of Health*, a column of the mortality at different ages in cases of fever treated in the *London Fever Hospital*; but Mr. Finlainson by whom the calculation was made, withheld the data on which it was founded, merely stating that the observation comprehended 6000 cases. Mr. Edmonds proved that the rate of mortality in Dr. Smith's observation increased 34 per cent every ten years, (3 per cent annually) and also that the same law applied to sickness, and cases observed in the London Hospital.[2] From facts published by the Factory Commissioners, I showed

[1] Life Tables 1832. Supplement to British Medical Almanack 1837, page 130.
[2] Lancet, Feb. 27th and Sept. 3rd. 1836. British Medical Almanack 1837, page 138.

Soz.- Präventivmed. 48 (2003) 219–224
© Birkhäuser Verlag, Basel, 2003

that among 2934 labourers in the East India Company's service, and persons employed in Factories, the attacks were nearly the same at all ages; and that the fatality of cases and the quantity of sickness, increased with age nearly at the same rate.[3] But as all the data were not given, or given in an unsatisfactory form, the value of these observations was much diminished.

In the spring of 1836, I collected, by the kind permission of Dr. Gregory, Physician to the London *Small Pox Hospital*, a series of 7851 cases, 2176 deaths of Small Pox, at every consecutive five years of age; a greater number of deaths than had entered into the previous observations. The facts are here given in detail; they have been carefully recorded by the officers of the institution; and though I went over the books but once, and the columns of deaths is far removed from the ages, there is probably no error of any consequence to the results. Two periods were taken: the first (20 years 1780–99) before vaccination had had any influence, the second embracing the 10 years ending in 1835.

The mortality of cases, at the age 0–5 years, was 41.97 per cent; it declined 19.12, and rose till at 50 and upwards it was 79.41. The minimum was attained at 10–15, at $12^1/_2$ years of age – when the probability of recovery was 4 to 1; the probability of recovery was reduced to 2 to 1 at the age 20–30; to 1 to 4 after the age of 50. The fatality of the cases, beginning at puberty, (10–20), increased at rates very nearly represented by 34 per cent; as will be apparent on comparing the mortality observed every 10 consecutive years, with the mortality calculated from one basis. Some of the calculated numbers, that advance regularly, are above, others below the numbers directly observed.[5]

[Small Pox Hospital Data]*

Age	10–20	20–30	30–40	40–50	50–
Deaths per cent (observed)	23.29	34.07	46.54	58.33	79.41
Deaths per cent (calculated)	24.66	33.12	44.46	59.70	80.11

Table Of 7850 cases of Small Pox, and 2475 Deaths at every five years of Age

Age	Cases				Deaths			
	1780–89	1790–99	1826–35	Total	1780–89	1790–99	1826–35	Total
0–5	0	16	240	256	0	1	104	105
5–10	43	37	184	264	9	10	45	64
10–15	258	169	190	617	40	41	37	118
15–20	871	766	666	2303	223	210	129	562
20–25	1083	870	812	2765	419	295	207	921
25–30	363	276	332	971	159	98	95	352
30–35	156	90	92	338	72	44	41	157
35–40	55	29	40	124	28	11	19	58
40–45	47	29	15	91	|	|	|	|
45–50	28	18	7	53	46	24	14	84
					|	|	|	|
50–	35	26	4	68	29	21	4	54
All Ages	2939	2329	2582	7850	1025	755	695	2475

Deaths in 100 cases of Small Pox at eight different ages

Age	Deaths per cent	Age	Deaths per cent
0–5	41.97[4]	30–40	46.54
5–10	24.24	40–50	58.33
10–15	19.12	50–	79.41
15–20	24.40	All Ages	31.53
20–30	34.07		

The application of this principle to practice is very obvious: small pox is dangerous in infancy; safest at puberty; and from that age the danger increases *one-third every ten years.* Sydenham says, "that persons in the prime of life are in greater danger in small pox, than women or children under fourteen."[6] This is all an observer so accurate could detect by the old methods of investigation.

The influence of age upon the mortality in *Cholera*, is exhibited in the following extensive series of observations,

[3] Macculloch's Statistics of the British Empire, Art. Vital Statistics, vol. ii, page 576.

[4] (ed.) Farr made an error in the second place of the subtraction of log(256) from log(105).

[5] To obtain the 5 calculated numbers, multiply 24.66 (λ1.3920) and every successive number produced by 1.343 (λ0.128). (ed.) λ denotes logarithm to base 10.

[6] Works, vol. 2, page 53. Edition, Wallis, 1788.

* Titles in brackets have been added.

Soz.- Präventivmed. 48 (2003) 219–224
© Birkhäuser Verlag, Basel, 2003

published from official Reports in the Austrian Medical Journal. The Reports were by Dr. J. Knoltz.[7]

Table showing the Deaths per cent and the Cases and Deaths of Cholera at eight different ages in Vienna and the country round in Lower Austria.

Age	in Vienna			in the country		
	Cases	Deaths	Deaths per cent	Deaths per cent	Deaths	Cases
0–10	327	174	53.21	41.87	206	492
10–20	478	188	39.33	38.66	196	507
20–30	837	317	37.87	31.81	307	965
30–40	801	356	44.45	34.49	219	635
40–50	690	363	52.61	40.71	208	511
50–60	635	370	58.27	43.27	167	386
60–70	374	249	66.43	49.35	113	229
70–	220	171	77.73	52.00	65	125
All Ages	4360	2188	49.02	38.46	1481	3848

There are two anomalies in these observations; the mortality attains its minimum at the age 20–30; and it does not increase so fast as in other observations. The rate of increase every ten years is 16 per cent; and 1.1596 (λ0.06245)[8] has been used to calculate the subjoined series of numbers running parallel with the facts observed.

Vienna

Age	20–30	30–40	40–50	50–60	60–70	70–
Deaths per cent (observed)	37.84	44.45	52.61	58.27	66.43	77.73
Deaths per cent (calculated)	37.87	43.73	50.49	58.30	67.32	77.73

The rate of increase is nearly the square root of the rate regulating the mortality of small-pox and other diseases (1.16 × 1.16 = 1.3456). But it would be unsafe to speculate on this isolated fact, unless the mode in which the observations were made had been detailed, in the Austrian report, with less official brevity. There has been everywhere a culpable disposition to deny the name of cholera to all cases not absolutely fatal; and so much dreaded the exaggerating the effects of treatment as to falsify science. This falsehood, like falsehood of every species, defeats its purpose. While it diminished the number of cases of cholera, it augmented the mortality, the opprobrium of medical art, and the terror it was intended to allay. Is it not a fact that where the mortality was 49 per cent the severer cases only were reported, and that milder cases, a majority of which occur in early life, were excluded? This would diminish the number of favourable cases at 10–20, 20–30, and make the apparent rate of dying increase less rapidly with age.

Age appears to have the same influence on the duration of diseases as on the mortality ; cases become one third longer every ten years from puberty.[9] There is a certain class of diseases, of long duration, deemed incurable, where the morbid process only ends with life. The problem in prognosis is to determine the probability of cure; in a given time this diminishes 34 per cent every ten years, as I have ascertained from observations collected at Bethlem, by Dr. Haslam, in 1784–94[10]. Cases 1664, cured at all ages, 574.

Recoveries from Insanity

Age	10–20	20–30	30–40	40–50	50–60	60–70
Recoveries per cent						
observed	29.0	41.0	34.2	24.0	17.5	12.9
calculated	56.9	42.3	31.5	23.4	17.5	13.0

The patients remained at Bethlem rather more than a year; this observation, therefore, shows the relative number of recoveries, at different ages, in a unit of time – in this instance, nearly a year. From the data preceding two principles may be established: (1) The rate of recovery in a unit of time diminishes 34 per cent every ten years; (2) The mean rate of dying per unit of sick time is the same at all ages. Future observation must show whether these are laws, or isolated facts.

There are few observations of sufficient extent and accuracy to show the influence of the patient's temperament, constitution, habits, &c, on the issue of diseases; and it would be useless to detail our empirical knowledge on these subjects. The mortality of cases in females is less than the mortality in males. This is established by many facts. The following is from an interesting pamphlet by Dr. R. Cowan:[11]

Oct. 1835–6. – Fever Patients in the Glasgow Fever Hospital

	Cases	Deaths	Deaths per cent
Males	1116	180	16.1
Females	1141	110	9.6

[7] Einige Notizen über die Brechdurchfall's Epidemie in Wien und auf dem platten Lande von Nieder Oesterreich in dem Jahre, 1831/2 betreffend. Aus dem Sanitäts Berichte des H. Dr. J. J. Knoltz. The mortality of Cholera was lower at all ages in the country (platten Lande) than in the city of Vienna: at the age 20–30 the mortality from Cholera (city and country 34.62) was scarcely greater than the mortality of small pox in London (34.07 per cent).

[8] (ed) λ denotes logarithm to base 10.

[9] See "British Medical Almanack" 1837, page 136. "Macculloch's Statistics of the British Empire." Article "Vital Statistics", page 284.

[10] See the facts in "Statistics of English Lunatic Asylums," by W. Farr.

[11] Statistics of Fever and Small Pox in Glasgow, April 28th, 1837.

© Birkhäuser Verlag, Basel, 2003

b. External Circumstances

The influence of external circumstances and applications on the issue of diseases is unquestionable; on another occasion I will endeavour to ascertain how much residence in cities and crowded hospitals, exposure to cold and want increase the danger of disease; how much drugs and medicines diminish the mortality. The seasons do not appear to modify the mortality of small pox to any extent.

London Small Pox Hospital, 1780–9. Cases admitted, 2952, – Deaths, 1034

Months	Temperature	Dryness (Daniel)	Cases admitted	Deaths	Deaths per cent
Dec-Jan-Feb	38°	2°.2	760	266	35.0
Jun-Jul-Aug	60°	6°.9	814	271	33.3
Mar-Apr-May	49°	6°.4	634	227	35.8
Sep-Oct-Nov	50°	4°.0	744	270	36.3

c. Diseases

The *third head* of this inquiry is the most important: it does not refer to the previous state of the patient, or accessory circumstances, but to the type and course of diseases.

In fact, the first step in prognosis is generally to determine whether the individual is ill, and what is the nature of the malady; for the fate of the patient depends upon his actual state; and the probability of recovery is often regulated by the probability and accuracy of diagnosis. Thus, to distinguish some malignant tumours, tubercles in the lungs, ischuria renalis, from other types of disease, is the principal element, in such cases, of prognosis; for these diseases are fatal, while those with which they may be confounded are attended with little danger.

It is to be regretted that the relative mortality of different diseases is still unknown. To determine the mortality of diseases they should be followed from the beginning to the end; every death or recovery should be recorded; and this, though exceedingly simple, has been rarely done. The mortality of cases can only be accurately ascertained by practitioners, who see cases as they occur, slight or severe, and seldom lose sight of them to the end.

Diseases may be examined (1) in their tendency to destroy life, expressed by the deaths out of a given number of cases; and (2) in their mean relative force of mortality, expressed by the deaths out of a given number sick at a given time. The following observations illustrate the mortality of different diseases. They are from the Austrian official returns of epidemic diseases in Lower Austria, Austria on the Ems, Bohemia ; and include 4–6 epidemics of each disease occurring between 1826 and 1832. The cholera in Galicia was the epidemic of 1831.[12]

	Cases	Deaths	Deaths per cent
Cholera (Galicia)	255774	96081	37.6
Fever (catarrhal, nervous, typhus)	1273	143	11.2
Dysentery	3961	418	10.8
Small-pox	14804	1588	10.7
Scarlet fever	2422	211	8.7
Hooping cough	8007	533	6.7
Measles	14051	327	2.3

Hence it appears that the probability of recovery from measles is as 97.7 to 2.3 (42 to 1); and that the chance of dying is three times greater in hooping cough, four times in scarlet fever, five times in fever.

The mortality in the *London Small Pox Hospital* in the fifty-six years from 1780 to 1835 has been deduced from a statement of the annual mortality published by Dr. Gregory:

Years	Cases	Deaths	Deaths per cent
1780–9	2954	1031	34.90
1790–9	2322	763	32.86
1800–9	1574	478	30.37
1810–9	1188	357	30.05
1820–9	2225	658	29.57
1830–4	1590	388	24.40
1780–834	11853	3675	30.99

The decrease of mortality is due to the admission of a greater number of cases occurring after vaccination. In the ten years 1826–35, when 2593 cases were treated, 693 died = 26.73 per cent. 2264 of the cases distributed according to their character show that the mortality of cases where vaccination had not preceded still remained unabated.

[Small Pox Hospital Data]

	Cases	Deaths	Deaths per cent
Not vaccinated	1393	571	41.1
Vaccinated	789	46	5.8
Inoculated	9	2	
Other diseases	73	1	

This is the mortality of small-pox in cities; in the country it is lower, as will be perceived from the Austrian return. It is probable, also, that the proportion of persons vaccinated is greater in Austria, where the Vaccine Establishment is efficient. In the General Hospital of Vienna, 1834, 533 cases of varicella were treated, and 469 of variola. Of the latter, 82 of

[12] Medicinischer Jahrbucher, &c., vols. 3–10 ; observers Knoltz, Von Nadherzy Streintz, Slawikowski.

Soz.- Präventivmed. 48 (2003) 219–224
© Birkhäuser Verlag, Basel, 2003

160 not vaccinated died (0.51;) 40 of 109 that had doubtful marks of vaccination (0.37); 25 of 200 vaccinated (0.125). Six of the 25 had putrid fever; 9 died of puerperal fever.

To determine the mortality of all attacks of sickness taken indiscriminately, army records furnish valuable data; for every case under the care of the Surgeon is entered, and followed to recovery, but not always to death, in chronic cases, as a certain number are invalided.

Cases treated in the whole of the Prussian standing-army, whether in or out of the Military Hospitals:[13]

Years	Total cases discharged	Cured	Died	Invalided	Missing
1821–30	1160719	1143081	12310	4571	157
Proportions	100	98.535	1.061	0.394	0.013
1831–2	550161	540611	7719	1725	76
Proportions	100	98.269	1403	0.314	0.014

The mortality computed on more than a *million* cases was 1.061 per cent, to which some of the invalided cases should be added. In the 2 years (1831–2) when cholera prevailed, the mortality of cases was raised 32 per cent. The Prussian soldiers are, on average, 20–25 years of age; they remain about 3 years in the service; their numbers in 1826 were estimated at 100000. If the mortality of patients at the age 20–25 is 1.061, the mortality at 50–55 should be 2.57 per cent. Attacks of diseases differ in intensity; some are so slight as to obtain no attention; for others, men consent to take physic; a third class incapacitates them for exertion. Itch, cutaneous and other slight diseases, run up the amount of cases in armies; syphilis constitutes perhaps 20 per cent of the attacks. This class of cases, and injuries got in quarrels, are not recognised by Friendly Societies; and medicine is taken in many cases that never fall "on the box," as the patients continue their employment. At the Liverpool Friendly Society this is clearly exemplified, where there were (1829–37) members equivalent to 23323 living 1 year; and 20251 entitled to relief.[14] The mortality of cases that fell on the box was 3.7 per cent; of the cases attended by surgeons 2.4 per cent; for only 40 applications for sick pay were made annually by 32 of 100 members, while 75 cases to every 100 members were attended by the surgeons, 28 at home, 47 at the surgeries.

Address for correspondence

Dr. Gerry B. Hill
263, Chelsea Road
Kingston, Ontario
Canada K7M 3Z3


To access this journal online:
http://www.birkhauser.ch

[13] Rust's *Magazin für die Heilkunde,* vols. 14–39.

[14] From a valuable return by J. Garthside, Esq. that shall be inserted entire in this or a future Almanack.

Soz.- Präventivmed. 48 (2003) 219–224
© Birkhäuser Verlag, Basel, 2003