To What Degree Are Mortality Statistics Dependable?*

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TO Cabot [1] should go much of the credit for stirring up general interest among progressive American physicians in checking clinical diagnoses by postmortem findings in fatal cases of disease. It seems strange, in view of this known interest, that so few studies following his pattern have ever reached publication. Analogous studies with a view to judging the possible effect of erroneous clinical diagnoses upon mortality statistics have apparently been even less frequently made, though their value to public health people and others concerned with such data can hardly be questioned.

The first published study of this sort known to us was made in 1934 by the senior author.[2] It was based on 1,805 New Haven Hospital autopsy records and their corresponding case histories. Incomplete information has come to us about a 1937 German study [3] of 8,182 cases, which was apparently somewhat similar, though not enough so to guarantee that a comparison of findings would be fruitful.

We have available in the Los Angeles County General Hospital an unexcelled field for such a study. About 2,000 autopsies a year are performed in that institution, and good records are kept. Dr. Newton Evans, Chief Pathologist, made these records available under proper professional safeguards; and this report is based on the records of 8,080 cases that came to autopsy during the years 1933 to 1937, inclusive. No coroner's cases or stillbirths were included.

Before beginning the report of the study proper, we should explain two peculiar problems facing diagnosticians in the Los Angeles County General Hospital. In the first place, many of the patients are Mexicans, people of some other foreign nationality, or people alone in the world. Because of language difficulties or because nobody but a very ill or almost moribund patient can be found to tell the story, it is frequently impossible to obtain a satisfactory history, which obviously often makes the matter of arriving at an accurate diagnosis extremely difficult.

In the second place, many of the patients enter the hospital only when death is near, and there is limited time for the physical and laboratory examinations necessary for correct diagnosis. Thirty-eight per cent of the cases we studied had been in the hospital 48 hours or less before death, and the

* Read before the Vital Statistics Section of the American Public Health Association at the Sixty-eighth Annual Meeting in Pittsburgh, Pa., October 20, 1939.

TABLE 1

Ante-mortem Diagnoses Checked by Autopsy

Code No.	Disease Classification *	Total Cases	Correct Diagnoses	Per cent Correct
7	Measles	34	34	100
8	Scarlet fever	35	35	100
9	Whooping cough	45	44	98
10	Diphtheria	97	95	98
13b	Bacillary dysentery	28	26	93
16	Acute poliomyelitis	61	56	92
18	Epidemic cerebrospinal meningitis	82	79	96
23	Tuberculosis of the respiratory system	668	604	90
24	Tuberculosis of the meninges	57	51	89
32a	Acute disseminated tuberculosis	51	30	59
34	Syphilis	199	151	76
36	Purulent infection—septicemia	40	25	62
43	Mycoses	27	25	93
45	Cancer of the mouth and pharynx	61	61	100
46	Cancer of the digestive tract and peritoneum	480	426	89
47	Cancer of the respiratory system	99	71	72
48	Cancer of the uterus	114	106	93
49	Cancer of other female genital organs	33	30	91
50	Cancer of the breast	66	64	97
51	Cancer of male genitourinary organs	99	71	72
53	Cancer of other organs, unspecified	119	84	71
54d	Nonmalignant tumors of the brain	28	19	68
55d	Tumors of the brain, unspecified	47	35	74
59	Diabetes mellitus	139	135	97
62	Pellagra	33	31	94
71a	Pernicious anemia	34	24	71
72a	True leukemias	44	35	79
75	Alcoholism	70	61	87
78	Nonepidemic encephalitis	29	14	48
79a	Simple meningitis	75	59	79
82a	Cerebral hemorrhage	251	185	74
82b	Cerebral embolism and thrombosis	171	130	76
82c	Softening of the brain	32	5	16
89a	Diseases of the ear	111	75	68
89b	Diseases of the mastoid process	71	56	79

* Not all cases studied are listed here, only those with more than 25 cases per class.

errors in ante-mortem diagnoses in this group were approximately twice as frequent as among the group that were in the hospital more than 48 hours before death.

Our study was aimed strictly at the mortality statistics target and was not intended as a test of the diagnostic ability of hospital physicians from the point of view of clinical medicine. For that reason our criteria of correctness of or error in the stated cause of death were taken from the last (1929) edition of the *Manual of the International List of Causes of Death;* and, whenever two or more causes were listed as ante-mortem diagnoses or post-mortem findings, or both, precedence was given to one or another in accordance with the rules in the *Manual of Joint Causes of Death.* We had for comparison, therefore, a list of deaths charged to causes as they would have been had no autopsies been performed, and the same list charged to causes as found at autopsy, these causes being those regularly listed in statistics on mortality.

In Table 1 we present the figures as we found them. All the cases represented 176 of the causes listed in the *Manual;* but for the sake of brevity and because the general principle is as well demonstrated by an abridged report, we have included in the table only those classes represented by more than 25 cases, the number of such classes being 69. The totals at the foot of the table, however, represented *all* the cases studied and not simply those listed.

As might be expected, the errors in

TABLE 1—(Cont.)

Ante-mortem Diagnoses Checked by Autopsy

Code No.	Disease Classification *	Total Cases	Correct Diagnoses	Per cent Correct
91a	Acute endocarditis	60	45	75
94b	Diseases of the coronary arteries	219	145	66
95b	Other and unspecified diseases of the heart	631	526	83
97	Arteriosclerosis	85	56	66
106b	Chronic bronchitis	51	15	29
107a	Bronchopneumonia	232	160	69
108	Lobar pneumonia	277	196	64
110	Pleurisy	29	24	83
114b	Other lung diseases, including gangrene	47	31	66
115a	Diseases of the pharynx and tonsils	33	25	76
117a	Ulcer of the stomach	136	105	77
117b	Ulcer of the duodenum	57	31	54
120	Diarrhea and enteritis, over 2 years	28	8	29
121	Appendicitis	177	160	90
122a	Hernia	76	60	79
122b	Intestinal obstruction	109	96	88
123	Other diseases of the intestines	39	19	49
124b	Cirrhosis of the liver	77	51	66
125b	Other diseases of the liver	33	17	51
126	Biliary calculi	30	17	57
127	Other gall-bladder diseases	56	41	73
130	Acute nephritis	29	20	69
131	Chronic nephritis	99	70	71
133	Other diseases of the kidneys	46	20	43
134	Urinary calculi	26	21	81
136a	Stricture of the urethra	27	17	63
137	Diseases of the prostate	159	130	82
139b	Diseases of the ovaries, etc.	47	31	66
140	Septic abortion	27	24	89
152	Acute abscess, phlegmon	36	31	86
157d	Miscellaneous congenital abnormalities	57	49	86
158	Congenital debility	27	25	93
159	Prematurity	349	345	99
200b	Undetermined	27	15	56
	Totals	† 8,080	† 6,365	79

* Not all cases studied are listed here, only those with more than 25 cases per class.
† These totals include *all* cases studied, not simply those listed above.

some classes appear much larger than in others. Taking the 8,080 cases as a whole, however, the 79 per cent of success in ante-mortem diagnoses which they indicate does not seem good enough to warrant the use of ordinary mortality data as the basis for some of the fine-spun calculations and predictions that we have seen based on such data. We make this broad statement because we doubt that the average per cent of success achieved elsewhere throughout our country exceeds, or even equals, that attained in the Los Angeles County General Hospital, though there may be some places that excel it.

We estimate a somewhat greater percentage of success in unautopsied cases than in autopsied cases, but not much greater, because requests for autopsy routinely follow all deaths in this hospital and the frequent tendency for autopsies to be performed only on cases that present great difficulty in diagnosis is thereby minimized.

The whole question, however, has two brighter aspects. First, whenever autopsies are performed nearly all of the previous errors are corrected; and the deaths are in such instances charged to their proper causes. In the above mentioned hospital, about 40 per cent of deaths, some months considerably more than that, are followed by autopsies, so the correction figure from this source alone may reasonably be as-

sumed to raise the total percentage of success well up toward 90. This, of course, cannot be said of all deaths that occur in the United States.

Second, in health publications and in various other phases of health education, we rarely use the classes of causes of death as given in the *Manual*. Broad as these classes seem to the clinician, they are much too narrow for effective publicity. The Los Angeles County Health Department follows a practice that is quite common, and in its *Annual Report* gives a list of what people often call the "Ten Leading Causes of Death." In last year's report the list was as follows:

1. Diseases of the heart
2. Cancer and other malignant tumors
3. Nephritis
4. Cerebral hemorrhage, embolism and thrombosis
5. Tuberculosis
6. Violent and accidental deaths
7. Pneumonia
8. Other diseases of the circulatory system
9. Congenital debility and malformations
10. Suicide

When grouped into these larger classes, and when the ante-mortem diagnosis which fell anywhere within the class to which the actual cause of death belonged was not charged as an error, the percentage of successful clinical determinations of causes of death rose to approximately 90, as indicated partially by the first three columns of figures in Table 2. Assuming, as is reasonable, that about 40 per cent of all diagnostic errors were corrected by autopsy, the causes of death as stated on death certificates issued from the hospital were about 93 or 94 per cent correct from this broad point of view.

In Table 2 we list the 5 large groups most commonly discussed among the 10 leading causes of death. To get an idea of how far the true picture in any group varies from that which would be given if no autopsies were performed, we must obviously compare the total number of clinical diagnoses rightly or wrongly assigned to that group with the total number of autopsy-proved cases properly belonging to that group. For example, if no autopsies were performed, 808 of the 8,080 cases would have been charged to tuberculosis, while autopsies showed that 834 cases should have been so charged, and so on.

A careful study of the records shows that mistakes in clinical diagnoses, which of course may be in either direction, go a long way toward cancelling each other. We do not say this to excuse mistakes, but after all it does leave us with a situation not nearly as bad as it might seem. The most questionable feature is an apparent tendency to attribute deaths to some of the more frequent causes when certain symptoms point that way, and not to keep on studying until everything possible has been done to check the correctness of the diagnoses. In our study the most outstanding evidence of this tendency was found in the "apoplexy group,"

TABLE 2

Special Study of Five Large Disease Groups

Code Numbers Covered by the Disease Group	*Name of the Disease Group*	*Cases Proved by Autopsy*	*Correct Clinical Diagnoses*	*Per cent of Correct Clinical Diagnoses*	*Total Clinical Diagnoses*	*Net Percentage of Error* *
23 to 32c	Tuberculosis Group	834	749	90	808	3
45 to 53	Cancer Group	1,087	963	89	1,050	4
82a and 82b	Apoplexy Group	422	384	90	501	19
91a to 95b	Heart Disease Group	937	877	94	972	4
107a to 109	Pneumonia Group	521	429	82	518	1
	Total	3,801	3,402	90	3,849	1

* Some of these errors were errors of excess, others of deficit.

where considerable numbers of cases of brain neoplasms, cerebral arteriosclerosis, and several other symptomatically similar conditions had been diagnosed as cerebral hemorrhage, thrombosis, or embolism. This was the only group, however, in which the net error exceeded 5 per cent.

We conclude from our study, therefore, that caution should be exercised in talking about trends and making comparisons based on small differences in reported death rates from specific causes; but we are certainly justified in the main when we list the leading causes of death in the order that we do and talk to the public about their relative importance and what may be done to meet the problems which they present.

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3. Magdeburger Klinisch-anatomische Todesursachenstatistik 1928–1936 Haupt zusammenstellung, *Reichs-Gesundheitsblatt*, Nr. 45, 1937, p. 741. Note: Only a table copied from this report was available for reference.

The Function of Government

IT is a function of government to preserve the person as well as the property of man . . . and there can be no national progress except through promoting the health and welfare of the citizens of the Nation—Senator James E. Murray, *U. S. Senate Report on the National Hospital Act of 1940.*