Comparison of the Coding of Death Certificates Related to Cancer in Seven Countries

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INTERNATIONAL MORTALITY STATISTICS have been derived for many years from information recorded in the medical certification portion of death certificates that have been coded in accordance with the International Classification of Diseases (ICD). The ICD, which was initially published in 1900 and has undergone decennial revisions, includes not only a detailed classification of diseases, injuries, and external causes of death but also international coding rules for selecting the underlying cause of death. Good mortality data depend on accurate and consistent coding of death certificates. Such accuracy means that all diagnostic statements about the same disease or condition, no matter how imprecise or poorly expressed, are given the same code number by different coders. There is no advantage in having an international classification for coding the causes of mortality if the rules for coding are applied so differently that the resulting statistics are not comparable.

During the previous decennial revisions of the ICD, the World Health Organization (WHO) attempted to evaluate the application of the ICD coding rules (*1*). When WHO planned for the ninth revision—ICD–9 (*2*), a subcommittee on oncology was constituted to prepare a special supplement on cancer—ICD–O, the International Classification of Diseases for Oncology (*3*). In addition to preparing ICD–O, this subcommittee studied the actual interpretations given to the coding rules pertaining to cancer and the resulting effect on cancer mortality statistics. In this paper we describe a research project undertaken to evaluate the use on the rules of the eighth (1965) revision—ICD–8 (*4*), especially as applied to neoplasms. The problems we found, and also proposed solutions that were the basis for the pertinent ICD–9 rules, are presented. The ICD–9 has a new section (VI) on ground rules for malignant neoplasms that provides much more guidance on their coding than ICD–8, which devotes only a brief paragraph (V) to the coding of malignant neoplasms of multiple sites.

Methods and Materials

An identical group of 1,246 U.S. death certificates, each with a cancer-related diagnosis was sent to the vital statistics departments of the seven countries that had agreed to participate in the study. The following people were responsible for having the death certificates coded in their respective countries: Ms. Peggy Loy, Office of Population Censuses and Surveys, London, England; Dr. Med. R. Leutner, National Bureau of Statistics, Wiesbaden, Federal Republic of Germany; Dr. Adrienne Rothschild, National Institute of Health and Medical Research, Paris, France; Gerd Sko Lettenstrom, Central Bureau of Statistics, Oslo, Norway; Mrs. Jacqueline Pelletier, head, Nosology Reference Center, Health Division, Statistics, Canada; Dr. O. Chepick, pathologist, Petrov Institute, Leningrad, U.S.S.R.; and the coding staff of the U.S. National Center for Health Statistics, Raleigh, N.C. The study participants were asked to code the underlying cause of death according to

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the rules used in their vital statistics office. However, in the Soviet Union, because of translation difficulties, two pathologists did the coding. The coding results from the participating countries were returned to us for analysis. Examples of the diagnoses on the certificates that the participants received for coding are given throughout this paper.

Basic rules for selecting the underlying cause of death are presented in ICD–9, volume 1. Each participant was requested to send us copies of any additional coding instructions other than those published in ICD–8. Most participants responded that they essentially used the rules published in ICD–8. In the United States, the National Center for Health Statistics (NCHS) annually publishes detailed instruction manuals for coding death records (*5,6*). Besides containing the basic rules published in the ICD, these manuals provide specific examples of problems encountered in coding death certificates.

In 1968, when ICD–8 went into effect, NCHS developed a computer program called ACME—Automated Classification of Medical Entities—to select the underlying cause of death after each diagnosis on the death certificate had been manually coded (*7*). To ensure that the code for each entity reflects the meaning that the certifier intended to convey, all information related to the cause of death must be taken into account by the manual coder. For example, the histological type of neoplasm, as well as the order of entry on the death certificate of the causes of death, is sometimes used in determining whether a site is primary or secondary. The basis of the ACME program is documented in a series of decision tables published by NCHS (*8*). In the current study, the U.S. participants used the ACME system to select the underlying cause of death after each entity had been manually coded, whereas participants from other countries made their selections only manually. All participants used ICD–8 codes and rules.

The group of 1,246 death certificates used in the study was taken at random from records of the Third National Cancer Survey assembled by the National Cancer Institute (*9*). In this survey, cancer incidence data for the 3-year period 1969–71 were collected from nine U.S. geographic areas, namely, the States of Iowa and Colorado plus seven metropolitan areas—Detroit, Atlanta, San Francisco Bay area, Birmingham, Minneapolis-St. Paul, Dallas-Ft. Worth, and Pittsburgh (*9*). An equal proportion of certificates was selected from each area, and some attempt was made to have all of the different sites of cancer represented, so that if a problem existed in respect to an infrequent site, it would not be overlooked. Because a computer algorithm was used for this selection, no bias was introduced.

The World Health Organization publishes an international form of the medical certificate of cause of death in volume 1 of each ICD revision. The form in ICD–9 is reproduced below. Most countries use this form or a slight modification of it. One of the modifications used in the United States appears on page 337. Part I is for reporting the cause leading directly to death—(*a*), as well as the antecedent conditions (*b*) and (*c*) that give rise to the cause reported in (*a*); the underlying cause is stated last. Part II is for "other significant conditions" contributing to death but not related to the cause given in Part I (*a*). In our study, the diagnoses recorded in Part I (*a*), (*b*), and (*c*) and Part II were copied from the selected sample of 1,246 U.S. death certificates. Each certificate was assigned a study number and sent to the participants in the various countries. One of the technical problems in preparing these sample copies was that typists often experienced difficulty in deciphering physicians' handwriting. Also, abbreviations of the medical diagnoses commonly used in the United States were difficult for some of the foreign participants to interpret, especially those from non-English speaking countries. Each nosologist who participated in the study selected and coded the underlying cause of death according to the rules published in the ICD–8 as interpreted in his or her country.

After the initial coding of the death certificates, the results were analyzed and the material was presented to the WHO working parties on neoplasms for study. These parties, which were involved in the ICD–9 ground rules, indexing, and topography, included Dr. Calum Muir and Mme. J. Nectoux of

INTERNATIONAL FORM OF MEDICAL CERTIFICATE OF CAUSE OF DEATH

CAUSE OF DEATH		Approximate interval between onset and death
I		
Disease or condition directly leading to death *	(*a*) . . . . . due to (or as a consequence of)	. . . . .
Antecedent causes Morbid conditions, if any, giving rise to the above cause, stating the underlying condition last	(*b*) . . . . . due to (or as a consequence of)	. . . . .
	(*c*)	. . . . .
II		
Other significant conditions contributing to the death, but not related to the disease or condition causing it	. . . . .	. . . . .
	. . . . .	. . . . .

* This does not mean the mode of dying, e.g., heart failure, asthenia, etc. It means the disease, injury, or complication which caused death.

SOURCE: International Classification of Diseases, World Health Organization, Geneva, Switzerland, 1975 revision, vol. 1, p. 701.

the International Agency for Research on Cancer, Lyon, France; Dr. John Berg of the Colorado Regional Cancer Center, Denver; Dr. Louis Thomas and Dr. Donald Henson of the Division of Laboratories, National Cancer Institute, Bethesda, Md., and Graham Corbett, ICD Unit of the World Health Organization, Geneva, Switzerland. On the basis of the findings presented to them, some new and more explicit rules were drafted, which were tested in the vital statistics departments of four of the seven countries in our study—Canada, France, Great Britain, and the United States. For this test, a 50 percent sample of the death certificates used originally were recoded. After these results were also returned and analyzed, further modifications were made in the rules relating to cancer. These modified rules are presented in volume 1 of the ninth revision.

Coding is affected not only by the rules for selecting the underlying cause of death, but also by the content and structure of the alphabetical index to the ICD (volume 2). Therefore the WHO oncology subcommittee assisted in developing the alphabetical index of neoplasms for ICD–9 (*10*). One aspect of this work was a complete review of all terms related to neoplasms that had been included in previous indexes. Many obsolete entities were deleted. We present details of the content and format of the alphabetical index of ICD–9 later in this paper and discuss their influence on uniformity of coding.

Results

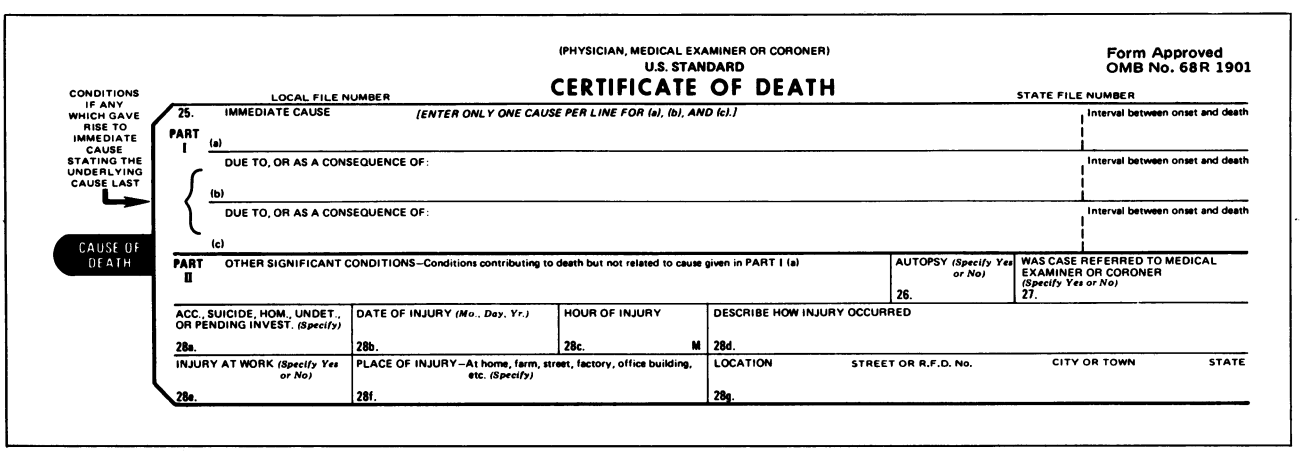
We compared the coded information at the three-digit level of ICD categories because international agreements require only three digits in reporting international data. Our analysis of the initial coding of death certificates by the seven participating countries showed that selection of the underlying cause of death differed among the seven countries in 47 percent of the certificates; that is, one or more of the participants selected and coded a different underlying cause of death for 584 of the 1,246 certificates. Table 1 lists a sample of the cases with at least one difference among countries in the selection and coding of the underlying cause of death. For example, on one death certificate for which many different underlying causes of death were selected and coded, the diagnoses on the death certificate were as follows:

CERTIFICATE 33

I (*a*) Cardiovascular collapse
(*b*) Cellulitis of mouth probably sepsis
II Acute leukemia

For this certificate, four participants using ICD–8 selected "Acute leukemia, NOS" [not otherwise specified] (ICD code No. 207.0) as the cause of death; one participant selected "Acute lymphatic leukemia" (204.0); one selected "Cellulitis of the mouth" (528.3); and one selected "Cellulitis of other multiple and unspecified areas" (682.9).

Using as a reference base the underlying cause of death as coded by the U.S. participants, we observed the following differences between U.S. coders and coders in other countries: Canada 12 percent, Great Britain and Norway 17 percent, France 20 percent, the Soviet Union 26 percent, and the Federal Republic of Germany 27 percent. These differences in coding do not imply that the U.S. selection of the cause of death was any better than that of the other coun-



(PHYSICIAN, MEDICAL EXAMINER OR CORONER)
U.S. STANDARD
CERTIFICATE OF DEATH
Form Approved
OMB No. 68R 1901

CONDITIONS IF ANY WHICH GAVE RISE TO IMMEDIATE CAUSE STATING THE UNDERLYING CAUSE LAST

LOCAL FILE NUMBER — STATE FILE NUMBER

CAUSE OF DEATH

25. PART I (a) IMMEDIATE CAUSE [ENTER ONLY ONE CAUSE PER LINE FOR (a), (b), AND (c).] — Interval between onset and death
DUE TO, OR AS A CONSEQUENCE OF: (b) — Interval between onset and death
DUE TO, OR AS A CONSEQUENCE OF: (c) — Interval between onset and death

PART II OTHER SIGNIFICANT CONDITIONS—Conditions contributing to death but not related to cause given in PART I (a) — AUTOPSY (Specify Yes or No) 26. — WAS CASE REFERRED TO MEDICAL EXAMINER OR CORONER (Specify Yes or No) 27.

ACC., SUICIDE, HOM., UNDET., OR PENDING INVEST. (Specify) 28a.	DATE OF INJURY (Mo., Day, Yr.) 28b.	HOUR OF INJURY 28c. M	DESCRIBE HOW INJURY OCCURRED 28d.
INJURY AT WORK (Specify Yes or No) 28e.	PLACE OF INJURY—At home, farm, street, factory, office building, etc. (Specify) 28f.	LOCATION 28g.	STREET OR R.F.D. No. / CITY OR TOWN / STATE

One of modifications of medical certificate of death used in the United States

Table 1. Sample of death certificates showing differences in selection and coding of underlying cause of death by the 7 countries participating in study

Death certificate No.	ICD-8 code numbers assigned for underlying cause of death by—						
	USA	France	Canada	Great Britain	Federal Republic of Germany	Norway	U.S.S.R.
2 ...	1538	1830	1538	1538	1538	153	1538
3 ...	191	1929	191	191X	1924	191	191
5 ...	191	1929	191	191X	197	191	191
6 ...	174	174X	1989	174X	174	174	174
9 ...	1991	1991	1991	1991	159	1991	1991
13 ...	185	185X	185	1989	1989	185	185
16 ...	1959	1959	1959	1713	1707	170	1713
19 ...	1460	1460	1460	1989	1460	146	1460
20 ...	1539	1539	1539	1975	1539	1950	1538
22 ...	575	2079	575	2079	2040	2079	2079
23 ...	1975	1991	1991	1990	1989	1991	1990
24 ...	191	191X	190	191X	191	191	191
28 ...	5609	5609	5609	5609	5330	5340	5330
31 ...	1972	1972	1990	1991	1991	1991	1990
33 ...	2070	2070	6829	5283	2040	2070	2070
35 ...	1990	1970	1990	1990	1991	1991	1990
39 ...	1541	1541	1541	453X	4440	154	1541
47 ...	5718	5719	1550	5719	1978	155	5719
48 ...	4272	1829	4272	4272	4272	1820	1829
50 ...	428	1541	1541	1541	1541	154	1541
51 ...	1621	1621	1621	1621	1621	1622	1970
53 ...	4409	4409	4409	4409	188	188	4409
61 ...	174	174X	174	174X	1989	174	174
62 ...	180	180X	180	1989	1989	180	180
64 ...	1990	1989	1990	1990	1991	1991	1970
67 ...	4109	4109	4109	4109	5129	410	4129
68 ...	2040	2040	2040	2040	2040	2040	2020
69 ...	1419	1419	1419	1419	1619	141	1419
71 ...	174	174X	174	174X	1621	174	174
73 ...	174	174X	174	174X	1989	174	4109
74 ...	1890	1890	442	442X	1890	442	442
75 ...	185	4339	185	185X	185	185	185
76 ...	185	185X	185	185X	1989	185	185
79 ...	174	174X	174	174X	1989	174	174
80 ...	147	149X	147	147X	147	147	1489
84 ...	1978	1550	1978	1978	1550	1977	1977
87 ...	1959	1959	1959	1959	1959	1959	1734
89 ...	1489	149X	1489	1489	1489	148	1488
90 ...	1489	149X	1489	1489	1489	148	1488
95 ...	6821	180X	180	180X	180	180	180
96 ...	2001	2022	2022	2001	2020	2001	2029
97 ...	185	185X	185	1989	1989	185	185
98 ...	1703	1621	1621	1621	1621	1621	4109
99 ...	1531	1621	1531	1621	1621	153	1538
100 ...	191	1621	1621	1621	1621	1621	1621
105 ...	4379	4369	4379	4379	4369	436	4369
106 ...	1600	1600	1600	1973	1983	160	1600

tries. However, because some reference point was needed as a base for comparison, the U.S. selections of cause of death were arbitrarily chosen. One possible explanation for the relatively few differences observed between Canada and the United States is that coders in Canada use many of the U.S. instruction manuals.

Most of the differences among coders were due to the lack of specific instructions on how to select the underlying cause of death for particular types of diagnoses. After the new and more explicit coding rules were drafted and tested in Canada, France, Great Britain, and the United States, a smaller number of discrepancies were found. Only 25 percent of the certificates had one or more coding differences. It is hoped that new rules published in ICD–9 will cut discrepancies to a minimum.

Statistical Effect of Coding Differences

The effect that differences in coding the underlying cause of death have on cancer mortality statistics is shown in table 2. For each of the seven study participants, this table shows the number of deaths that were coded to each three-digit category for malignant neoplasms, including the total for each organ system, the total number of cancers, the totals for diseases of the circulatory system, and the total for all other diseases, as well as accidents and injuries. In the United States, cancer was selected as the underlying cause of death for 87.3 percent of the 1,246 death certificates. Participants in other countries selected cancer as the underlying cause for 89.6 to 93.4 percent of the death certificates. The difference between the percentage of malignant neoplasms coded by the United States and by other countries is statistically significant ($P = <0.01$). Conversely, in the United States, "Diseases of the circulatory system" accounted for 7.2 percent of the total deaths, and "All other diseases," for 5.5 percent. This combined total of 13 percent of the records (see last line of table 2) compares with a range of only 7 to 10 percent in the other countries. Obviously, the United States chose circulatory diseases over malignant neoplasms as the underlying cause of death more often than the other countries.

Another important difference between the United States and the other countries was in the number of cases coded to "Secondary malignant neoplasms," categories 196–198 in ICD–8 (table 2). Two participants selected these secondary codes for 10 percent of the death certificates, whereas the other five used them for only 4 or 5 percent. This difference is sta-

Table 2. Number and percent of the 1,246 death certificates coded to each ICD-8 category by the 7 countries participating in study

Category of International Classification of Diseases—8th revision	USA		France		Canada		Great Britain		Federal Republic of Germany		Norway		U.S.S.R.	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total malignant neoplasms	1,088	87.3	1,164	93.4	1,121	90.0	1,116	89.6	1,164	93.4	1,162	93.3	1,117	89.6
Total buccal cavity and pharynx (140-149)	145	11.6	147	11.8	142	11.4	133	10.7	137	11.0	148	11.9	143	11.5
Lip (140)	3	0.2	3	0.2	1	0.1	2	0.2	2	0.2	3	0.2	2	0.2
Tongue (141)	33	2.6	33	2.6	32	2.6	30	2.4	30	2.4	32	2.6	36	2.9
Salivary gland (142)	11	0.9	11	0.9	9	0.7	9	0.7	9	0.7	9	0.7	11	0.9
Gum (143)	3	0.2	0	...	3	0.2	3	0.2	4	0.3	3	0.2	3	0.2
Floor of mouth (144)	11	0.9	12	1.0	10	0.8	11	0.9	12	1.0	10	0.8	0	...
Other and unspecified parts of mouth (145)	19	1.5	21	1.7	20	1.6	18	1.4	18	1.4	22	1.8	32	2.6
Oropharynx (146)	17	1.4	15	1.2	17	1.4	15	1.2	13	1.0	17	1.4	15	1.2
Nasopharynx (147)	14	1.1	12	1.0	15	1.2	11	0.9	12	1.0	15	1.2	13	1.0
Hypopharynx (148)	14	1.1	15	1.2	16	1.3	15	1.2	16	1.3	16	1.3	17	1.4
Pharynx, unspecified (149)	20	1.6	25	2.0	19	1.5	19	1.5	21	1.7	21	1.7	14	1.1
Total digestive organs and peritoneum (150-159)	202	16.2	217	17.4	204	16.4	181	14.5	221	17.7	210	16.9	221	17.7
Esophagus (150)	7	0.6	7	0.6	7	0.6	7	0.6	6	0.5	8	0.6	6	0.5
Stomach (151)	31	2.5	32	2.6	29	2.3	29	2.3	32	2.6	29	2.3	31	2.5
Small intestine (152)	2	0.2	3	0.2	3	0.2	2	0.2	2	0.2	2	0.2	6	0.5
Large intestine (153)	108	8.7	111	8.9	105	8.4	91	7.3	99	7.9	116	9.3	98	7.9
Rectum (154)	30	2.4	34	2.7	32	2.6	30	2.4	35	2.8	28	2.2	36	2.9
Liver and intrahepatic bile ducts (primary) (155)	8	0.6	12	1.0	9	0.7	7	0.6	28	2.2	10	0.8	25	2.0
Gallbladder and bile ducts (156)	5	0.4	4	0.3	5	0.4	4	0.3	3	0.2	5	0.4	2	0.2
Pancreas (157)	9	0.7	11	0.9	12	1.0	7	0.6	9	0.7	12	1.0	13	1.0
Peritoneum and retroperitoneal (158)	2	0.2	3	0.2	1	0.1	3	0.2	5	0.4	0	...	3	0.2
Unspecified digestive (159)	0	...	0	...	1	0.1	1	0.1	2	0.2	0	...	1	0.1
Total respiratory system (160-163)	95	7.6	121	9.7	119	9.6	107	8.6	109	8.7	113	9.1	111	8.9
Nose, nasal cavities, middle ear, and accessory sinuses (160)	2	0.2	2	0.2	2	0.2	1	0.1	...	...	3	0.2	4	0.3
Larynx (161)	13	1.0	17	1.4	16	1.3	11	0.9	13	1.0	16	1.3	18	1.4
Trachea, bronchus, and lung (162)	77	6.2	96	7.7	95	7.6	91	7.3	90	7.2	91	7.3	82	6.6
Other and unspecified respiratory (163)	3	0.2	6	0.5	6	0.5	4	0.3	6	0.5	3	0.2	7	0.6
Bone (170)	7	0.6	5	0.4	4	0.3	3	0.2	11	0.9	7	0.6	2	0.2
Connective and other soft tissue (171)	4	0.3	6	0.5	6	0.5	4	0.3	1	0.1	13	1.0	13	1.0
Melanoma and other malignant neoplasms of skin (172-173)	24	1.9	17	1.4	26	2.1	19	1.5	16	1.3	20	1.6	31	2.5
Breast (174)	84	6.7	95	7.6	89	7.1	87	7.0	65	5.2	93	7.5	86	6.9
Total female genital organs (180-184)	56	4.5	59	4.7	57	4.6	50	4.0	51	4.1	60	4.8	61	4.9
Cervix (180)	23	1.8	22	1.8	24	1.9	21	1.7	20	1.6	24	1.9	24	1.9
Chorionepithelioma (181)	2	0.2	2	0.2	2	0.2	1	0.1	0	...	2	0.2	2	0.2
Uterus (182)	11	0.9	14	1.1	11	0.9	11	0.9	11	0.9	12	1.0	14	1.1
Ovary, fallopian tube, and broad ligament (183)	18	1.4	19	1.5	18	1.4	14	1.1	18	1.4	19	1.5	19	1.5
Other and unspecified female genital organs (184)	2	0.2	9	0.2	2	0.2	3	0.2	2	0.2	3	0.2	2	0.2

Table 2. *(continued)*

Category of International Classification of Diseases—8th revision	USA		France		Canada		Great Britain		Federal Republic of Germany		Norway		U.S.S.R.	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total male genital organs (185-187)	53	4.3	60	4.8	55	4.4	42	3.4	47	3.8	63	5.1	60	4.8
Prostate (185)	47	3.8	56	4.5	48	3.9	39	3.1	45	3.6	58	4.7	56	4.5
Testis (186)	6	0.5	4	0.3	7	0.6	3	0.2	2	0.2	5	0.4	4	0.3
Other male genital organs (187)	0	...	0	...	0	...	0	...	0	...	0	...	0	...
Total urinary organs	55	4.4	57	4.6	54	4.3	53	4.3	55	4.4	56	4.5	49	3.9
Bladder (188)	32	2.6	33	2.6	33	2.6	33	2.6	34	2.7	35	2.8	28	2.2
Other and unspecified urinary organs (189)	23	1.8	24	1.9	21	1.7	20	1.6	21	1.7	21	1.7	21	1.7
Eye (190)	2	0.2	1	0.1	3	0.2	3	0.2	4	0.3	3	0.2	2	0.2
Total brain and central nervous system (191-192)	55	4.4	42	3.4	50	4.0	47	3.8	47	3.8	47	3.8	47	3.8
Brain (191)	33	2.6	19	1.5	30	2.4	28	2.2	41	3.3	24	1.9	28	2.2
Other nervous system (192)	22	1.8	23	1.8	20	1.6	19	1.5	6	0.5	23	1.8	19	1.5
Total endocrine glands (193-194)	11	0.9	11	0.9	11	0.9	9	0.7	8	0.6	12	1.0	11	0.9
Thyroid (193)	6	0.5	7	0.6	7	0.6	6	0.5	6	0.6	8	0.6	5	0.4
Other endocrine glands (194)	5	0.4	4	0.3	4	0.3	3	0.2	2	0.2	4	0.3	6	0.5
Ill-defined sites (195)	40	3.2	49	3.9	36	2.9	36	2.9	48	3.9	40	3.2	21	1.7
Total secondary and unspecified (196-198)	49	3.9	70	5.6	48	3.9	125	10.0	121	9.7	35	2.8	34	2.7
Secondary and unspecified of lymph nodes (196)	1	0.1	2	0.2	0	...	2	0.2	1	0.1	2	0.2	0	...
Secondary and unspecified of respiratory and digestive systems (197)	34	2.7	28	2.2	34	2.7	62	5.0	40	3.2	26	2.1	23	1.8
Other secondary (198)	14	1.1	40	3.2	14	1.1	61	4.9	80	6.4	7	0.6	11	0.9
Unspecified site (199)	50	4.0	37	3.0	63	5.1	57	4.6	62	5.0	78	6.3	67	5.4
Total lymphatic and hematopoietic tissue (200-209)	156	12.5	170	13.6	154	12.4	160	12.8	161	12.9	164	13.2	158	12.7
Lymphosarcoma and reticulum-cell sarcoma (200)	31	2.5	31	2.5	32	2.6	34	2.7	31	2.5	33	2.6	26	2.1
Hodgkin's (201)	10	0.8	12	1.0	11	0.9	12	1.0	11	0.9	11	0.9	11	0.9
Other lymphoid (202)	15	1.2	18	1.4	12	1.0	13	1.0	14	1.1	17	1.4	19	1.5
Multiple myeloma (203)	13	1.0	14	1.1	13	1.0	14	1.1	14	1.1	14	1.1	12	1.0
Lymphatic leukemia (204)	44	3.5	52	4.2	39	3.1	45	3.6	50	4.0	47	3.8	49	3.9
Myeloid leukemia (205)	29	2.3	27	2.2	29	2.3	28	2.2	29	2.3	28	2.2	28	2.2
Monocytic leukemia (206)	1	0.1	2	0.2	1	0.1	1	0.1	2	0.2	2	0.2	1	0.1
Other unspecified leukemia (207)	10	0.8	12	1.0	14	1.1	11	0.9	8	0.6	10	0.8	10	0.8
Polycythemia vera (208)	2	0.2	2	0.2	2	0.2	2	0.2	2	0.2	2	0.2	2	0.2
Myelofibrosis (209)	1	0.1	0	...	1	0.1	0	...	0	...	0	...	0	...
Diseases of circulatory system	90	7.2	54	4.3	78	6.3	77	6.2	59	4.7	60	4.8	92	7.4
All other diseases	68	5.5	28	2.2	47	3.8	53	4.3	23	1.8	24	1.9	37	3.0
Grand total	1,246	100.0	1,246	99.9	1,246	100.1	1,246	100.1	1,246	99.9	1,246	100.0	1,246	100.0

tistically significant ($P = <0.01$). A lower percentage of coding of "Secondary malignant neoplasms" was usually associated with a higher rate of coding to specific sites of primary cancer.

The differences are even greater for certain specific sites of cancer. For example, the number of certificates coded "Malignant neoplasms of soft tissues" (category 171) ranged from 1 (Federal Republic of Germany) to 13 each in Norway and the Soviet Union. This difference for soft tissue malignancies is statistically significant ($P = <0.01$). In Norway, the coders selected colon cancer (category 153) as the cause of death for 116 of the death certificates, whereas in Great Britain this rubric was selected for only 91, a difference of 25 cases, or 21 percent. In France, the lung (category 162) was the site selected for 96 certificates; in the United States, this site was selected for 69. For breast cancer (category 174), the range was from 65 to 95; and for prostate cancer (category 185), from 39 to 58. There were not enough cases of cancer of the breast and prostate to be of statistical significance. The codes for neoplasms of the brain (category 191) and nervous system (category 192) are applied differently in various countries. In the Federal Republic of Germany, 41 death certificates were coded to category 192 and only 6 to 191, whereas in France, 19 of these same certificates were coded to category 191 and 23 to category 192. In other words, the ratio of neoplasms of the brain to neoplasms of other parts of the nervous system varied considerably even though the total number of certificates assigned to these two causes of death were almost equal.

Table 3 shows the age-adjusted cancer death rates (total for all sites) per 100,000 population for six of the participating countries for 1970–71. Based on the proportion of deaths in the United States coded to cancer (as derived from table 2), the "corrected" or "normalized" age-adjusted cancer death rate for the other countries is shown in column 3 of table 3. Since the coders in the United States selected fewer malignant neoplasms as the underlying cause of death than did the coders in other countries, by this adjustment, the mortality rate for malignant neoplasms was decreased for the other countries. For example, Canada's actual mortality rate for all sites was just about the same as that for the United States (131 per 100,000), as shown in column 1. However, when the coding rate for this study is applied, the Canadian rate is reduced to 127 per 100,000, or a rate lower than that for the United States. Changes in the adjusted rates for other countries also are shown in table 3. The largest difference between the actual rates and the adjusted rates was for the Federal Republic of Germany, for which the actual rate was 149.9 and the adjusted rate 140.2, a 9.7 difference.

Table 3. Age-adjusted 1970–71 death rates per 100,000 for total malignant neoplasms for 6 participating countries and these rates as "corrected" with United States as a base

Country	Actual rates [1]	Percent of total deaths coded to malignant neoplasms [2]	"Corrected" rates
United States	131.32	87.3	131.32
Canada	131.05	90.0	127.12
Great Britain	152.35	89.6	148.39
France	137.50	93.4	128.56
Federal Republic of Germany	149.90	93.4	140.16
Norway	117.99	93.3	110.44

[1] From World Health Statistics Annual 1970–71. World Health Organization, Geneva, Switzerland, 1973. No figures available for U.S.S.R.
[2] From line 1, table 2.
NOTE: Statistical analysis was done by John Horn, Demography Section, Biometry Branch, National Cancer Institute.

Coding Problems and Proposed Solutions

In this section, 15 common problems that were identified in the study are presented, together with proposed solutions. Similar types of problems are grouped together. Most of them were selected because coders in the different countries chose different underlying causes of death based on the same death certificate. Entries from death certificates that exemplify the problems are reproduced. Also, portions of the ICD–9 rules have been excerpted *(2a)*, as well as a few other miscellaneous rules affecting neoplasms.

Problem 1. *Determining whether a site is primary or secondary, especially when site is qualified as "metastatic."*

As previously explained and as shown in table 2, two countries (Great Britain and the Federal Republic of Germany) coded three times as many certificates to the secondary categories (196–198) as did the other countries. The coding of the following certificate illustrates the problem:

CERTIFICATE 13

I(*a*) Metastatic cancer prostate

As table 1 shows, certificate 13 was coded 198.9, "Secondary cancer of prostate," by Great Britain and the Federal Republic of Germany and 185, "primary carcinoma of prostate," by the other countries. Followback studies made in the TNCS *(9)* indicated

that cases qualified by the adjective "metastatic" were usually primary in the site mentioned. This observation applied to "metastatic of" or "metastatic from," but not to "metastatic to."

Proposed solution. Since the word "metastatic" may be interpreted to mean either primary or secondary, a new section J, giving examples for various circumstances, has been added to section VI of the ICD–9 rules (NOTES in brackets in excerpts from the ICD have been inserted by us):

J. *"Metastatic" cancer*

The adjective "metastatic" is used ambiguously, sometimes to mean secondary deposits from a primary elsewhere and sometimes to mean a metastasizing primary. No arbitrary rule can satisfactorily solve this problem since usage varies in different languages and different countries, but the following rule is proposed as an expedient when there is doubt as to the meaning intended:

(a) Cancer described as "metastatic from" a site should be interpreted as primary of that site, and cancer described as "metastatic to" a site should be interpreted as secondary of that site.

Example: I(*a*) Carcinoma in lymph nodes and lungs
(*b*) Metastatic from nasopharynx
Code to primary malignant neoplasm of nasopharynx (147.9)

Example: I(*a*) Metastatic cancer from liver to lung
Code to primary malignant neoplasm of liver (155.0)

(b) If two or more sites are reported and all are qualified as "metastatic", code as for "primary site unknown" in E above [NOTE: See Problem 2.]

Example: I(*a*) Metastatic carcinoma of lung
(*b*) Metastatic carcinoma of breast
Code to 199.1

Example: I(*a*) Metastatic melanoma of lung and liver
Code to 172.9

(c) If only one site is reported and this is qualified as "metastatic", proceed as follows:

(1) code to the category for "unspecified site" for the morphological type concerned unless this code is 199

Example: I(*a*) Metastatic renal cell carcinoma of lung
Code to 189.0 [NOTE: The morphology indicates kidney.]

Example: I(*a*) Metastatic osteosarcoma of brain
Code to 170.9 [NOTE: The morphology indicates origin in bone.]

(2) otherwise, code as for primary malignant neoplasm of the reported site except for the following sites, which should be coded to 199:

bone
brain, spinal cord, meninges
liver
lymph nodes
pleura
peritoneum, retroperitoneum, mediastinum, heart, diaphragm
sites classifiable to 195

Example: I(*a*) Metastatic lung cancer
Code to 162.9

Example: I(*a*) Metastatic cancer of brain
Code to 199.1

Example: I(*a*) Metastatic cancer of hip
Code to 199.1

(d) If no site is reported, but the morphological type is qualified as "metastatic" code as for "primary site unknown" in E above. [NOTE: See Problem 2.]

(e) If two or more site are reported and some are qualified as "metastatic" while others are not, "metastatic" cancer of the sites listed under (c)(2) above should be interpreted as secondary. If sites other than these are qualified as "metastatic", attempt to resolve the problem of selecting the underlying cause by taking into account the order of entry on the certificate and any statements of the duration of the conditions reported.

Example: I(*a*) Abdominal carcinomatosis
(*b*) Bronchial carcinomatosis
(*c*) Metastatic mammary cancer
Code to 174.9

Section *J(a)* indicates that cancer described as "metastatic from" a site should be interpreted as primary in that site. This interpretation is no different from that in the ICD–8 rules. "Metastatic to" was always interpreted as a secondary site.

Statistical analysts using ICD–8 often combined "Malignant neoplasms of unspecified sites" (category 199) with the secondary categories 196–198. In ICD–9 the rules for mortality coding have been simplified by eliminating the categories for secondary sites 196–198 so that coding is to be only to 199 (Malignant neoplasm of unspecified site):

F. *Secondary sites*

Categories 196, 197 and 198 are not to be used for underlying-cause mortality coding. Secondary neoplasm of specified sites, or of unspecified site, without mention of a primary site, should be coded to the category for "unspecified site" for the morphological type involved (e.g. carcinoma 199.1, sarcoma 171.9, melanoma 172.9).

Categories 196, 197 and 198 are for use in multiple-condition coding and in morbidity coding and for these purposes include all secondary neoplasms of specified site regardless of the morphological types of neoplasm (e.g. secondary melanoma of lung 197.0, secondary squamous cell carcinoma, cervical lymph node 196.0).

Therefore, since secondary site code numbers are no longer to be used for the underlying cause of mortality, the unspecified site for the appropriate morphological type would be coded if no other site was listed as primary:

I(*a*) Metastatic carcinoma to colon

This certificate would have been coded 197.5 in ICD–

8 but now will be coded to 199.1 (Unspecified site) in ICD–9.

Section J(b) of the ICD–9 rules states that if two or more sites are reported and all are qualified as "metastatic," assignment should be made to the category for "Primary site unknown," that is, to the morphological type involved. [NOTE: See E in Problem 2.]

Section J(*c*)1 continues the rules for the adjective "metastatic" but as applied to one site and still takes into consideration the morphological type.

A related problem to that of "metastatic" is the word "primary." The ICD is based on the premise that certifiers will qualify sites such as the liver or the lymph nodes as primary or secondary. Unfortunately, the medical profession is not usually cognizant of this premise, and its members seldom use the word "primary." For the liver, three different categories are assigned in ICD–9: 155.0 (Malignant neoplasm of liver, primary), 155.2 (Malignant neoplasm of liver, not specified as primary or secondary), and 197.7 (Secondary malignant neoplasm of liver). Thus, in effect—unlike ICD–8, which classified "Liver, unspecified" as 197.8—all malignant liver neoplasms other than those stated to be secondary will be included in category 155 at the three-digit level. The two following examples of death certificate entries show how these different liver categories have caused confusion.

CERTIFICATE 84
- I(*a*) Carcinoma, liver
- (*b*) Metastases
- II Coronary artery disease

Two countries coded certificate 84 to primary liver cancer, four to liver, unspecified, and one to secondary liver. Actually, on review, this certificate was found to represent a primary carcinoma in the cecum that had metastasized to the liver, but the death certificate could not have been coded to this site on the basis of the information given.

CERTIFICATE 471
- I(*a*) Carcinoma of liver
- (*c*) Carcinoma of liver, metastatic
- II Chronic bronchitis

The preceding death certificate was coded to "primary of liver" by one country, to "secondary liver" by three countries, and "liver, unspecified" by three countries. Review of the decedent's case showed a hepatoma.

Section J(c)2 in the ICD–9 rules states that when only one site that is qualified as metastatic is reported and the morphological type is classified to 199, assignment usually should be made to primary malignant neoplasm of that site. An exception is made when the site is one that is commonly secondary: for example, liver, brain, bone, and so forth; in that case, assignment should be made to 199.

Problem 2. *Interpretation of "Primary site unknown"*

CERTIFICATE 669
- I(*a*) Bowel obstruction
- (*b*) Anaplastic adenocarcinoma of abdominal cavity
- (*c*) Primary site unknown

Four countries coded the preceding certificate to 198.9 (Secondary malignant neoplasm of abdomen) and three to 195.0 (Malignant neoplasm of abdomen). No country coded it to 199—unspecified.

Proposed solution. Section VI of the ICD–9 rules includes the following instruction:

E. *"Primary site unknown"*

When the statement "primary site unknown" appears on a certificate, code to the category for "unspecified site" for the morphological type involved (e.g. adenocarcinoma 199.1, fibrosarcoma 171.9, osteosarcoma 170.9); any other sites of malignant neoplasm reported elsewhere on the certificate should be assumed to be secondary.

Therefore for certificate 669, the correct code for the underlying cause of death would be 199.1 since the certifier specifically stated "primary site unknown" on the certificate.

Problem 3. *Relationship of certain diseases, especially heart and other circulatory diseases, to a malignant neoplasm.*

It is apparent from table 2 that coders from some countries considered that cancer caused heart disease more often than did coders from other countries. One of the reasons for this difference was the interpretation in the ICD–8 rules of what is considered acute or terminal circulatory disease. The problem arises when cancer is reported to be the cause of myocardial degeneration or coronary artery disease. U.S. coders assigned these deaths to the heart, whereas other countries tended to select cancer, for example:

CERTIFICATE 863
- I(*a*) Arteriosclerotic heart disease
- (*b*) Bronchogenic carcinoma
- (*c*) Metastasis to ribs
- II Arteriosclerosis

U.S. and Canadian coders selected category 412 (Arteriosclerotic heart disease), whereas all other coders selected lung cancer as the cause of death. The rules for determining the relationship between heart disease and cancer evidently were not always clear in ICD–8 or were not followed.

Proposed solution. To clarify the relationship between heart disease and cancer, three items (*h, i,* and *j*) have been added to section IB in the ICD–9 rules (*2c*):

B. *Interpretation of "highly improbable"*
As a guide to the acceptability of sequences in the application of the selection rules, the following relationships should be regarded as "highly improbable":

* * * * * * *

(h) chronic ischaemic heart disease (412–414) reported as "due to" any neoplasm;
(i) any condition described as atherosclerotic [arteriosclerotic] reported as "due to" neoplasm;
(j) any hypertensive condition reported as "due to" any neoplasm except carcinoid tumors or endocrine or renal neoplasams;

* * * * * * *

In addition to the items that comprise the "highly improbable" sequences, certain acute or terminal circulatory diseases reported as due to malignant neoplasm are acceptable as possible sequences in Part I of the certificate. The specific rubrics for acute or terminal circulatory diseases in 410–438 are listed as being due to malignant neoplasms (410, 411, 415, 420–422, 426–428, 429.8, and 430–438 with certain exceptions). Guides to making decisions as to what is and what is not an acute or terminal circulatory disease are thus provided in ICD–9, whereas ICD–8 left that determination to the individual coder.

Another reason why the percentage of cases coded to heart and circulatory disease in the United States was higher (7.2 percent) than the 4.0 percent in counteries like France, Norway, and the Federal Republic of Germany was that these countries sometimes selected cancer from Part II of the death certificate when heart or circulatory disease was mentioned in Part I, for example:

CERTIFICATE 1168
I(*a*) Respiratory insufficiency
(*b*) Pulmonary embolism and pulmonary emphysema
II Squamous cell cancer of lung with metastasis.

Four countries selected lung cancer as the cause of death, whereas the United States, Canada, and Great Britain selected pulmonary embolism. The ICD–9 rule, states, as in ICD–8, that a condition in Part II of the certificate should be selected as the cause of the condition in Part I only if there is no doubt about the causal relationship of the two conditions:

The condition selected by the above rules may, however, be an obvious sequel of another condition which was not reported in a correct causal relationship with it, e.g. in Part II or on the same line in Part I. If so, then *Rule 3* also applies and the primary condition is selected. It applies, however, only when there is no doubt about the causal relationship between the two conditions; it is not sufficient that a causal relationship between them would have been accepted if the certifier had reported it.

For certificate 1168, because there is doubt about whether the cancer caused the pulmonary condition, the condition in Part I—pulmonary embolism—should be selected.

Problem 4. *Determining whether a condition in Part I is a complication of a procedure for cancer not mentioned in Part I*

CERTIFICATE 517
I(*a*) Myocardial infarction (immediate)
II Post operative left pneumonectomy cancer lung

Four countries selected lung cancer from Part II of certificate 517 as the underlying cause of death, and three countries coded the heart disease.

Proposed solution. The new rules state (*2d*):

Certain conditions that are common post-operative complications (pneumonia (any type), haemorrhage, thrombophlebitis, embolism, thrombosis, infarction) can be considered as direct sequels to an operation unless it is stated to have occurred 4 or more weeks before death.

Previously it was not specifically indicated in the international rules that certain conditions were to be considered as direct sequelae of an operation. The ninth edition spells this out and shows, among other examples, that the following certificate is to be coded to lung cancer (the condition for which the operation was performed):

Example 27: I(*a*) Myocardial infarction (immediate)
II Left pneumonectomy of carcinoma of lung 3 weeks ago
Select carcinoma of lung

Myocardial infarction is considered a direct sequela of an operation except when the operation was known to have been performed 4 weeks or more before death.

Problem 5. *Multiple sites*

The selection of the underlying cause of death when more than one site is mentioned on the death certificate has always been recognized as a problem, and specific rules to deal with it were published in ICD–8 under section V "Malignant neoplasms of multiple sites." Nevertheless, many discrepancies in the coding of certificates mentioning multiple sites of cancer have been observed in our study, for example:

CERTIFICATE 868

I(*a*) Carcinomatosis
(*b*) Carcinoma of stomach
(*c*) Carcinoma of prostate

Although five countries selected 185 (Malignant neoplasm of prostate), one country selected stomach and another, primary site unknown (Carcinomatosis). The order of entry indicates that the prostate was the primary and underlying cause of death, and there has been no change in the rules in this respect between the eighth and ninth ICD revisions. However, autopsy showed that in this instance adenocarcinoma of the stomach had metastasized to the prostate. This example illustrates how diagnoses entered on the certificate in an incorrect order can result in the selection of an inaccurate cause of death.

Physicians should be cognizant of the death certificate's format and the importance of accurately reporting diagnoses in the proper sequence. Guidelines for this are presented in the "Physicians' Handbook on Medical Certification: Death, Fetal Death, Birth" (*10*).

CERTIFICATE 485

I(*a*) Peritonitis (2 days)
(*b*) Perforation of tumor (2 days)
(*c*) Carcinoma of prostate and bladder (1 + year)
II Post operative carcinoma of the rectum

For this certificate, two countries (France and Canada) selected the site given in Part II (rectum), even though the rules indicate that assignment should be made to the first-mentioned site in Part I. Both the old and new rules specify that this certificate should be coded to the first-mentioned site—cancer of the prostate. Followback on the TNCS data (*9*) showed that the decedent had a carcinoma of the rectum in 1969, of which there was no evidence at autopsy. The prostate cancer was proved by autopsy to be the cause of death.

Proposed solution. The section on multiple sites has been expanded in ICD–9, principally by giving examples of the different multiple-site problems and how they should be coded:

B. *Multiple sites*

If malignant neoplasms of more than one site are entered on the certificate, the site indicated as primary should be selected, regardless of the position of the conditions on the certificate. This indication may be:

(a) the specification of one site as primary;

Example: I(*a*) Carcinoma of bladder
(*b*) Primary in kidney
Code to carcinoma of kidney (189.0).

(b) the specification of other sites as "secondary", "metastases" or "spread";

Example: I(*a*) Carcinoma of breast with secondaries in brain
Code to carcinoma of breast (174.9).

Example: I(*a*) Cancer of lung with spread to kidney, adrenal and brain
Code to cancer of lung (162.9).

(c) an acceptable order of entry pointing to one site as primary;

Example: I(*a*) Cancer of liver
(*b*) Cancer of stomach
Code to cancer of stomach (151.9). The order of entry indicates that this was the primary site.

Malignant neoplasm of lymph nodes not specified as primary should be assumed to be secondary.

Example: I(*a*) Cancer in supraclavicular lymph node
(*b*)
(*c*)
II Gastric carcinoma
Code to cancer of stomach (151.9).

If there is no indication as to which was the primary site or if it appears that there were two or more primary malignant neoplasms (for example, if sites are entered on the same line or in different Parts of the certificate), prefer a defined site to an ill-defined site in category 195. Otherwise, prefer the first mentioned.

Example: I(*a*) Carcinoma, breast and caecum
Code to carcinoma of breast (174.9).

Example: I(*a*) Carcinoma of adrenal gland
(*b*)
(*c*)
II Carcinoma of caecum
Code to carcinoma of adrenal gland (194.4).

Example: I(*a*) Cancer of abdomen and stomach
Code to cancer of stomach (151.9).

Problem 6. *Difficulties of coding neoplasms of certain areas and regions of the body*

CERTIFICATE 473

I(*a*) General carcinomatosis
(*b*) Adenocarcinoma of ileo-cecal area
II Embolism of left popliteal artery

All countries except the United States coded certificate 473 to ileocecum (rubric 153.0). The United States considered the ileocecal area to be an ill-defined site (195.0, malignant neoplasm of abdomen).

Proposed solution. To clarify this coding problem, the following rule was added in ICD–9:

C. *Imprecise or doubtful descriptions of site*

Neoplasms of sites prefixed by "peri", "para", "pre", "supra", "infra", etc. or described as in the "area" or "region" of a site, unless these terms are specifically indexed, should be coded as follows: for morphological types classified to one of the categories 170, 171, 172, 173, 191 or 192, code to the appropriate subdivision of that category; otherwise, code to the appropriate subdivision of 195 (Other and ill-defined sites).

Example: Fibrosarcoma in the region of the wrist
Code to 171.2 (fibrosarcoma of upper limb)

Example: Peribiliary carcinoma
Code to 195.2 (carcinoma of abdomen)

Neoplasms described as of one site *or* another should be coded to the rubric that embraces both sites or, if no appropriate rubric exists, to "unspecified site".

Example: Osteosarcoma of lumbar vertebrae or sacrum
Code to 170.9 (osteosarcoma, unspecified site)

Example: Carcinoma of small intestine or colon
Code to 159.0 (carcinoma of intestine NOS)

Example: Cancer of pancreas or lung
Code to 199.1 (cancer of unspecified site)

Problem 7a. *Inferring site of neoplasm*

CERTIFICATE 538
I(*a*) Mechanical bowel obstruction
(*b*) Metastatic adenocarcinoma

The U.S. nosologist coded this certificate to 153.9 (Intestine NOS), but four countries coded it to 199 (Malignant neoplasm without specification of site), one country coded it to 198.9 (Secondary of other site,), and one country coded it to 197.5 (Secondary of colon and rectum). Followback to the hospital records in the TNCS (*9*) showed the cause of death to be a primary adenocarcinoma of the ovary. The reason that the United States selected Intestine, NOS, as the site was that the alphabetical index in ICD–8, under "Obstruction—intestine—malignant," states, "See neoplasm, intestine, malignant." Obviously, this indexing was ignored or not interpreted the same by all other countries. There was similar indexing under such terms as "Effusion, pleura, malignant"—197.2 (Secondary neoplasm of pleura) in ICD–8.

Proposed solution. The WHO oncology committee did not agree with such inferences, and such indexing has been removed from ICD–9. Also section VI–D "Neoplasm of unspecified site" has been added in the rules of ICD–9:

D. *Neoplasm of unspecified site*

When there is no specification of the site of a neoplasm, code to "unspecified site" for the morphological type involved, even though the neoplasm is associated with some other condition (e.g. obstruction, haemorrhage, perforation) of a specified site.

Example: I(*a*) Perforation of stomach
(*b*) Carcinoma
Code to 199.1

Example: I(*a*) Ureteric obstruction
(*b*) Sarcoma
Code to 171.9

Example: I(a) Haemorrhage of bladder
(*b*) Transitional cell carcinoma
Code to 199.1

In other words, certificate 538 would be coded to 199.1 with ICD–9.

Problem 7b. *Inferring that "metastatic disease" means malignant neoplasm*

Another kind of inference was made from the following certificate.

CERTIFICATE 658
I(*a*) Metastatic cerebral disease

Five countries presumed that "metastatic" referred to cancer. Four coded this certificate to 198.3 (Secondary malignant neoplasm of brain), and one country considered the cause of death to be primary malignant neoplasm of brain (191). Two countries did not consider the cause to be a neoplasm and coded the certificate to 347.9 (Other diseases to the brain). Actually the hospital records showed this case to be a cancer of the lip with metastasis to the brain.

Proposed solution. The problem represented by certificate 658 was solved in ICD–9 by adding the phrase "Metastatic disease" to the alphabetical index.

Problem 7c. *Inferring operation was performed for malignant neoplasm*

CERTIFICATE 500
I(*a*) Myocardial infarct
(*b*)
(*c*) Laryngectomy and radical neck dissection

Although, admittedly, poor certification is exemplified here, as it is in many of the other samples in this paper, five different categories were assigned to this certificate. Two countries selected category 508 (Other diseases of upper respiratory tract); two countries, the heart condition (category 410); one country, category 231 (Neoplasm of unspecified nature of

respiratory organs); one country, category 161 (Malignant neoplasm of larynx); and one country, an E category (an external cause). Actually the decedent had a cancer of the larynx. When the certifier fails to report specific information, it is difficult to obtain consistent coding.

Proposed solution. There is a section on rules for surgical operations (IV in ICD–8 and V in ICD–9) that states: ". . . if an operation appears on the certificate as cause of death without mention of the condition for which it was performed . . . it is assumed that the condition for which the operation is usually performed is present." Since the diagnoses on the certificate include both a laryngectomy, which is usually done for a malignant neoplasm in the larynx, and a radical neck dissection, which is usually performed for cancer, it seems reasonable to code this case to cancer of the larynx.

Problem 8. *Relationship of certain infectious diseases to cancer*

CERTIFICATE 408

I(*a*) Disseminated candidiasis (about 1 week)
(*b*) Acute lymphatic leukemia—diagnosed 4 years ago

Although the rules in ICD–8 specifically state that certain infectious diseases cannot be caused by anything else (infectious or parasitic disease categories 000–138 except erysipelas (035), tetanus (037), septicemia or pyemia (038), and gas gangrene (039.0)), only two countries coded this death to infectious diseases; the rest selected the leukemia.

Proposed solution. The exceptions in ICD–8, such as erysipelas, tetanus, and so forth, have now been expanded in section *I.B.*(*a*) of the ICD–9 rules to include (*2c*):

1. Colitis, enteritis, gastroenteritis, and diarrhea (009.1–009.3)
2. Diseases due to other mycobacteria (031)
3. Vincent's angina (101)
4. Mycoses (110–119)

Since candidiasis (category 112) is included in No. 4 (mycoses), certificate 408 would be coded to leukemia with ICD–9.

Problem 9. *Lymphosarcoma and other malignant lymphomas jointly reported with leukemia (any type)*

CERTIFICATE 338

I(*a*) Cardiac arrest
(*b*) Bilateral pneumonia
(*c*) Lymphosarcoma—leukemia
II Anuria

Five countries coded this certificate to lymphosarcoma, one country (the United States) to category 202.2 (Other primary malignant neoplasms of lymphoid tissue), and one other country to 204.9 (Unspecified lymphatic leukemia). Other diagnoses found difficult to code were "lymphosarcoma terminating in leukemia" and "lymphosarcoma cell leukemia," which were not indexed in ICD–8 and which some countries took to be the same as leukosarcoma.

Proposed solution. Under the rules for malignant neoplasms in ICD–9, a new section, G. Leukaemia, has been added, which states that when a condition classifiable to categories 200–202 is reported as terminating in leukemia, it is to be coded to 200–202 (Lymphomas). Also the terms lymphosarcoma cell leukemia, leukosarcoma, and leukolymphosarcoma are being indexed to 207.8 (Other specified leukemia) in ICD–9. These amendments should clear up most of the difficulties.

G. Leukaemia

Acute exacerbation of or blastic crisis in chronic leukaemia should be coded to the chronic form.

Example: I(*a*) Acute and chronic lymphatic leukaemia
Code to 204.1 (chronic lymphatic leukaemia)

Acute leukaemia of any type should be coded to the acute form regardless of the interval between onset and death.

When a condition classifiable to categories 200–202 is reported as terminating in leukaemia, code to 200–202.

Problem 10. *Acute and chronic leukemia jointly reported on certificate*

CERTIFICATE 386

I(*a*) Acute myeloblastic leukemia 10 weeks
(*b*) Transformation from chronic myelocytic leukemia 5½ years

Five countries coded this certificate to the chronic phase, but two selected the acute phase.

Proposed solution. This problem has been taken care of in the same section of ICD–9 as problem 9 (see preceding excerpt from ICD–9); that section states that the chronic form should be coded.

Problem 11. *How to code certain morphological types that are indexed to specific sites when another site is given on the certificate*

CERTIFICATE 364

I(*a*) Mucoepidermoid carcinoma of larynx

All countries coded this diagnosis to the larynx except the United States, which kept to the specific designation in the ICD–8 index of category 142.9 (Malignant neoplasm of salivary gland).

Proposed solution. As stated in section VI.A. of the ICD–9 rules, the morphological types classified in ICD–0 appear in the Alphabetical Index of ICD–9 (*10*) with their M codes and with an indication as to the coding by site. This indication may take the form of a reference to the "Neoplasm" listing in the index when the morphological type could occur in a variety of organs, for example:

Adenoacanthoma (M8570/3)—see Neoplasm, malignant

Or the index may refer the coder to a particular part of the "Neoplasm" listing when the morphological type arises in a particular type of tissue, for example:

Sarcoma (M8800/3)—see Neoplasm, connective tissue, malignant

It may give the code for the site assumed to be most likely when no site is specified, for example:

Astrocytoma (M9400/3)
specified sites—see Neoplasm, malignant
unspecified site 191.9

Or it may give a code to be used whatever site is reported when the vast majority of neoplasms of the morphological type occur in a particular site, for example:

Hepatocarcinoma (M8170/3) 155.0

As the ICD–9 rules emphasize:

Coders should, therefore, look up the morphological type in the Alphabetical Index before coding by site.

In ICD–9, "mucoepidermoid" carcinoma (illustrated in certificate 364) appears in the alphabetical index with the reference ". . . see Neoplasm, malignant." Therefore this death certificate would be coded to malignant neoplasm of the larynx.

Problem 12a. *Incorrect indexing*

In ICD–8, "malignant carcinoid" is clearly indexed to rubric 258.9. However, when death certificates listed "malignant carcinoid" as the underlying cause of death, the majority of the countries ignored this indexing and coded to a malignant neoplasm, for example.

CERTIFICATE 362
I(*a*) Malignant carcinoid of ileum with metastasis
II Obstructive inferior vena cava

Two countries coded this death certificate, as designated in ICD–8, to 258.9. The other countries ignored the index and coded it to 152.9 (Malignant neoplasm of ileum).

Proposed solution. If a certain rule or indexing designation is considered to be incorrect, every effort should be made to get it corrected officially at WHO. Comparable statistics cannot be obtained if everyone does what he or she thinks is correct.

Problem 12b. *Interpretation of note in index about connective tissue neoplasms (10a)*

Two countries (table 2) selected connective tissue tumors as the primary cause of death more often than the other countries, so that the mortality rates for connective tissue tumors were higher in these two countries than in the others.

CERTIFICATE 360
I(*a*) Fibrosarcoma of hilum of liver

This certificate was coded by one country to connective tissue and by all other countries to one of the neoplastic liver rubrics. The note in the alphabetical index of ICD–8 under "Neoplasm, connective tissue" states that such neoplasms are to be coded to the stated site except for a few designated exceptions.

Proposed solution. In the ICD–9 alphabetical index, the note under neoplasms of connective tissue has been rewritten in an effort to clarify the question. The revised note states that if the site mentioned does not appear under the neoplastic list of connective tissues, the death certificate is to be coded to the stated site.

Problem 13. *Adjusting non-English editions of the ICD to conform with usage of medical terms in different languages*

In the course of the study it was observed that France coded neoplasms without further specification to 199.1 "Malignant," since this is what French physicians usually mean by the term. However, the French translation of the ICD–8 index does not reflect this usage for the word "neoplasm," which in the French edition is assigned to 239.9 "neoplasms of unspecified nature"—a direct translation of the English version.

Proposed solution. It is hoped that when the same terminology means different things in different countries, the ICD–9 index will reflect the proper meaning in each language.

Problem 14. *Coding certain morphological types of nervous system tumors*

CERTIFICATE 961
I(*a*) Cardiorespiratory arrest
(*b*) Cerebral hemorrhage
(*c*) Astrocytoma

Four countries coded this certificate to 191 (Malignant neoplasm of brain), and three countries to 192.9 (Malignant neoplasm of other parts of nervous system). As mentioned in the discussion of table 2, the number of certificates coded to the brain and to other parts of the nervous system varied considerably from country to country, although the total for categories 191 and 192 was almost identical. The morphological type astrocytoma was indexed in ICD–8 to 192.9, but certain countries obviously considered it to be a brain tumor some of the time.

Proposed solution. In ICD–9, the indexing of this term and others previously included in 192.9 have been classified to 191 (Brain) if no specific site is mentioned.

Problem 15. *Distinguishing between 199.0 and 199.1*

Most of the analysis of the differences among the countries was carried out only at the three-digit level. However, there was obviously great variation in the use of the fourth digit of category 199 (Malignant neoplasm without specification of site), for example:

CERTIFICATE 245
- I(*a*) Inanition and debilitation
- (*b*) Carcinomatosis
- (*c*) Primary carcinoma site undetermined

Five countries coded the preceding certificate to 199.0; one country coded it to 199.1 and one to 198.9.

CERTIFICATE 388
- I(*a*) Metastatic carcinoma ? months

Four countries coded certificate 388 to 199.0 and two to 199.1; one country coded it to 198.9 secondary of other sites.

Proposed solution. Since most analysts do not divide their data between 199.0 and 199.1, consideration was given to eliminating this fourth-digit separation for 199. However, WHO has kept .0 and .1 in ICD–9 but changed the title for 199.0 from "Multiple" to "Disseminated."

Introduction of New Rule

A note in ICD–8 for use in primary mortality coding states that complications and misadventures in therapeutic procedures (categories E930, and E931) should not be coded if the condition requiring treatment is known. This note has been replaced in ICD–9 by rule 12, which provides for the assignment of deaths that have resulted from an error or accident occurring during medical care to the accident or error (E850–858, E870–876) rather than to the condition that required the treatment (*2e*):

Rule 12. Errors and accidents in medical care. Where the selected underlying cause was subject to medical care and the reported sequence in Part I indicates explicitly that the death was the result of an error or accident occurring during medical care (conditions classifiable to categories E850–E858, E870–E876), regard the sequence of events leading to death as starting at the point at which the error or accident occurred. This does not apply to attempts at resuscitation.

Example 72:
- I(*a*) Cerebral infarction
- (*b*) Anoxia
- (*c*) Wrong positioning of endotracheal tube during induction of anaesthesia in operation for carcinoma of uterus

Code to anoxic brain damage resulting from a procedure (997.0) and endotracheal tube wrongly placed during anaesthetic procedure (E876.3).

Example 73:
- I(*a*) Hypernatraemia
- (*b*) Saline emetic and gastric lavage
- (*c*) Double dose of morphine (treatment for pain control in carcinomatosis)

Code to overdose of morphine (965.0 and E850.0).

* * * * * * *

This rule may reduce the number of cases coded to malignant neoplasms. In example 72, the certificate would have been coded to cancer of the uterus in ICD–8, but under the new rules of ICD–9, it would not be coded as a cancer. In example 73, which involves a report of a drug overdose, the certificate would be coded to the accidental poisoning category both with ICD–8 and ICD–9.

Indexing of Neoplasms

Guidance for coding morphological types of neoplasms has always been given in the alphabetical index (*10*). The WHO working party on indexing of neoplasms reviewed all neoplastic terms listed in the seventh and eighth revisions of the International Classifications of Diseases, deleting many obsolete terms but retaining those that were still found in records, even though many might be undesirable according to present-day standards.

The principal axis of indexing neoplasms in previous editions of the ICD has been under the word "Neoplasm" in volume 2, which has an alphabetical listing of the various sites and tissues of the body, followed by code numbers in three different columns headed "Malignant," "Benign," and "Unspecified." In ICD-9, this same format is used except that two additional columns have been added: "Carcinoma-in-situ" and "Uncertain behavior." The five columns

represent the fifth-digit behavior code of ICD-O morphology, as explained in ICD-9.

In addition, all morphological types included in ICD–O are listed with their M (morphology) code numbers in volume 1, pages 667–690, as well as in the appropriate alphabetical place in volume 2. In coding it is best to look up the morphology initially in volume 2 before referring to the list of sites. For example, since "Kupfer cell sarcoma" (M–9124/3) is indexed to 155.0 (Primary liver cancer) in volume 2, one need look no further. However, in the case of the diagnosis "Adenocarcinoma of the stomach," the listing for "adenocarcinoma" states, "See also neoplasm, malignant." It is then necessary to refer to the listing of "Neoplasm, malignant" in the volume 2 index and locate the site, in this case—Stomach (151.9).

The following format has been extensively used for neoplasms in ICD–9:

Oat cell carcinoma (M-8042/3)
  Specified site—see neoplasm, malignant
  Unspecified site—162.9

In other words, if the diagnosis is oat cell carcinoma of the breast, it would be coded to 174.9 "malignant neoplasm of breast." On the other hand, if the diagnosis is "oat cell carcinoma" and no specific site is stated, the ICD–9 index indicates that you code 162.9 (Malignant neoplasm of lung), which is the usual primary site for oat cell carcinomas. This specific indexing should solve many problems that have existed in the past and provide more consistency in coding.

Conclusion

Results of this study indicate that significant differences exist among countries in the application of the rules for selecting the underlying cause of death—differences that seriously affect cancer mortality statistics. Epidemiologists studying differences in mortality rates in various geographic areas have not been able to ascertain whether the differences are real or the result of variations in coding practices. It is hoped that the more detailed rules for coding cancer diagnoses included in the ninth revision of the International Classification of Diseases, which goes into effect January 1, 1979, will result in greater consistency in the selection of the underlying cause of death at the international level.

Physicians need to be informed of the proper format for filling out death certificates. They should be made aware that rules are applied to select the underlying cause of death from certificates. Reference to the original records of the Third National Cancer Survey (*9*), from which the death certificate sample in our study was drawn, revealed that the certifying physicians had not always filled out the certificate properly or given adequate information. In a future paper, the information that physicians enter on death certificates will be compared with that in their hospital diagnoses.

The World Health Organization conducts training sessions and supplies material for the leading nosologists in the various countries. Each country will initiate workshops to acquaint the coders with the changes and new rules in ICD–9.

After ICD–9 has been in use for 6 months or more, a study similar to the one reported here should be done to see if countries are achieving better uniformity in coding the underlying cause of death. Until comparability is attained, mortality statistics on cancer will be of limited value.

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