Comparability of Cause of Death Between ICD–9 and ICD–10: Preliminary Estimates

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Abstract

Objectives—This report presents preliminary results describing the effects of implementing the Tenth Revision of the *International Classification of Diseases* (ICD–10) on mortality statistics for selected causes of death effective with deaths occurring in the United States in 1999. The report also describes major features of the Tenth Revision (ICD–10), including changes from the Ninth Revision (ICD–9) in classification and rules for selecting underlying causes of death. Application of comparability ratios is also discussed.

Methods—The report is based on cause-of-death information from a large sample of 1996 death certificates filed in the 50 States and the District of Columbia. Cause-of-death information in the sample includes underlying cause of death classified by both ICD–9 and ICD–10. Because the data file on which comparability information is derived is incomplete, results are preliminary.

Results—Preliminary comparability ratios by cause of death presented in this report indicate the extent of discontinuities in cause-of-death trends from 1998 through 1999 resulting from implementing ICD–10. For some leading causes (e.g., Septicemia, Influenza and pneumonia, Alzheimer's disease, and Nephritis, nephrotic syndrome and nephrosis), the discontinuity in trend is substantial. The ranking of leading causes of death is also substantially affected for some causes of death.

Conclusions—Results of this study, although preliminary, are essential to analyzing trends in mortality between ICD–9 and ICD–10. In particular, the results provide a means for interpreting changes between 1998, which is the last year in which ICD–9 was used, and 1999, the year in which ICD–10 was implemented for mortality in the United States.

Keywords: comparability • mortality • ICD–10 • bridge-coding

Introduction

This report presents preliminary data describing the effects of the implementation of the Tenth Revision of the *International Classification of Diseases* (ICD–10) on mortality statistics for selected causes of death. ICD–10 was implemented in the United States beginning with deaths occurring in 1999 and replaces the Ninth Revision of the ICD (ICD–9), which was implemented in the United States with 1979 mortality data.

The *International Classification of Diseases* has been revised approximately every 10 years since 1900 (1) (table A). The purpose of the revision is to stay abreast of medical advances in terms of disease nomenclature and etiology. The introduction of new classifications is costly to the Federal government and the States, and often introduces major disruptions in time series of mortality and morbidity statistics. However, revisions are essential to stay current with advances in medical science and to ensure the international comparability of health statistics.

ICD–10 differs from ICD–9 in several respects. ICD–10 is far more detailed than ICD–9, with about 8,000 categories compared with about 5,000 categories; ICD–10 uses alphanumeric codes compared with numeric codes in ICD–9; some additions and modifications were made to the chapters in the ICD; and some of the coding rules and rules for selecting the underlying cause of death have been changed. Measures of the discontinuities in cause-of-death statistics resulting from these classification and rule changes are critical to the interpretation of mortality trends.

Table A. Implementation dates of ten revisions of the *International Classification of Diseases*

Revision	Years in use by U.S.
First.	1900–09
Second.	1910–20
Third	1921–29
Fourth	1930–38
Fifth.	1939–48
Sixth	1949–57
Seventh	1958–67
Eighth, adapted.	1968–78
Ninth	1979–98
Tenth	1999–

Studies of the comparability between revisions of the ICD have been carried out and published in the United States at least since the Fifth Revision (2–5). Comparability studies—also called bridge-coding studies—are designed to measure the effects of a new revision of the ICD on the comparability with the previous revision of mortality statistics by cause of death. These studies involve the dual classification of a single year's mortality data, i.e., classifying the underlying cause of death on mortality records by both the new revision and the previous revision. The key element of a comparability study is the comparability ratio, which is derived from the dual classification. It is calculated by dividing the number of deaths classified by the new revision by the number of deaths classified by the previous revision. The resulting ratios represent the net effect of the new revision on cause-of-death statistics and can be used with prudence as factors to adjust mortality statistics for causes of death classified by a previous revision to be comparable to rates for the same causes classified by the new revision.

This report discusses major features of the Tenth Revision and changes in classification and rules for selecting underlying causes of death from the Ninth Revision. Comparability ratios based on preliminary data are presented that describe the net effects of the Tenth Revision on mortality statistics for selected causes of death. Application of comparability ratios is also discussed.

Major features of ICD–10 and changes in classification

Several new features and changes from ICD–9 to ICD–10 will affect the classification of cause of death. ICD–10 is much more detailed with about 8,000 categories for classifying causes of death compared with nearly 5,000 in ICD–9. Generally, with successive revisions, the trend is to expand disease categories to provide more detailed information about the type or site of the disease. For example, the single code for acute myocardial infarction (ICD–9 code 410—with no 4th digit subcategories) is expanded in ICD–10 to six different codes (I21.0—I21.4, I21.9), which specify the site of the infarction. Also, an increased number of terms have been assigned perinatal codes. For example, while ICD–9 provides a single code for uremia (585) regardless of the age of the decedent, ICD–10 provides a perinatal code for uremia. Thus, in ICD–10, for decedents less than 28 days of age, uremia is coded P96.0 and N19 for all other ages. In a few cases, less detail is shown. Essential hypertension (ICD–9 codes 401.0, 401.1, 401.9), for example, has been reduced to a single code in ICD–10 (I10—with no 4th digit subcategories).

ICD–10 uses a 4-digit alphanumeric coding scheme compared with the 4-digit numeric codes used in ICD–9. Each of the 21 chapters of ICD–10 is classified to a letter or letters of the alphabet (see table B). Infectious disease codes in chapter I, for example, begin with an "A" or "B." Thus, Acute poliomyelitis is associated with the codes A80.0–A80.9 and Viral hepatitis is classified as B15.0–B19.9. The 4-digit alphanumeric scheme used with ICD–10 allows a larger number of codes than the 4-digit numeric scheme used with ICD–9.

Chapters of the ICD have been added and rearranged. Chapter titles for ICD–9 and ICD–10 are shown in table B. ICD–9 chapter VI, Diseases of the nervous system and sense organs, was divided into three chapters in ICD–10: chapter VI, Diseases of the nervous system; chapter VII, Diseases of the eye and adnexa; and chapter VIII, Diseases of the ear and mastoid process. Also, External causes of morbidity and mortality and Factors influencing health status and contact with health services, which were supplementary classifications in ICD–9, have been assigned as chapters XX and XXI, respectively, in ICD–10. Chapters III (Endocrine, nutritional and metabolic diseases and immunity disorders) and IV (Diseases of the blood and blood-forming organs) in ICD–9 are exchanged in ICD–10. Chapter IV now contains the endocrine, nutritional and metabolic diseases, and chapter III contains the diseases of blood and blood-forming organs. Immune disorders remain in chapter III. Diseases of the genitourinary system (previously chapter X) and Complications of pregnancy, childbirth, and the puerperium (previously chapter XI) have become chapters XIV and XV, respectively, in ICD–10.

Cause-of-death titles have been changed and regrouped. Examples of title changes include the ICD–9 title Chronic obstructive pulmonary diseases and allied conditions, which became Chronic lower respiratory diseases in ICD–10. ICD–9's Suicide became Intentional self-harm, and Homicide became Assault in ICD–10. Notable regroupings include some cerebrovascular disorders, specifically transient cerebral ischemic attacks, which have been moved from Diseases of the circulatory system (ICD–9 code 435) to Diseases of the nervous system (ICD–10 codes G45.8 and G45.9). Septic shock, classified in ICD–9 as Shock without mention of trauma (785.5) in Symptoms, signs, and ill-defined conditions, is classified in ICD–10 to Unspecified septicemia (A41.9) in chapter I (Certain infectious and parasitic diseases). Respiratory failure (799.1) was moved from Symptoms, signs, and ill-defined conditions to Diseases of the respiratory system (J96). Myelodysplastic syndromes were moved from Diseases of the blood and blood-forming organs (289.8) to Neoplasms of uncertain behavior (D46). End stage renal disease, classified under Other disorders of kidney and ureter in ICD–9 (593.9), has been reclassified in ICD–10 as Renal failure (N18.0). Transport accidents have been regrouped by the characteristics of the injured person (e.g., pedestrian, pedal cyclist, motorcycle rider, car occupant). In ICD–9, transport accidents were grouped by the type of vehicle involved in the accident.

Changes in international selection and modification rules

Mortality statistics by cause of death are compiled from entries on the medical certification portion of the death certificate that follows the World Health Organization (WHO) format (6). Causes of death

Table B. Chapter titles for the Ninth and Tenth Revisions, *International Classification of Diseases*

Chapter	ICD–9[1] chapter titles (code range[2])	ICD–10[1] chapter titles (code range[2])
I	Infectious and parasitic diseases . . . . (001–139)	Certain infectious and parasitic diseases . . . . (A00–B99)
II	Neoplasms . . . . (140–239)	Neoplasms . . . .(C00–D48)
III	Endocrine, nutritional and metabolic diseases and immunity disorders . . . . (240–279)	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism . . . .(D50–D89)
IV	Diseases of blood and blood-forming organs . . . . (280–289)	Endocrine, nutritional and metabolic diseases . . . .(E00–E90)
V	Mental disorders . . . . (290–319)	Mental and behavioral disorders . . . .(F00–F99)
VI	Diseases of the nervous system and sense organs . . . . (320–389)	Diseases of the nervous system . . . .(G00–G99)
VII	Diseases of the circulatory system . . . . (390–459)	Diseases of the eye and adnexa . . . .(H00–H59)
VIII	Diseases of the respiratory system . . . . (460–519)	Diseases of the ear and mastoid process . . . .(H60–H95)
IX	Diseases of the digestive system . . . . (520–579)	Diseases of the circulatory system . . . .(I00–I99)
X	Diseases of the genitourinary system . . . . (580–629)	Diseases of the respiratory system . . . . (J00–J99)
XI	Complications of pregnancy, childbirth and the puerperium . . . . (630–676)	Diseases of the digestive system . . . .(K00–K93)
XII	Diseases of the skin and subcutaneous tissue . . . . (680–709)	Diseases of the skin and subcutaneous tissue . . . .(L00–L99)
XIII	Diseases of the musculoskeletal system and connective tissue . . . (710–739)	Diseases of the musculoskeletal system and connective tissue . . (M00–M99)
XIV	Congenital anomalies . . . . (740–759)	Diseases of the genitourinary system . . . .(N00–N99)
XV	Certain conditions originating in the perinatal period . . . . (760–779)	Pregnancy, childbirth and the puerperium . . . . (O00–O99)
XVI	Symptoms, signs and ill-defined conditions . . . . (780–799)	Certain conditions originating in the perinatal period . . . . (P00–P96)
XVII	Injury and poisoning . . . . (800–999)	Congenital malformations, deformations and chromosomal abnormalities . . . . (Q00–Q99)
XVIII	- - -	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified. . . . .(R00–R99)
XIX	- - -	Injury, poisoning and certain other consequences of external causes . . . . (S00–T98)
XX	- - -	External causes of morbidity and mortality . . . .(V01–Y98)
XXI	- - -	Factors influencing health status and contact with health services . . . . (Z00–Z99)
- - -	Supplementary classification of external causes of injury and poisoning . . . . (E800–E999)	- - -
- - -	Supplementary classification of factors influencing health status and contact with health services. . . . .(V01–V82)	- - -

- - - Category not applicable.

[1]ICD–9 is *International Classification of Diseases*, Ninth Revision, and ICD–10 is *International Classification of Diseases,* Tenth Revision.

[2]The fourth digits of the upper and lower limits of the code ranges are not shown.

include "all those diseases, morbid conditions or injuries which either resulted in or contributed to death and the circumstances of the accident or violence which produced these injuries" (6: p. 30). The medical certification of death is divided into two sections (see figure 1). In Part I, the physician is asked to provide the causal chain of morbid conditions that led to death, beginning with the condition most proximate to death on line (a) and working backwards to the initiating condition. The lines (a) through (d) in Part I are connected by the phrase "due to, or as a consequence of." They were designed to encourage the physician to provide the causally related sequence of medical conditions that resulted in death. Thus, the condition on line (a) should be due to the condition on line (b), and the condition on line (b) should be a consequence of the condition on line (c), etc., until the full sequence is described back to the originating or initiating condition. If only one step in the chain of morbid events is recorded, a single entry on line (a) is adequate. Part I of the medical certification is designed to facilitate the selection of the underlying cause of death when two or more causes are recorded on the certificate. The underlying cause of death is defined as "(a) the disease or injury which initiated the train of morbid events leading directly to death, or (b) the circumstances of the accident or violence which produced the fatal injury" (6: p. 31) and is generally considered the most useful cause from a public health standpoint. Part II solicits other conditions that the physician believed contributed to death, but were not in the causal chain. Figure 1 shows the medical certification part of the U.S. Standard Certificate of Death. While some details of the death certificate vary by State, all States use the same general format for medical certification outlined in the U.S. Standard

Certificate (7,8). The U.S. Standard Certificate, in turn, closely follows the format recommended by the WHO.

If the death certificate is properly completed, the disease or condition listed on the lowest line used in Part I is usually accepted as the underlying cause of death. This is an application of "The General Principle" (6). The General Principle is applied unless it is highly improbable that the condition on the lowest line used could have given rise to all of the diseases or conditions listed above it. In some cases, the sequence of morbid events entered on the death certificate is not specified correctly. A variety of errors may occur in completing the medical certification of death. Common problems include the following: the causal chain may be listed in reverse order; the distinction between Part I and Part II may have been ignored so that the causal sequence in Part I is simply extended unbroken into Part II; or the reported underlying cause is unlikely, in an etiological sense, to have caused the condition listed above it. In addition, sometimes the physician attributes the death to uninformative causes such as cardiac arrest or pulmonary arrest.

To resolve the problems of incorrect or implausible cause- of-death statements, the WHO designed standardized rules to select an under-lying cause of death from the information available on the death certificate that is most informative from a public health perspective. The rules for the Tenth Revision as updated by WHO since publication of ICD–10 (6) are described in an NCHS instruction manual (8). The rules for the Ninth Revision are described in an earlier ICD–9 edition of the same NCHS instruction manual and in Volume I of the ICD–9 manual (9). Coding rules beyond the "General Principle" are invoked if the cause-of-death section is completed incorrectly or if their application
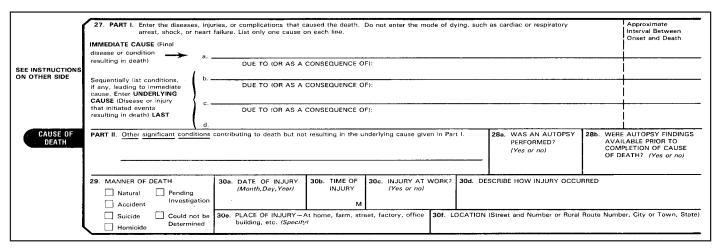
Figure 1. Medical certification portion of the U.S. Standard Certificate of Death

can improve the specificity and characterization of the cause of death in a manner consistent with the ICD. The rules are applied in two steps: selection of a tentative underlying cause of death, and modification of the tentative underlying cause in view of the other conditions reported on the certificate in either Part I or Part II. Modification involves several considerations by the medical coder: determining whether conditions in Part II could have given rise to the underlying cause, giving preference to specific terms over generalized terms, and creating linkages of conditions that are consistent with the terminology of the ICD.

The rules for selecting the underlying cause of death have been reevaluated and in some instances changed. Several changes to the Ninth Revision rules and the interpretation of these rules have been made with the Tenth Revision. (See table I for a summary comparison of ICD–9 and ICD–10 rules for selecting the underlying cause of death.) Some of the more prominent changes are discussed below. Other changes and their effects on specific causes of death are discussed in the Results section.

In general, the international selection and modification rules for ICD–10 are similar to ICD–9. In structure, two rules were consolidated (i.e., those involving senility and ill-defined conditions) and two rules were dropped (i.e., those involving old pneumonia, influenza, and maternal conditions, and errors and accidents in medical care). The greatest impact on statistical data reflects changes in details under rules and coding instructions. Most prominent is a change in the rules for direct sequels (Rule 3). The ICD–10 direct sequel rule states, "[i]f the condition selected by the General Principle or by Rule 1 or Rule 2 is obviously a direct consequence of another reported condition, whether in Part I or Part II [of the medical certification portion of the death certificate], select this primary condition" (6: p. 34). The cause of death most affected by Rule 3 is pneumonia, which is often the consequence of another condition or injury. In ICD–10, the applicability of Rule 3 to pneumonia is broader than in ICD–9 so pneumonia is considered a consequence of a much wider range of conditions. As a result, pneumonia is much less likely to be selected as the underlying cause of death under ICD–10 than under ICD–9. It follows that several other conditions, including a small number of heart diseases, cerebrovascular diseases, complications of diabetes, malignant neoplasms, and other wasting diseases, when listed with pneumonia, will be more likely to be selected.

Also important are several changes in the way the primary site of malignant neoplasms is selected. In ICD–10, order of entry is not used

to make neoplasms secondary or primary. Thus, if cancer of the stomach is listed in Part I, line (a), and cancer of the breast is listed in line (b), both are considered primary sites because neither is listed as a common site of metastasis. In ICD–9, cancer of the breast would be selected as the primary and underlying cause of death because it is listed on the lowest line used in Part I. In ICD–10, when two or more malignant neoplasms are considered primary, the underlying cause of death is assigned to Malignant neoplasms of independent (primary) multiple sites (C97) except when the sites are in the same organ system. In this case, the underlying cause is coded to the ill-defined site of the organ system. For example, if stomach cancer is listed in Part I, line (a), and cancer of the gallbladder is listed in line (b), the underlying cause should be Ill-defined sites within the digestive system (C26.9). In ICD–9, the underlying cause would be selected on the basis of order of entry, i.e., cancer of the gallbladder.

In ICD–10, secondary cancers are acceptable as the underlying cause of death if no primary site is specified. Thus, if metastatic brain carcinoma is the only condition certified, it is selected as the underlying cause of death in ICD–10. In ICD–9, secondary cancers were invalid as an underlying cause of death. In the aforementioned example where only metastatic brain carcinoma is listed, the ICD–9 underlying cause would be Other malignant neoplasm without specification of site (199.1).

In ICD–10, lung has been added to the list of common sites of metastasis and is considered secondary whenever it appears in Part I with any other site not on the list. Thus, if cancer of colon is listed in line (a) and cancer of lung in line (b), then cancer of lung is considered secondary and cancer of colon is selected as the underlying cause. However, if cancer of lung were to be listed in line (a) and cancer of brain in line (b), cancer of lung would be selected as the underlying cause of death because brain is also listed as a common site of metastasis. Although these changes do not have an impact on the malignant neoplasm category as a whole, they do have an impact on the distribution of underlying cause of death among various subcategories of malignant neoplasms.

Two important changes have been made to the rules that regulate how senility and ill-defined conditions are handled (Rule A). First, although Sudden infant death syndrome (SIDS) is classified in the ill-defined conditions chapter in ICD–10 (chapter XVIII), SIDS is exempt from Rule A. Rule A states specifically that "[w]here the selected cause is classifiable to chapter XVIII. . . except for R95 [SIDS]. . . and a

condition classified elsewhere . . . is reported on the certificate, reselect the cause of death as if the condition classified to chapter XVIII had not been reported, except to take account of that condition if it modifies the coding'' (6: p. 42). In ICD–9, SIDS is classified as ill-defined and is subject to the ill-defined rule (ICD–9, Rule 5). Thus, SIDS is likely to be selected as the underlying cause of death more often under ICD–10. Second, several conditions not contained in chapter XVIII are treated as ill-defined in ICD–10 (7). These include unspecified cardiac arrest (I46.9), unspecified hypotension (I95.9), Other and unspecified disorders of circulatory system (I99), Acute respiratory failure (J96.0), Unspecified respiratory failure (J96.9), and Respiratory failure of new-born (P28.5). Under the ICD–9 Rule 5, these causes of death are not treated as ill-defined conditions.

Changes in the instructions regarding highly improbable sequences were made with ICD–10. Each of the following was con-sidered an improbable sequence under ICD–9 rules and an acceptable sequence in ICD–10: a) Certain infectious and parasitic diseases can be due to certain diseases outside of chapter I; b) any infectious disease can be due to disorders of the immune mechanism, chemo-therapy, and tumors of the immune system; c) any malignant neoplasm can be due to human immunodeficiency virus (HIV) infection. Under ICD–9, only a few specified malignant neoplasms could be due to HIV. d) Diabetes can be considered due to malnutrition; e) Intracranial hemorrhage can be due to certain heart diseases (I05–I08, I09.1, I33–I38) and diseases of the digestive system; and f) Cerebral embo-lism can be due to diseases of the digestive system.

Comparability ratios

The classification and rule changes between ICD–10 and ICD–9 have a considerable impact on some of the major causes of death in the United States. The shifting of deaths away from some cause-of-death categories and into others resulting from these changes creates discontinuities in cause-of-death trends from 1998, the last year of ICD–9, and 1999, the first year of ICD–10. The comparability ratios presented in this report are designed to measure these discontinuities and are key to understanding the trend in mortality statistics from 1998 to 1999.

The comparability ratios presented in this report are based on coding the same deaths occurring in 1996 by both the Ninth and Tenth Revisions and measure the net effect of ICD–10 by cause of death. Operationally, the comparability ratio for cause of death i (C_i) is cal-culated as:

$$C_i = \frac{D_{i,\text{ICD}-10}}{D_{i,\text{ICD}-9}}$$

where $D_{i,\text{ICD}-10}$ is the number of deaths due to cause i classified by ICD–10 and $D_{i,\text{ICD}-9}$ is the number of deaths due to cause i classified by ICD–9. A comparability ratio of 1.00 indicates that the same number of deaths was assigned to cause i under both ICD–9 and ICD–10 denoting no net effect of ICD–10 on that particular cause of death. A ratio showing perfect correspondence between the two revisions does not necessarily indicate that the cause was totally unaffected by ICD–10, but merely that any increases in the allocation to cause i were completely offset by decreases in the allocation to cause i.

A comparability ratio less than 1.00 results from fewer deaths being classified to cause i under ICD–10 compared with the comparable cause under ICD–9. For example, the preliminary comparability ratio for Viral hepatitis is 0.8343 (table 1). In ICD–9, 1,346 deaths were classified as Viral hepatitis. In ICD–10, when the same deaths were classified, the number of deaths due to Viral hepatitis fell to 1,123, a decrease of 223 deaths or about 16.5 percent. This means that Viral hepatitis was less likely to be selected as the underlying cause of death in ICD–10 than in ICD–9.

Comparability ratios greater than 1.00 are the result of a larger number of deaths being classified to cause i under ICD–10. For example, the comparability ratio for Septicemia is 1.1949 (table 1). In ICD–9, 17,791 deaths were classified to Septicemia. In ICD–10, 21,258 deaths were classified to Septicemia, an increase of 3,467 deaths or nearly 20 percent. Thus, Septicemia is more likely to be selected as the underlying cause of death in ICD–10 than in ICD–9.

Data and methods

Data

The data in this report are based on cause-of-death information from a large nonrandom sample of 1996 death certificates filed in the 50 States and the District of Columbia. The cause-of-death informa-tion in the sample includes underlying cause of death classified by both ICD–9 and ICD–10. The sample comprises 1,852,671 out of the total 2,314,690 (80 percent) resident deaths occurring in the United States during 1996. All records that could be coded in time for the preparation of this report were included. Because the data file on which comparability information is derived is incomplete, compara-bility results are preliminary. A description of the sample is included below.

Classification of underlying cause

The underlying cause of death for each record in the 1996 mortality data was originally classified by ICD–9 (10). A major task of this study was to reclassify 1996 mortality records by ICD–10 to provide an underlying cause of death classified by each revision. This was done primarily by using the ICD–10 versions of the mortality medical software programs designed to select the underlying cause of death from electronic death record data. Two pieces of this suite of software are particularly involved. The Mortality Medical Indexing, Classification, and Retrieval (MICAR) system makes code assign-ments to each entity on the death certificate based on the presence or absence of cause-of-death terms and how these are positioned relative to one another. The Automated Classification of Medical Entities (ACME) program uses the resulting entity codes to select the underlying cause of death based on a set of decision tables consistent with the ICD selection rules (11–13). See Technical notes for more detail regarding the application of the automated coding systems.

Not all of the 1996 mortality records could be classified by ICD–10 using the automated systems. Some records (about 20 percent of the total 2,314,690) were rejected by the automated systems. This required manual intervention to obtain a valid underlying cause of death. More than 450,000 rejects were initially excluded from the sample and set aside for manual coding. Of these, a total of 13,703 were manually coded in time for the release of this report. Records containing mention of certain causes of death are routinely rejected by the automated

systems, either because the rules governing these causes have not been programmed or because records with mention of these causes require careful examination. For example, these include rare causes, maternal deaths, some external causes, and deaths due to complications of surgeries and adverse effects of drugs. Data for these causes of death are sparse in the comparability file. Consequently, the preliminary data regarding comparability for these causes are not shown. Records are also rejected when the software is unable to recognize the terminology listed on the death certificate.

In addition, approximately 40,000 records were excluded from the sample because the death certificate had initially been submitted with cause of death pending investigation or a cause or causes that were later determined to be incorrect. These records were updated in the final mortality file as amendments were received and thus the ICD–9 underlying cause is classified correctly. However, updates were not made to the original MICAR input files, and, as a result, ICD–10 classifications reflect an unknown or incorrect underlying cause. These records are, in almost all cases, external causes (particularly suicides and homicides) when classified by ICD–9 and are likely to be so classified in ICD–10. It is possible that some records were overlooked that should be excluded from the sample due to a pending certification. This should be a very small number overall and should not substantially affect the comparability ratios presented.

Exclusion of the above-mentioned records is unlikely to result in seriously biased estimates of the comparability ratios presented in this report. Although these records are excluded on a nonrandom basis and may not be fully representative of the cause-of-death distribution in the 1996 mortality file, the comparability ratios shown in tables 1 and 2 are indicative of the distribution of deaths by cause of death across the Ninth and Tenth Revisions rather than the simple cause-of-death distribution in the mortality file. Generally, for most causes, the cause-of-death distribution of the records across revisions should not be substantially different for the excluded records than for those included in the sample. For example, the probability that a record is classified as heart disease in both ICD–9 and ICD–10 should be similar whether the record is included or excluded from the sample. Thus, the sample is assumed to be representative of the distribution of deaths by cause across revisions and is treated as a simple random sample. Even so, for some causes of death, it is possible that the distribution across revisions may be different for the excluded records. Thus, comparability ratios for these causes may be subject to some sampling bias. Where it is obvious that a cause of death is not adequately represented in the comparability file, a comparability ratio for that cause is not shown. Standard errors for the comparability ratios are calculated using PROC RATIO, a procedure in the SUDAAN statistical software designed to calculate standard errors for the ratio of two random variables (14). See Technical notes for more detail about the calculation of the standard error of the comparability ratio.

Cause-of-death tabulation lists

Two of the tabulation lists developed by NCHS for use with mortality data classified by ICD–10 are used to tabulate the comparability data in this report (15). The List of 113 Selected Causes of Death (113-cause list) was developed for the general analysis of ICD–10 mortality statistics and for ranking leading causes of death. It is similar in structure and content and replaces the List of 72 Selected Causes of Death (72-cause list) used for ICD–9 mortality

statistics (16). The List of 130 Selected Causes of Infant Death (ICD–10 infant cause list) was developed for the analysis of infant mortality and for ranking leading causes of infant death. It is similar to and replaces the List of 61 Selected Causes of Infant Death (ICD–9 infant cause list) (16). Although the names of the lists imply 113 and 130 causes of death, these figures refer to the number of mutually exclusive categories in each list. In reality, the 113-cause list contains a total of 135 cause-of-death categories; the infant list contains 158 total categories.

Comparability ratios are intended to measure the effect of changes in classification and coding rules. Thus, it is important to avoid potentially confounding effects of variation in the tabulation lists used for the two revisions. For example, an important cause-of-death category in the 72-cause list is Accidents and adverse effects. However, in the 113-cause list, accidents are categorized separately from the adverse effects. A comparability ratio for accidents using the 113-cause list category in the numerator and the 72-cause list category in the denominator reflects not only the changes in classification and coding rules, but also the decrease in allocation because the deaths from adverse effects are missing in the 113-cause list category. Further, because of the greater detail in the ICD–10 113-cause list, many categories are not included in the 72-cause list (e.g., Salmonella infections, Malignant neoplasm of pancreas, and Alcoholic liver disease). As a result, under these circumstances, comparability ratios for the causes of death added in ICD–10 cannot be calculated. To address these problems, ICD–9 codes were assigned to the 113 causes of death in the 113-cause list. The same has been done for the infant cause list (i.e., ICD–9 codes were assigned to the 130 causes of death in the ICD–10 infant cause list). Table C shows the 113-cause list (135 categories) with comparable ICD–10 and ICD–9 codes. Table D shows the 130-cause list for infant deaths (158 categories) with comparable ICD–10 and ICD–9 codes.

Results

The following section highlights and explains comparability results for major causes of death presented in tables 1 and 2. Table 1 shows comparability ratios for the 113-cause list. Table 2 shows comparability ratios for the 130-infant-cause list. Ratios are shown only for those causes in these lists that are deemed reliable. (See Technical notes for a discussion of the criteria for determining the reliability of comparability ratios.) These tables also show the number of deaths in the comparability file classified by ICD–10 and ICD–9, standard errors and 95-percent confidence intervals for comparability ratios. Comparability ratios for major causes of death in the United States are discussed below. Explanations for the magnitude of the comparability ratios are also provided.

Diseases of heart

The comparability ratio for Diseases of heart (113-list number 054) is 0.9858, denoting a nearly 1.5 percent net decrease in the allocation of heart disease as the underlying cause of death. Although it is a small shift in percent, it is a substantial shift in the absolute number of deaths (8,841). The net decrease is the result primarily of shifts away from heart diseases to other causes of death due to the change in Rule A. Under Rule A in ICD–10, cardiac arrest is treated as an ill-defined condition. Thus, it is ignored in the selection of the

Table C. Comparable category numbers for 113 selected causes of death according to the Ninth and Tenth Revisions, *International Classification of Diseases*

List number	Cause of death	Category codes according to ICD–10[1]	Category codes according to ICD–9[1]
001	Salmonella infections	A01–A02	002–003
002	Shigellosis and amebiasis	A03,A06	004,006
003	Certain other intestinal infections	A04,A07–A09	007–009
004	Tuberculosis	A16–A19	010–018
005	Respiratory tuberculosis	A16	010–012
006	Other tuberculosis	A17–A19	013–018
007	Whooping cough	A37	033
008	Scarlet fever and erysipelas	A38,A46	034.1–035
009	Meningococcal infection	A39	036
010	Septicemia	A40–A41	038
011	Syphilis	A50–A53	090–097
012	Acute poliomyelitis	A80	045
013	Arthropod–borne viral encephalitis	A83–A84,A85.2	062–064
014	Measles	B05	055
015	Viral hepatitis	B15–B19	070
016	Human immunodeficiency virus (HIV) disease	B20–B24	042–044
017	Malaria	B50–B54	084
018	Other and unspecified infectious and parasitic diseases and their sequelae	A00,A05,A20–A36,A42–A44,A48–A49,A54–A79,A81–A82,A85.0–A85.1,A85.8, A86–B04,B06–B09,B25–B49,B55–B99	001,005,020–032,037,039–041,046–054,056–061,065–066,071–083,085–088,098–134,136, 139,771.3
019	Malignant neoplasms	C00–C97	140–208
020	Malignant neoplasms of lip, oral cavity and pharynx	C00–C14	140–149
021	Malignant neoplasm of esophagus	C15	150
022	Malignant neoplasm of stomach	C16	151
023	Malignant neoplasms of colon, rectum and anus	C18–C21	153–154
024	Malignant neoplasms of liver and intrahepatic bile ducts	C22	155
025	Malignant neoplasm of pancreas	C25	157
026	Malignant neoplasm of larynx	C32	161
027	Malignant neoplasms of trachea, bronchus and lung	C33–C34	162
028	Malignant melanoma of skin	C43	172
029	Malignant neoplasm of breast	C50	174–175
030	Malignant neoplasm of cervix uteri	C53	180
031	Malignant neoplasms of corpus uteri and uterus, part unspecified	C54–C55	179,182
032	Malignant neoplasm of ovary	C56	183.0
033	Malignant neoplasm of prostate	C61	185
034	Malignant neoplasms of kidney and renal pelvis	C64–C65	189.0,189.1
035	Malignant neoplasm of bladder	C67	188
036	Malignant neoplasms of meninges, brain and other parts of central nervous system	C70–C72	191–192
037	Malignant neoplasms of lymphoid, hematopoietic and related tissue	C81–C96	200–208
038	Hodgkin's disease	C81	201
039	Non-Hodgkin's lymphoma	C82–C85	200,202
040	Leukemia	C91–C95	204–208
041	Multiple myeloma and immunoproliferative neoplasms	C88,C90	203
042	Other and unspecified malignant neoplasms of lymphoid, hematopoietic and related tissue	C96	- - -

See footnotes at end of table.

List number	Cause of death	Category codes according to	
		ICD–10[1]	ICD–9[1]
043	All other and unspecified malignant neoplasms	C17,C23–C24,C26–C31,C37–C41,C44–C49, C51–C52,C57–C60,C62–C63,C66,C68– C69,C73–C80,C97	152,156,158–160,163–171,173,181,183.2– 184,186–187,189.2–190,193–199
044	In situ neoplasms, benign neoplasms and neoplasms of uncertain or unknown behavior	D00–D48	210–239
045	Anemias	D50–D64	280–285
046	Diabetes mellitus	E10–E14	250
047	Nutritional deficiencies	E40–E64	260–269
048	Malnutrition	E40–E46	260–263
049	Other nutritional deficiencies	E50–E64	264–269
050	Meningitis	G00,G03	320–322
051	Parkinson's disease	G20–G21	332
052	Alzheimer's disease	G30	331.0
053	Major cardiovascular diseases	I00–I78	390–434,436–448
054	Diseases of heart	I00–I09,I11,I13,I20–I51	390–398,402,404,410–429
055	Acute rheumatic fever and chronic rheumatic heart diseases	I00–I09	390–398
056	Hypertensive heart disease	I11	402
057	Hypertensive heart and renal disease	I13	404
058	Ischemic heart diseases	I20–I25	410–414,429.2
059	Acute myocardial infarction	I21–I22	410
060	Other acute ischemic heart diseases	I24	411
061	Other forms of chronic ischemic heart disease	I20,I25	412–414,429.2
062	Atherosclerotic cardiovascular disease, so described	I25.0	429.2
063	All other forms of chronic ischemic heart disease	I20,I25.1–I25.9	412–414
064	Other heart diseases	I26–I51	415–429.1,429.3–429.9
065	Acute and subacute endocarditis	I33	421
066	Diseases of pericardium and acute myocarditis	I30–I31,I40	420,422–423
067	Heart failure	I50	428
068	All other forms of heart disease	I26–I28,I34–I38,I42–I49,I51	415–417,424–427,429.0–429.1,429.3–429.9
069	Essential (primary) hypertension and hypertensive renal disease	I10,I12	401,403
070	Cerebrovascular diseases	I60–I69	430–434,436–438
071	Atherosclerosis	I70	440
072	Other diseases of circulatory system	I71–I78	441–448
073	Aortic aneurysm and dissection	I71	441
074	Other diseases of arteries, arterioles and capillaries	I72–I78	442–448
075	Other disorders of circulatory system	I80–I99	451–459
076	Influenza and pneumonia	J10–J18	480–487
077	Influenza	J10–J11	487
078	Pneumonia	J12–J18	480–486
079	Other acute lower respiratory infections	J20–J22	466
080	Acute bronchitis and bronchiolitis	J20–J21	466
081	Unspecified acute lower respiratory infection	J22	- - -
082	Chronic lower respiratory diseases	J40–J47	490–494,496
083	Bronchitis, chronic and unspecified	J40–J42	490–491
084	Emphysema	J43	492
085	Asthma	J45–J46	493
086	Other chronic lower respiratory diseases	J44,J47	494,496
087	Pneumoconioses and chemical effects	J60–J66,J68	500–506

See footnotes at end of table.

Table C. Comparable category numbers for 113 selected causes of death according to the Ninth and Tenth Revisions, *International Classification of Diseases*—Con.

List number	Cause of death	Category codes according to ICD–10[1]	Category codes according to ICD–9[1]
088	Pneumonitis due to solids and liquids	J69	507
089	Other diseases of respiratory system	J00–J06,J30–J39,J67,J70–J98	034.0,460–465,470–478,495,508–519
090	Peptic ulcer	K25–K28	531–534
091	Diseases of appendix	K35–K38	540–543
092	Hernia	K40–K46	550–553
093	Chronic liver disease and cirrhosis	K70,K73–K74	571
094	Alcoholic liver disease	K70	571.0–571.3
095	Other chronic liver disease and cirrhosis	K73–K74	571.4–571.9
096	Cholelithiasis and other disorders of gallbladder	K80–K82	574–575
097	Nephritis, nephrotic syndrome and nephrosis	N00–N07,N17–N19,N25–N27	580–589
098	Acute and rapidly progressive nephritic and nephrotic syndrome	N00–N01,N04	580–581
099	Chronic glomerulonephritis, nephritis and nephropathy not specified as acute or chronic, and renal sclerosis unspecified	N02–N03,N05–N07,N26	582–583,587
100	Renal failure	N17–N19	584–586
101	Other disorders of kidney	N25,N27	588–589
102	Infections of kidney	N10–N12,N13.6,N15.1	590
103	Hyperplasia of prostate	N40	600
104	Inflammatory diseases of female pelvic organs	N70–N76	614–616
105	Pregnancy, childbirth and the puerperium	O00–099	630–676
106	Pregnancy with abortive outcome	O00–O07	630–639
107	Other complications of pregnancy, childbirth and the puerperium	O10–O99	640–676
108	Certain conditions originating in the perinatal period	P00–P96	760–771.2,771.4–779
109	Congenital malformations, deformations, and chromosomal abnormalities	Q00–Q99	740–759
110	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	R00–R99	780–799
111	All other diseases (Residual)	Residual	Residual
112	Accidents (unintentional injuries)	V01–X59,Y85–Y86	E800–E869,E880–E929
113	Transport accidents	V01–V99,Y85	E800–E848,E929.0,E929.1
114	Motor vehicle accidents	V02–V04,V09.0,V09.2,,V12–V14,V19.0–V19.2,V19.4–V19.6,V20–V79,V80.3–V80.5,V81.0–V81.1,V82.0–V82.1,V83–V86,V87.0–V87.8,V88.0–V88.8,V89.0,V89.2	E810–E825
115	Other land transport accidents	V01,V05–V06,V09.1,V09.3–V09.9,V10–V11,V15–V18,V19.3,V19.8–V19.9,V80.0–V80.2,V80.6–V80.9,V81.2–V81.9,V82.2–V82.9,V87.9,V88.9,V89.1,V89.3,V89.9	E800–E807,E826–E829
116	Water, air and space, and other and unspecified transport accidents and their sequelae	V90–V99,Y85	E830–E848,E929.0,E929.1
117	Nontransport accidents	W00–X59,Y86	E850–E869,E880–E928,E929.2–E929.9
118	Falls	W00–W19	E880–E888
119	Accidental discharge of firearms	W32–W34	E922
120	Accidental drowning and submersion	W65–W74	E910
121	Accidental exposure to smoke, fire and flames	X00–X09	E890–E899
122	Accidental poisoning and exposure to noxious substances	X40–X49	E850–E869,E924.1
123	Other and unspecified nontransport accidents and their sequelae	W20–W31,W35–W64,W75–W99,X10–X39,X50–X59,Y86	E900–E909,E911–E921,E923–E924.0,E924.8–E928,E929.2–E929.9
124	Intentional self-harm (suicide)	X60–X84,Y87.0	E950–E959
125	Intentional self-harm (suicide) by discharge of firearms	X72–X74	E955.0–E955.4

See footnotes at end of table.

Table C. Comparable category numbers for 113 selected causes of death according to the Ninth and Tenth Revisions, *International Classification of Diseases*—Con.

List number	Cause of death	Category codes according to	
		ICD–10[1]	ICD–9[1]
126	Intentional self-harm (suicide) by other and unspecified means and their sequelae.	X60–X71,X75–X84,Y87.0	E950–E954,E955.5–E959
127	Assault (homicide)	X85–Y09,Y87.1	E960–E969
128	Assault (homicide) by discharge of firearms.	X93–X95	E965.0–E965.4
129	Assault (homicide) by other and unspecified means and their sequelae	X85–X92,X96–Y09,Y87.1	E960–E964,E965.5–E969
130	Legal intervention.	Y35,Y89.0	E970–E978
131	Events of undetermined intent	Y10–Y34,Y87.2,Y89.9	E980–E989
132	Discharge of firearms, undetermined intent	Y22–Y24	E985.0–E985.4
133	Other and unspecified events of undetermined intent and their sequelae. . . .	Y10–Y21,Y25–Y34,Y87.2,Y89.9	E980–E984,E985.5–E989
134	Operations of war and their sequelae.	Y36,Y89.1	E990–E999
135	Complications of medical and surgical care	Y40–Y84,Y88	E870–E879,E930–E949

- - - No comparable category classified by ICD–9 exists.

[1]ICD–10 is *International Classification Diseases*, Tenth Revision, and ICD–9 is *International Classification of Diseases*, Ninth Revision.

Table D. Comparable category numbers for 130 selected causes of infant death according to the Ninth and Tenth Revisions, *International Classification of Diseases*

List number	Cause of death	Category numbers according to ICD–10[1]	Category numbers according to ICD–9[1]
001	Certain infectious and parasitic diseases	A00–B99	001–033,034.1–134,136–139,771.3
002	Certain intestinal infectious diseases	A00–A08	001–008
003	Diarrhea and gastroenteritis of infectious origin	A09	009
004	Tuberculosis	A16–A19	010–018
005	Tetanus	A33,A35	037,771.3
006	Diptheria	A36	032
007	Whooping cough	A37	033
008	Meningococcal infection	A39	036
009	Septicemia	A40–A41	038
010	Congenital syphilis	A50	090
011	Gonococcal infection	A54	098
012	Viral diseases	A80–B34	042–079
013	Acute poliomyelitis	A80	045
014	Varicella (chickenpox)	B01	052
015	Measles	B05	055
016	Human immunodeficiency virus (HIV) disease	B20–B24	042–044
017	Mumps	B26	072
018	Other and unspecified viral diseases	A81–B00,B02–B04,B06–B19,B25,B27–B34	046–051,053–054,056–071,073–079
019	Candidiasis	B37	112
020	Malaria	B50–B54	084
021	Pneumocystosis	B59	136.3
022	All other and unspecified infectious and parasitic diseases	A20–A32,A38,A42–A49,A51–A53,A55–A79,B35–B36,B38–B49,B55–B58,B60–B99	020–031,034.1–035,039–041,080–083,085–088,091–097,099–111,114–134,136.0–136.2,136.4–139
023	Neoplasms	C00–D48	140–239
024	Malignant neoplasms	C00–C97	140–208
025	Hodgkin's disease and non-Hodgkin's lymphomas	C81–C85	200–202
026	Leukemia	C91–C95	204–208
027	Other and unspecified malignant neoplasms	C00–C80,C88–C90,C96–C97	140–199,203
028	In situ neoplasms, benign neoplasms and neoplasms of uncertain or unknown behavior	D00–D48	210–239
029	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	D50–D89	135,279–289
030	Anemias	D50–D64	280–285
031	Other diseases of blood and blood-forming organs	D65–D76	286–289
032	Certain disorders involving the immune mechanism	D80–D89	135,279
033	Endocrine, nutritional and metabolic diseases	E00–E88	240–278
034	Short stature, not elsewhere classified	E34.3	259.4
035	Malnutrition and other nutritional deficiencies	E40–E64	260–269
036	Cystic fibrosis	E84	277.0
037	Volume depletion, disorders of fluid, electrolyte and acid-base balance	E86–E87	276
038	All other endocrine, nutritional and metabolic diseases	E00–E32,E34.0–E34.2,E34.4–E34.9,E65–E83,E85,E88	240–259.3,259.8–259.9,270–275,277.1–278
039	Diseases of the nervous system	G00–G98	320–359,435
040	Meningitis	G00,G03	320–322
041	Infantile spinal muscular atrophy, type I (Werdnig-Hoffman)	G12.0	335.0
042	Infantile cerebral palsy	G80	343
043	Anoxic brain damage, not elsewhere classified	G93.1	348.1

See footnotes at end of table.

List number	Cause of death	Category numbers according to	
		ICD–10[1]	ICD–9[1]
044	Other diseases of nervous system	G04,G06–G11,G12.1–G12.9,G20–G72,G81–G92,G93.0,G93.2–G93.9,G95–G98	323–334,335.1–342,344–348.0,348.2–359,435
045	Diseases of the ear and mastoid process	H60–H93	380–389
046	Diseases of the circulatory system.	I00–I99	390–434,436–459
047	Pulmonary heart disease and diseases of pulmonary circulation	I26–I28	415–417
048	Pericarditis, endocarditis and myocarditis	I30,I33,I40	420–422
049	Cardiomyopathy	I42	425
050	Cardiac arrest	I46	427.5
051	Cerebrovascular diseases	I60–I69	430–434,436–438
052	All other diseases of circulatory system	I00–I25,I31,I34–I38,I44–I45,I47–I51,I70–I99	390–414,423–424,426–427.4,427.6–429,440–459
053	Diseases of the respiratory system	J00–J98	034.0,460–519
054	Acute upper respiratory infections.	J00–J06	034.0,460–465
055	Influenza and pneumonia.	J10–J18	480–487
056	Influenza	J10–J11	487
057	Pneumonia.	J12–J18	480–486
058	Acute bronchitis and acute bronchiolitis	J20–J21	466
059	Bronchitis, chronic and unspecified	J40–J42	490–491
060	Asthma	J45–J46	493
061	Pneumonitis due to solids and liquids	J69	507
062	Other and unspecified diseases of respiratory system	J22,J30–J39,J43–J44,J47–J68,J70–J98	470–479,492,494–506,508–519
063	Diseases of the digestive system	K00–K92	520–579
064	Gastritis, duodenitis, and noninfective enteritis and colitis	K29,K50–K55	535,555–558
065	Hernia of abdominal cavity and intestinal obstruction without hernia.	K40–K46,K56	550–553,560
066	All other and unspecified diseases of digestive system	K00–K28,K30–K38,K57–K92	520–534,536–543,562–579
067	Diseases of the genitourinary system	N00–N98	580–629
068	Renal failure and other disorders of kidney	N17–N19,N25,N27	584–589
069	Other and unspecified diseases of genitourinary system	N00–N15,N20–N23,N26,N28–N98	580–583,590–629
070	Certain conditions originating in the perinatal period	P00–P96	760–771.2,771.4–779
071	Newborn affected by maternal factors and by complications of pregnancy, labor and delivery	P00–P04	760–763
072	Newborn affected by maternal hypertensive disorders	P00.0	760.0
073	Newborn affected by other maternal conditions which may be unrelated to present pregnancy	P00.1–P00.9	760.1–760.6,760.8–760.9
074	Newborn affected by maternal complications of pregnancy.	P01	761
075	Newborn affected by incompetent cervix	P01.0	761.0
076	Newborn affected by premature rupture of membranes	P01.1	761.1
077	Newborn affected by multiple pregnancy	P01.5	761.5
078	Newborn affected by other maternal complications of pregnancy.	P01.2–P01.4,P01.6–P01.9	761.2–761.4,761.6–761.9
079	Newborn affected by complications of placenta, cord, and membranes . . .	P02	762
080	Newborn affected by complications involving placenta	P02.0–P02.3	762.0–762.3
081	Newborn affected by complications involving cord	P02.4–P02.6	762.4–762.6
082	Newborn affected by chorioamnionitis.	P02.7	762.7
083	Newborn affected by other and unspecified abnormalities of membranes.	P02.8–P02.9	762.8–762.9
084	Newborn affected by other complications of labor and delivery	P03	763.0–763.4,763.6–763.9
085	Newborn affected by noxious influences transmitted via placenta or breast milk	P04	760.7, 763.5
086	Disorders related to length of gestation and fetal malnutrition.	P05–P08	764–766

See footnotes at end of table.

Table D. Comparable category numbers for 130 selected causes of infant death according to the Ninth and Tenth Revisions, *International Classification of Diseases*—Con.

List number	Cause of death	ICD–10[1]	ICD–9[1]
		Category numbers according to	
087	Slow fetal growth and fetal malnutrition	P05	764
088	Disorders related to short gestation and low birth weight, not elsewhere classified.	P07	765
089	Extremely low birth weight or extreme immaturity	P07.0,P07.2	765.0
090	Other low birth weight or preterm	P07.1,P07.3	765.1
091	Disorders related to long gestation and high birth weight	P08	766
092	Birth trauma.	P10–P15	767
093	Intrauterine hypoxia and birth asphyxia	P20–P21	768
094	Intrauterine hypoxia	P20	768.2–768.4
095	Birth asphyxia	P21	768.5–768.9
096	Respiratory distress of newborn	P22	769
097	Other respiratory conditions originating in the perinatal period	P23–P28	770
098	Congenital pneumonia	P23	770.0
099	Neonatal aspiration syndromes	P24	770.1
100	Interstitial emphysema and related conditions originating in the perinatal period.	P25	770.2
101	Pulmonary hemorrhage originating in the perinatal period.	P26	770.3
102	Chronic respiratory disease originating in the perinatal period	P27	770.7
103	Atelectasis	P28.0–P28.1	770.4–770.5
104	All other respiratory conditions originating in the perinatal period	P28.2–P28.9	770.6–770.8
105	Infections specific to the perinatal period	P35–P39	771.0–771.2,771.4–771.8
106	Bacterial sepsis of newborn	P36	771.8
107	Omphalitis of newborn with or without mild hemorrhage.	P38	771.4
108	All other infections specific to the perinatal period	P35,P37,P39	771.0–771.2,771.5–771.7
109	Hemorrhagic and hematological disorders of newborn	P50–P61	772–774,776
110	Neonatal hemorrhage.	P50–P52,P54	772
111	Hemorrhagic disease of newborn	P53	776.0
112	Hemolytic disease of newborn due to isoimmunization and other perinatal jaundice.	P55–P59	773–774
113	Hematological disorders	P60–P61	776.1–776.9
114	Syndrome of infant of a diabetic mother and neonatal diabetes mellitus	P70.0–P70.2	775.0–775.1
115	Necrotizing enterocolitis of newborn	P77	777.5
116	Hydrops fetalis not due to hemolytic disease	P83.2	778.0
117	Other perinatal conditions	P29,P70.3–P76,P78–P81,P83.0–P83.1,P83.3–P96	775.2–775.9,777.0–777.4,777.6–777.9,778.1–779
118	Congenital malformations, deformations and chromosomal abnormalities	Q00–Q99	740–759
119	Anencephaly and similar malformations	Q00	740
120	Congenital hydrocephalus	Q03	742.3
121	Spina bifida.	Q05	741
122	Other congenital malformations of nervous system.	Q01–Q02,Q04,Q06–Q07	742.0–742.2,742.4–742.9
123	Congenital malformations of heart.	Q20–Q24	745–746
124	Other congenital malformations of circulatory system	Q25–Q28	747
125	Congenital malformations of respiratory system.	Q30–Q34	748
126	Congenital malformations of digestive system.	Q35–Q45	749–751
127	Congenital malformations of genitourinary system	Q50–Q64	752–753
128	Congenital malformations and deformations of musculoskeletal system, limbs and integument	Q65–Q85	754–757
129	Down's syndrome	Q90	758.0
130	Edward's syndrome	Q91.0–Q91.3	758.2

See footnotes at end of table.

Table D. Comparable category numbers for 130 selected causes of infant death according to the Ninth and Tenth Revisions, *International Classification of Diseases*—Con.

List number	Cause of death	Category numbers according to	
		ICD–10[1]	ICD–9[1]
131	Patau's syndrome	Q91.4–Q91.7	758.1
132	Other congenital malformations and deformations	Q10–Q18,Q86–Q89	743–744,759
133	Other chromosomal abnormalities, not elsewhere classified.	Q92–Q99	758.3–758.9
134	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified.	R00–R99	780–799
135	Sudden infant death syndrome	R95	798.0
136	Other symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	R00–R53,R55–594,R96–R99	780–796,798.1–799
137	All other diseases	F01–F99,H00–H57,L00–M99	290–319,360–379,680–739
138	External causes of mortality.	V01–Y89	E800–E999
139	Accidents (unintentional injuries).	V01–X59	E800–E869,E880–E929
140	Transport accidents.	V01–V99	E800–E848,E920–E929.1
141	Motor vehicle accidents	V02–V04,V09.0,V09.2,V12–V14,V19.0–V19.2,V19.4–V19.6,V20–V79,V80.3–V80.5,V81.0–V81.1,V82.0–V82.1,V83–V86,V87.0–V87.8,V88.0–V88.8,V89.0,V89.2	E810–E825
142	Other and unspecified transport accidents	V01,V05–V06,V09.1,V09.3–V09.9,V10–V11,V15–V18,V19.3,V19.8,V19.9,V80.0–V80.2,V80.6–V80.9,V81.2–V81.9,V82.2–V82.9,V87.9,V88.9,V89.1,V89.3,V89.9,V90–V99	E800–E807,E826–E848,E929.0–E929.1
143	Falls	W00–W19	E880–E888
144	Accidental discharge of firearms.	W32–W34	E922
145	Accidental drowning and submersion.	W65–W74	E910
146	Accidental suffocation and strangulation in bed.	W75	E913.0
147	Other accidental suffocation and strangulation	W76–W77,W81–W84	E913.1–E913.9
148	Accidental inhalation and ingestion of food or other objects causing obstruction of respiratory tract	W78–W80	E911–E912
149	Accidents caused by exposure to smoke, fire and flames.	X00–X09	E890–E899
150	Accidental poisoning and exposure to noxious substances	X40–X49	E850–E869,E924.1
151	Other and unspecified accidents	W20–W31,W35–W64,W85–W99,X10–X39,X50–X59	E900–E909,E914–E921,E923–E924.0,E924.8–E929
152	Assault (homicide)	X85–Y09	E960–E968
153	Assault (homicide) by hanging, strangulation and suffocation.	X91	E963
154	Assault (homicide) by discharge of firearms.	X93–X95	E965.0–E965.4
155	Neglect, abandonment and other maltreatment syndromes	Y06–Y07	E967,E968.4
156	Assault (homicide) by other and unspecified means	X85–X90,X92,X96–X99,Y00–Y05,Y08–Y09	E960–E962,E964,E965.5–E966,E968.0–E968.3,968.8–E968.9
157	Complications of medical and surgical care	Y40–Y84	E870–E879,E930–E949
158	Other external causes	X60–X84,Y10–Y36	E970–E979

[1]ICD–10 is *International Classification of Diseases,* Tenth Revision, and ICD–9 is *International Classification of Diseases,* Ninth Revision.

underlying cause of death if another more specific cause is listed on the death certificate. Of the heart disease deaths classified by ICD–9, 98 percent were classified as heart disease in ICD–10. Of the 2 percent not classified as heart disease, most were classified as cardiac arrest in ICD–9 (427.5), but were allocated to various other causes of death in ICD–10. Some deaths were also added to the ICD–10 classification of heart disease from other causes of death. Many of these are deaths classified in ICD–9 as pneumonia added as the result of the change in Rule 3. Because pneumonia is a direct consequence of heart disease, heart disease is selected in ICD–10 as the underlying cause of death when both conditions are listed.

Malignant neoplasms

The comparability ratio for Malignant neoplasms (113-list number 019) is 1.0068. This indicates that the number of deaths due to malignant neoplasms remained stable across revisions. Neverthe-less, a substantial number of deaths were classified under Malignant neoplasms in ICD–10 that were not Malignant neoplasms in ICD–9. Most of these were classified as pneumonia in ICD–9 and were affected by the change in Rule 3. In addition, some deaths shifted out of the malignant neoplasm category due to the revision. Most of these are classified in ICD–10 as HIV or as neoplasms of uncertain behavior (part of 113-list category In situ neoplasms, benign neo-plasms and neoplasms of uncertain or unknown behavior).

The movement of deaths from malignant neoplasms to HIV results from changes in the interpretation of highly improbable sequences. In ICD–9, most malignant neoplasms listed as due to HIV were considered to be improbable sequences. In ICD–10, any malignant neoplasm can be due to HIV. The shift from malignant neoplasms to neoplasms of uncertain behavior occurs largely as the result of the interpretation of the term "mass." In ICD–9, presence of the term "mass" was inter-preted to mean a malignancy if reported in specific circumstances with other stated malignant neoplasms. The same is not true for ICD–10, which treats the term "mass" as a disease of the site of the mass.

Some shifts among specified malignant neoplasms occurred with ICD–10 due to the change in the rule governing the selection of the primary site. Nearly all the specified malignant neoplasm categories show some shifts of deaths into and out of the specified category. For example, many deaths due to Malignant neoplasms of trachea, bron-chus, and lung (113-list number 027) classified by ICD–9, were clas-sified in ICD–10 to more than 15 other specified malignant neoplasm categories, resulting in a comparability ratio of 0.9837. This occurred primarily because ICD–10, in contrast with ICD–9, classifies malignant neoplasms of the lung as secondary to many other cancers. All other and unspecified malignant neoplasms (113-list number 043), which has a comparability ratio of 1.1251, was the category most affected by the change in the rules governing selection of the primary site. The increase in this category is primarily due to increases in Malignant neoplasms of independent (primary) multiple sites (C97), which draws deaths from a myriad of other specified malignant neoplasms. In ICD–10, selection of the primary site is not determined by order of entry on the death certificate. Thus, when two primary sites from different organ systems are listed, the death is classified to C97.

Cerebrovascular diseases

The comparability ratio for Cerebrovascular diseases (113-list number 070) is 1.0588, which indicates a net increase of about 6 percent in allocation to Cerebrovascular diseases with the imple-mentation of ICD–10. This increase is due primarily to the change in Rule 3. Most of the deaths added to Cerebrovascular diseases in ICD–10 were classified as pneumonia in ICD–9. Because pneumonia is a direct consequence of Cerebrovascular diseases, Cerebrovas-cular diseases are selected instead of pneumonia as the underlying cause of death in ICD–10 when both are listed on the death certificate.

Chronic lower respiratory diseases

The comparability ratio for Chronic lower respiratory diseases (113-list number 082) is 1.0478. The nearly 5-percent increase in allocation to this cause of death is due to the change in Rule 3. Nearly all of the increase consists of deaths previously coded as pneumonia in ICD–9. Chronic lower respiratory diseases are another group of causes of death for which pneumonia is a direct conse-quence.

Among the specified subcategories of Chronic lower respiratory diseases, comparability ratios show decreases due to the ICD–10 classification. Bronchitis, chronic and unspecified (113-list number 083), for example, has a comparability ratio of 0.3935. This indicates a substantial (about 60 percent) decrease when classified by ICD–10. Although not quite as dramatic, ratios less than 1.0 are also noted for Emphysema (113-list number 084) and Asthma (113-list number 085). Many deaths coded to bronchitis, emphysema, and asthma in ICD–9 are coded in ICD–10 to Other specified chronic obstructive pulmonary disease (J44.8), a code that is part of the category Other chronic lower respiratory diseases (113-list number 086)—hence the comparability ratio of 1.0970 for this category. A code comparable to J44.8 did not exist in ICD–9. These deaths are affected because of the inclusion on the death certificate of the term "chronic obstructive pulmonary disease (COPD)—"obstructive" being the operative word—with "bronchitis," "emphysema," or "asthma." In ICD–9, if COPD was listed with bron-chitis, the two terms were combined as obstructive chronic bronchitis (491.2), which is part of the category Bronchitis, chronic and unspeci-fied. In ICD–10, obstructive chronic bronchitis is coded as J44.8, which is not part of the category Bronchitis, chronic and unspecified. If COPD was listed with emphysema or asthma, in ICD–9 emphysema (or asthma) is preferred as the underlying cause. However, in ICD–10, a linkage has been created so the two terms are combined and coded as J44.8. Bronchitis also links with emphysema to become J44.8 in ICD–10. This combination linkage did not exist in ICD–9.

Influenza and pneumonia

A change in the direct sequel rule (Rule 3) is responsible for the comparability ratio of 0.6982 for Influenza and pneumonia (113-list number 076). While Influenza (113-list number 077) is largely unaffected by the revision (comparability ratio of 1.0088), Pneumonia (113-list number 078) has a comparability ratio of 0.6957. When pneumonia is listed on the death certificate with another cause of death, and it is obviously a direct consequence of that other cause, then the other cause is selected as the underlying cause of death. In ICD–10, this rule is applied more broadly than in ICD–9 and specifies many more causes for which pneumonia is considered a direct consequence. Thus, deaths classified as pneumonia in ICD–9 are classified in ICD–10 to many other causes. The most prominent

causes are Diseases of heart, Cerebrovascular diseases, Malignant neoplasms, Chronic lower respiratory diseases, Septicemia, Malnutrition, and Chronic liver disease and cirrhosis.

Diabetes mellitus

The comparability ratio for Diabetes mellitus (113-list number 046) is 1.0082, which indicates a less than 1 percent increase due to ICD–10. This relatively small increase is primarily due to the changes in Rules A and 3. Some deaths that were coded in ICD–9 to cardiac arrest (427.5) are being coded in ICD–10 to diabetes. Because cardiac arrest is treated as an ill-defined condition in ICD–10 under Rule A, it is ignored in the selection of the underlying cause when other better-defined conditions are present. Also, deaths coded in ICD–9 to pneumonia are coded in ICD–10 to diabetes. Complications of diabetes are among the causes for which pneumonia is an obvious direct consequence. Thus, subsequent to the ICD–10 version of Rule 3, complications of diabetes are selected over pneumonia as the underlying cause when both conditions are listed on the death certificate.

Nephritis, nephrotic syndrome and nephrosis

Nephritis, nephrotic syndrome and nephrosis (113-list number 097) has a comparability ratio of 1.2320. The 23-percent increase in this category is due primarily to changes in the classification of Renal failure (113-list number 100), which has a comparability ratio of 1.2949. End-stage renal disease (ESRD), which was classified as an unspecified disorder of the kidney in ICD–9 (593.9) (grouped with All other diseases), has been reclassified in ICD–10 as End-stage renal disease (N18.0), a subcategory of Renal failure (N17–N19). This results in adding a substantial number of deaths to the Renal failure and Nephritis, nephrotic syndrome and nephrosis categories.

When applied to years later than 1996, the comparability ratios for Nephritis, nephrotic syndrome and nephrosis and Renal failure presented in this report may underestimate the increase in these causes due to ICD–10. From 1996 through 1999, reporting of ESRD increased by about 1,900 deaths. This increase disproportionately affects the numerator of the comparability ratio because ESRD is included with Renal failure in ICD–10, but not in ICD–9. Thus, the numerator of the comparability ratio should probably be larger by roughly 1,900 deaths, giving a comparability ratio about 1.4 for Renal failure and about 1.3 for Nephritis, nephrotic syndrome and nephrosis.

Chronic liver disease and cirrhosis

The comparability ratio for Chronic liver disease and cirrhosis (113-list number 093) is 1.0367, denoting a nearly 4-percent increase due to the implementation of ICD–10. Some of this increase was due to the change in Rule 3. Chronic liver disease is selected as the underlying cause of death instead of pneumonia when both are listed on the death certificate. The majority of deaths added to Chronic liver disease and cirrhosis were coded in ICD–9 to Alcohol dependence syndrome (303) and unspecified chronic hepatitis (573.3). Liver failure is linked with alcoholism and chronic hepatitis under the Tenth Revision rules to create Alcoholic liver failure (K70.4), a new category in ICD–10. Thus, when liver failure is reported on the death certificate

with alcoholism or chronic hepatitis, the death will be classified to K70.4. This was not the case in ICD–9.

Infectious diseases

Of all the infectious diseases discussed below, only Septicemia and HIV are currently among leading causes of death. The others— viral hepatitis, tuberculosis, and syphilis—are very important from a public health standpoint and are significantly affected by the implementation of ICD–10

Septicemia

Septicemia (113-list number 010) has a comparability ratio of 1.1949. A large proportion of this nearly 20 percent increase is due to the change in Rule 3 in ICD–10. Under ICD–10, Septicemia is selected as the underlying cause of death over pneumonia when both are listed on the death certificate. Also important is a change in the classification of septic shock. Septic shock, coded in ICD–9 as Shock without mention of trauma (785.5) and allocated to the category Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified, is coded in ICD–10 as Unspecified septicemia (A41.9).

Human immunodeficiency virus (HIV) disease

The comparability ratio for HIV (113-list number 016) is 1.0637, denoting about 6 percent more deaths due to HIV in ICD–10. The increase in HIV deaths is primarily the result of the change in highly improbable sequences. In ICD–9, only certain specific malignant neoplasms could be due to HIV. Malignant neoplasms that could be part of a valid sequence with HIV in ICD–9 included Kaposi's sarcoma (173), Reticulosarcoma (200.0), Burkitt's tumor (200.2), immunoblastic sarcoma (200.8), and primary lymphoma of the brain (202.8). If other specified malignant neoplasms were listed as due to HIV, the sequence would be considered highly improbable and the specified malignant neoplasm would be selected as the underlying cause of death. In ICD–10, any sequence involving a malignant neoplasm due to HIV is considered acceptable, and HIV is selected as the underlying cause of death.

The increase in HIV is also partly due to the change in Rule 3 (pneumonia and the majority of infectious conditions are considered a direct sequel of HIV). Some records previously classified to viral hepatitis were added to HIV. Viral hepatitis is a direct sequel of HIV in ICD–10, but not in ICD–9. When HIV and viral hepatitis are both listed on the death certificate, HIV is selected as the underlying cause of death.

When applied to years later than 1996, the comparability ratios for HIV presented in this report may underestimate the increase due to ICD–10. An examination of underlying and multiple cause trends from 1996 to 1998 suggest a slightly higher comparability ratio for HIV based on 1998 data.

Viral hepatitis

Viral hepatitis (113-list number 015) decreased by about 17 percent with the implementation of ICD–10 (comparability ratio of 0.8343). Most of this decrease is caused by viral hepatitis being considered as a direct sequel of HIV in ICD–10, but not in ICD–9. Thus, when HIV and viral hepatitis are both listed on the death certificate, HIV is selected as the underlying cause of death. A part of the decrease is due to errors in the MICAR system decision tables.

Deaths are being classified in error to B94.2, Sequelae of viral hepatitis. This error will be corrected with the release of the final 1999 mortality data.

Tuberculosis

The comparability ratio for Tuberculosis (113-list number 004) is 0.8547, a decrease of about 15 percent due to implementation of ICD–10 classification. A small part of this decrease is due to an error in the MICAR system decision tables. Deaths were classified in error to B90.9, Sequelae of tuberculosis. This error will be corrected with the release of the final 1999 mortality data. The other part of the decrease is due to a change in the way Lupus, not otherwise specified (NOS) is classified. In ICD–9, lupus NOS was assigned a tuberculous code (017.0). In ICD–10, lupus NOS is assigned to Lupus erythematosus (L93). Also, Pneumoconiosis associated with tuberculosis (J65) is a new category in ICD–10 that is included in the broader category Pneumoconiosis and chemical effects (113-list number 087). In ICD–9, deaths with this diagnosis were assigned to the tuberculosis category.

Syphilis

Syphilis (113-list number 011) has a comparability ratio of 0.6364, a nearly 37-percent decrease in allocation with the implementation of ICD–10. Most of the decrease is due to a change in the way late effects (or sequelae) of syphilis are interpreted. In ICD–9, late effects or sequelae had to be stated explicitly or the syphilis had to be stated as arrested, cured, healed, inactive, old, or quiescent for a diagnosis involving late effects. In ICD–10, late effects or sequelae of syphilis are determined by duration. If the syphilis or condition or conditions resulting from the syphilis had a duration of 1 year or more then the death is classified to B94.8 which includes sequelae of syphilis.

Alzheimer's disease

The comparability ratio for Alzheimer's disease (113-list number 052) is 1.5536, which indicates a 55 percent increase in Alzheimer's disease deaths when classified by ICD–10. In absolute terms, over 10,000 more deaths were classified to Alzheimer's disease in ICD–10 than in ICD–9. Nearly all of this increase (about 95 percent) comes from deaths classified in ICD–9 as Presenile dementia (290.1). In ICD–9, a definitive diagnosis was required for classification as Alzheimer's disease. Terms such as "Alzheimer's-type dementia" or "Alzheimer's dementia" were classified as Presenile dementia rather than Alzheimer's disease. In addition, in ICD–9, if an unspecified chronic organic psychotic condition (294.9) is mentioned with Alzheimer's disease, the two conditions form a linkage and are coded to 290.1. Under ICD–10, this linkage does not exist, strictures regarding definitive diagnosis are relaxed, and, thus any mention of Alzheimer's is classified as Alzheimer's disease (G30). This involves the reclassification of nearly all cases of Presenile dementia to Alzheimer's disease.

The application of the comparability ratio presented for Alzheimer's disease to years later than 1996 may be problematic (i.e., it may substantially underestimate the increase in Alzheimer's due to implementation of the ICD–10 classification). Increases in the reporting of Alzheimer's-type dementia as a cause of death have occurred since

1996, resulting in substantial increases in Presenile dementia (290.1) from 1996 to 1998. Table E shows the trend in ICD–9-classified Alzheimer's disease and Presenile dementia deaths from 1996 to 1998. The number of Alzheimer's disease deaths increased by about 1,000 deaths between 1996 and 1997; between 1997 and 1998, the increase was only about 300 deaths. In contrast, the increase in Presenile dementia was more substantial, about 2,000 deaths each year. Thus, the comparability ratio based on 1998 data is probably at least 1.69 (approximating the ICD–10-classified Alzheimer's disease deaths by adding the Alzheimer's disease and Presenile dementia deaths). Assuming proportionately similar increases in the ICD–9 classification of Alzheimer's disease and Presenile dementia from 1998 to 1999, the comparability ratio based on 1999 data could be as high as 1.8 or 1.9.

In situ neoplasms, benign neoplasms, and neoplasms of uncertain or unknown behavior

For In situ neoplasms, benign neoplasms, and neoplasms of uncertain or unknown behavior (113-list number 044), the comparability ratio is 1.6744. The increase in this category is due primarily to a classification change involving myelodysplasia. In ICD–9, some of these deaths were classified to Diseases of the blood and blood-forming organs (289.8), and others as Other specified anomalies of spinal cord (742.5). In ICD–10, these deaths are classified to Myelodysplastic syndrome unspecified (D46.9) or Myeloproliferative syndrome (D47.1). Both are neoplasms of uncertain or unknown behavior. Deaths are also being added from various malignant neoplasms due to a change in the interpretation of the term "mass." In ICD–9, the term "mass" was assumed to be malignant if reported in specific circumstances with other stated malignant neoplasms. In ICD–10, the term "mass" is treated as a disease of the site of the mass.

External causes of death

Accidents (unintentional injuries)

For Accidents (unintentional injuries) (113-list number 112), the comparability ratio is 1.0303, which indicates an increase in deaths of 3 percent due to the revision. Virtually all of this increase involves shifts from natural causes in ICD–9 to unintentional injuries in ICD–10. Most of these deaths were classified as pneumonia or cardiac arrest in ICD–9, and were changed to unintentional injuries due to the change in Rule 3 and the change in Rule A, respectively. In these cases, the unintentional injury was specified in Part II of the death certificate and the pneumonia or cardiac arrest specified in Part I. In ICD–9, the conditions reported in Part I are selected as the underlying cause of death. In ICD–10, pneumonia is a direct

Table E. Number of deaths due to Alzheimer's disease and Presenile dementia: United States, 1996–98

Cause of death (ICD–9 code)[1]	Year		
	1996	1997	1998
Alzheimer's disease. . . . . . . (331.0)	21,397	22,475	22,725
Presenile dementia . . . . (290.1)	11,877	13,622	15,672

[1]ICD–9 is *International Classification of Diseases,* Ninth Edition.

consequence of an unintentional injury. Thus, the unintentional injury is selected as the underlying cause even if the duration of the injury is less than one year. In ICD–9, the injury had to occur less than 4 weeks before death. Cardiac arrest is treated as an ill-defined condition in ICD–10 and thus, is ignored in the selection of underlying cause, giving preference to the injury listed in Part II.

Specific unintentional injuries that merit attention include Motor vehicle accidents (113-list number 114) and Falls (113-list number 118). The preliminary comparability ratio for Motor vehicle accidents is 0.8527. The reason for this 15-percent decrease is that, in ICD–10, it must be explicit that the injury involved a "motor" vehicle. In ICD–9, in the absence of the term "motor" or when a vehicle accident was reported as occurring on a highway or road, the assumption was to classify the accident as involving a motor vehicle. The ICD–10 convention does not allow this assumption and classifies such accidents as involving unspecified vehicles (categorized in ICD–10 as Other land transport accidents). However, for U.S. data, it has been decided that if the accident occurred on a highway or road, classification to Motor vehicle accident is appropriate. This change in classification is effective in the United States with the release of preliminary 1999 mortality data and results in a revised comparability ratio for Motor vehicle accidents of 0.9754. This ratio is only applicable to data in which the aforementioned classification change was implemented; some States may have released data that does not include this change.

Falls decreased about 16 percent with the implementation of ICD–10 (comparability ratio of 0.8409). This decrease is the result of a change in the treatment of unspecified fractures. In ICD–9, if the term "fracture" is listed on the death certificate without mention of an external cause, the death is classified to Fracture, cause unspecified (E887), which is grouped with Accidental falls (E880–E888). In ICD–10, a fall is not assumed to be responsible for the unspecified fracture, and the death is classified to Exposure to unspecified factor (X59), which while classified as an unintentional injury is not classified as a fall.

Intentional self-harm (suicide) and Assault (homicide)

Comparability ratios for Intentional self-harm (suicide) (113-list number 124) and Assault (homicide) (113-list number 127) are very close to 1.0. Only a very few deaths were not classified consistently in these categories. It is not yet clear whether these inconsistencies are real or whether they are records that were unable to be identified as pending amendment. Regardless, the shifts are small enough that it can be concluded that the revision does not substantially affect mortality patterns for suicide or homicide.

Infant deaths

Major causes of death unique to infants are discussed below. Comparability ratios for these causes are shown in table 2. Other major infant causes not discussed below, such as unintentional injuries and Influenza and pneumonia have comparability patterns similar to those for noninfants.

Sudden infant death syndrome

The comparability ratio for Sudden infant death syndrome (SIDS) (130-list number 135) is 1.0362. The nearly 4-percent increase in SIDS across revisions is due to a change in Rule A. In ICD–9, SIDS was treated as an ill-defined condition and ignored in the presence of other better-defined conditions. In ICD–10, SIDS is not considered to be ill-defined. Thus, in ICD–10, SIDS may be selected as the underlying cause of death even when other conditions are listed on the death certificate.

Certain conditions originating in the perinatal period

Six subcategories of Certain conditions originating in the perinatal period are consistently ranked among the leading causes of infant death. They are Disorders related to short gestation and low birthweight; Newborn affected by maternal complications of pregnancy; Respiratory distress of newborn; Newborn affected by complications of placenta, cord, and membranes; Bacterial sepsis of newborn; and Intrauterine hypoxia and birth asphyxia. The comparability ratio for Disorders related to short gestation and low birth weight (130-list number 088) is 1.1060. Most of the nearly 11-percent increase is due to the change in Rule A. In ICD–9, these deaths were classified to Other respiratory problems after birth (770.8), which includes respiratory failure of newborn. In ICD–10, Respiratory failure of newborn is treated as an ill-defined condition and is ignored in the presence of other better-defined causes. Disorders related to short gestation and low birth weight are therefore selected as the underlying cause of death.

Newborn affected by maternal complications of pregnancy (130-list number 074) has a comparability ratio of 1.0295, indicating a 3-percent increase due to the revision. Deaths added to this category were classified in ICD–9 as Other respiratory problems after birth (770.8) and Agenesis, hypoplasia, and dysplasia of lung (748.5). Deaths due to Other respiratory problems after birth in ICD–9 are classified in ICD–10 to maternal complications due to the change in Rule A. In addition, in ICD–10, when hypoplasia or dysplasia of lung is mentioned on the death certificate with prematurity or short gestation, they form a linkage and the appropriate classification is Primary atelectasis of newborn (P28.0) rather than Hypoplasia and dysplasia of lung (Q33.6). Maternal complications of pregnancy can be due to P28.0, but not to Q33.6. Thus, the complication listed is selected as the underlying cause of death.

The comparability ratio for Respiratory distress of newborn (130-list number 096) is 1.0257. The 3-percent increase in this category is the result of the change in Rule A, which shifted deaths from Other respiratory problems after birth (770.8) to Respiratory distress of newborn. In ICD–10, respiratory failures are classified as ill-defined conditions and ignored in favor of better-defined conditions such as respiratory distress when listed on the death certificate.

Newborn affected by complications of placenta, cord, and membranes (130-list number 079) increased by nearly 5 percent (comparability ratio of 1.0470) due to the implementation of ICD–10. The increase is primarily due to the shifting of deaths from two causes in ICD–9, Cerebrovascular diseases, and Respiratory distress of newborn. In ICD–9, infant deaths involving Hypoxic ischemic encephalopathy (a cerebrovascular disease coded to 437.1) were not assigned a newborn ICD code. Because the Ninth Revision rules did not allow 437.1 to be due to any cause in the newborn chapter, 437.1 was selected as the underlying cause of death. In ICD–10, for infants, Hypoxic ischemic encephalopathy is classified as Unspecified brain damage due to birth injury (P11.2). Under ICD–10 rules, P11.2 will be due to almost any other cause in the newborn chapter including

complications of placenta, cord, and membranes. In these cases, the latter is selected as the underlying cause of death. Due to a classification change with ICD–10, Respiratory distress of newborn (P22.0) can be due to complications of placenta, cord, and membranes. In ICD–9, this sequence was not valid and Respiratory distress of newborn would have been selected as the underlying cause of death.

Bacterial sepsis of newborn (130-list number 106) has a comparability ratio of 0.9144. The nearly 9-percent drop in this category is primarily the result of system errors in the ICD–10 software (both ACME and MICAR). This resulted in shifts to causes of death other than Bacterial sepsis of newborn. This error will be fixed with the 2001 mortality data. When it is corrected, Bacterial sepsis of newborn is likely to increase due to the implementation of ICD–10.

The comparability ratio for Intrauterine hypoxia and birth asphyxia (130-list number 093) is 1.4477. The 45-percent increase in this category is primarily the result of the change in classification involving deaths classified in ICD–9 as Hypoxic ischemic encephalopathy (437.1). For infants, this cause is reclassified in ICD–10 as Unspecified brain damage due to birth injury (P11.2), which may be due to almost any other cause in the newborn chapter, including birth asphyxia. In ICD–9, 437.1 could not be due to causes in the newborn chapter. The change in Rule A is also important. In ICD–9, categories Other respiratory problems after birth (770.8) and Other and ill-defined conditions originating in the perinatal period (779.8) are not considered to be ill-defined. In ICD–10, these conditions are ill-defined and ignored in favor of Intrauterine hypoxia and birth asphyxia in the selection of the underlying cause of death.

Congenital malformations, deformations, and chromosomal abnormalities

The comparability ratio for Congenital malformations, deformations and chromosomal abnormalities is 0.9064. The nearly 10-percent decrease in deaths from this category is primarily the result of shifts away from Congenital malformations of the respiratory system (130-list number 125), particularly Hypoplasia and dysplasia of lung, to Primary atelactasis of newborn (P28.0). In ICD–10, when hypoplasia or dysplasia of lung is mentioned on the death certificate with prematurity or short gestation, the appropriate classification is Primary atelectasis of newborn rather than Hypoplasia or dysplasia of lung (Q33.6). In ICD–9, no such linkage existed, and the congenital anomaly would be the preferred underlying cause.

Another important classification change involves a shift from Congenital anomalies of the diaphragm (756.6) in ICD–9 to Diaphragmatic hernia without obstruction or gangrene (K44.9) in ICD–10. In ICD–9, an infant diagnosis of diaphragmatic hernia is classified by rule as a congenital anomaly even if the congenital anomaly is not explicitly stated. In ICD–10, no such rule exists and diaphragmatic hernia is classified to a K code.

Discussion and conclusion

Impact of new revision

Periodic revision of the ICD is essential to stay abreast of advances in medical science and changes in medical terminology. However, implementation of a new revision is disruptive in both institutional and statistical terms. Institutionally, revision of the ICD

requires an enormous investment of national resources to revise software, training, publications, edit procedures, etc. In the United States, implementation of ICD–10 involved a team of medical epidemiologists, statisticians, programmers, nosologists, and systems analysts over 7 years to complete the task.

Statistically, the new revision and resulting changes in classification and rules for selecting the underlying cause of death have important implications for the analysis of mortality trends by cause of death. Preliminary comparability ratios by cause of death presented in this report indicate the extent of discontinuities in cause-of-death trends from 1998 to 1999. For some of these causes (e.g., Septicemia, Influenza and pneumonia, Alzheimer's disease, and Nephritis, nephrotic syndrome, and nephrosis) the discontinuity in trend will be substantial.

New revisions can create substantially changed profiles of health problems and disease burdens, which are often measured using mortality data. An example is *Healthy People 2010*, which uses mortality data to measure health status in a broad range of areas including cardiovascular disease, cancer, infant mortality, and diabetes (17). Some interesting changes in the overall health profile of the United States due to the implementation of ICD–10 are shown in table F. This is a comparison of the 10 leading causes of death in the United States for 1996 based on ICD–9 and ICD–10 (10). The top five causes of death have the same rank (note that the titles for some causes have changed between revisions). In contrast, some notable changes in rank occurred for leading causes 6 through 10. Influenza and pneumonia and Diabetes, ranked 6th and 7th respectively, when classified by ICD–9, switch places when classified by ICD–10. Alzheimer's disease, previously not ranked in the top 10, is ranked 8th when classified by ICD–10. HIV infection and Suicide drop from 8th and 9th to 9th and 10th, respectively. Chronic liver disease and cirrhosis, ranked 10th under ICD–9, drop out of the top 10 under ICD–10.

Application of comparability ratios

The preliminary comparability ratios presented in this report may be used as factors for adjusting cause-of-death-specific-mortality statistics classified by ICD–9 as comparable with cause-specific mortality statistics classified by ICD–10. However, this should be done with caution and an awareness of the limitations of the study.

The applicability of the preliminary comparability ratios for measuring discontinuities in cause-of-death trends depends on two important factors. First, although sampling bias is generally unlikely as noted in the Methods section of this report, there is potential bias for some causes of death in the sample selection. Comparability ratios are not shown for causes that are clearly poorly represented in the comparability file. Second, the use of 1996 mortality data as the benchmark for the comparability file may also introduce bias in comparability ratios for some causes of death. Such bias is particularly notable for HIV, Alzheimer's disease, and Nephritis, nephrotic syndrome, and nephrosis. Because of changes in the composition of the components of these causes since 1996, comparability ratios for these causes, based on 1996 data, are less applicable for measuring the discontinuity in trends from 1998 to 1999. Research to better quantify comparability ratios for these causes is ongoing.

The number of deaths or the death rate for a particular cause of death classified by ICD–9 is adjusted by multiplying the relevant statistic by the comparability ratio for that cause. The following formula can be used to modify the number of deaths for cause i classified by ICD–9:

Table F. The 10 leading causes of death in 1996 classified by *International Classification of Diseases*, Ninth and Tenth Revisions

Rank	ICD–9[1] tites and codes	ICD–10[1] titles and codes
1	Diseases of heart . . . . (390–398,402,404–429)	Diseases of heart . . . . (I00–I09,I11,I13,I20–I51)
2	Malignant neoplasms, including neoplasms of lymphatic and hematopoietic tissues . . . . (140–208)	Malignant neoplasms . . . . (C00–C97)
3	Cerebrovascular diseases . . . . (430–438)	Cerebrovascular diseases . . . . (I60–I69)
4	Chronic obstructive pulmonary diseases and allied conditions . . . . (490–496)	Chronic lower respiratory diseases . . . . (J40–J47)
5	Accidents and adverse effects . . . . (E800–E949)	Accidents (unintentional injuries) . . . . (V01–X59,Y85–Y86)
6	Pneumonia and influenza . . . . (480–487)	Diabetes mellitus . . . . (E10–E14)
7	Diabetes mellitus . . . . (250)	Influenza and pneumonia . . . . (J10–J18)
8	Human immunodeficiency virus (HIV) infection . . . . (*042–*044)	Alzheimer's disease. . . . . (G30)
9	Suicide . . . . (E950–E959)	Human immunodeficiency virus (HIV) disease . . . . (B20–B24)
10	Chronic liver disease and cirrhosis . . . . (571)	Intentional self-harm (suicide) . . . . (X60–X84, Y87.0)

[1]ICD–9 is *International Classification Diseases*, Ninth Revision, and ICD–10 is *International Classification of Diseases*, Tenth Revision.

$$D_{i,ICD-9}^{CM} = D_{i,ICD-9} \cdot C_i$$

where $D_{i,ICD-9}$ is the number of deaths for cause i classified by ICD–9, $D_{i,ICD-9}^{CM}$ is the comparability-modified number of deaths for cause i classified by ICD–9, and C_i is the comparability ratio for cause i. The death rate for cause i is adjusted similarly by substituting the rate for the number of deaths. Table G shows mortality data for 1998 and preliminary 1999 for Influenza and pneumonia. Ignoring the implementation of ICD–10, it appears that Influenza and pneumonia deaths declined dramatically, by 30.7 percent between 1998 and 1999 (from 91,871 to 64,144). Under the same assumption, a comparison of age-adjusted death rates shows that the risk of dying from Influenza and pneumonia dropped by 32.1 percent from 1998 to 1999 (from 34.6 to 23.5 per 100,000 standard population). However, application of the comparability ratio shows that nearly all of the decline in Influenza and pneumonia mortality is due to the introduction of ICD–10. Modifying the 1998 figures using the comparability ratio for Influenza and pneumonia and comparing them with 1999 data shows that, taking into account the revision of the ICD, the reduction in number of deaths was 0.7 percent, and the risk of dying from Influenza and pneumonia declined by only 2.9 percent. Failure to take into account the effects of the implementation of ICD–10 can result in a greatly distorted view of changes in mortality risk for some causes of death.

Caution should be taken when applying the comparability ratios presented in this report to age-, race-, sex-, or State-specific mortality

Table G. Deaths and death rates for Influenza and pneumonia: United States, 1998 and preliminary 1999

[1998 data classified using ICD–9 codes 480–487; preliminary 1999 data classified using ICD–10 codes J10–J18]

				Percent change 1998–99	
	1998	Comparability-modified 1998[1]	1999	Overall	Due to change in mortality risk[2]
Deaths	91,871	64,144	63,686	–30.7	–0.7
Death rate	34.0	23.7	23.4	–31.2	–1.3
Age-adjusted death rate.	34.6	24.2	23.5	–32.1	–2.9

[1]Calculated by multiplying 1998 data by the comparability ratio for Influenza and pneumonia of 0.6982.
[2]Comparing comparability-modified 1998 data to preliminary 1999 data.

data. Theoretically, the classification and coding rules for ICD–10 should generally be applied uniformly regardless of demographic characteristics (except in some cases infants will be treated differently) or geographic location. Thus, a single comparability ratio for a particular cause of death should theoretically be adequate. However, in practice, the demographic and geographic population subgroups will sometimes be different in composition (i.e., with regard to their cause-of-death distribution). This will result in some demographic and geographic variation in cause-specific comparability ratios. The question, yet to be answered, is whether the variation is sufficient to warrant the use of comparability ratios disaggregated by demographic and geographic subgroups.

With the implementation of ICD–10, a set of mortality trends and patterns will emerge that are discontinuous with those produced under ICD–9. Trends for many causes of death and the ranking of leading causes of death will be substantially affected. The comparability ratios presented in this report, although preliminary, will serve to estimate the extent of the discontinuity and will help to make any analysis of mortality change between 1998 and 1999 more accurate and complete. The final comparability study to be prepared during the coming year will provide more robust estimates for the causes described in this paper and new information on causes of death not covered in this preliminary study.

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List of Detailed Tables

Table 1. Estimated comparability ratios for 113 selected causes of death

List number	Cause of death[1]	Number of deaths allocated according to		Estimated comparability ratio	Standard error	Relative standard error	95 percent confidence limits	
		ICD–10[2]	ICD–9[2]				Lower	Upper
001	Salmonella infections	30	37	0.8108	0.0644	7.9	0.6846	0.9370
002	Shigellosis and amebiasis	*	*	*	*	*	*	*
003	Certain other intestinal infections	*	*	*	*	*	*	*
004	Tuberculosis	653	764	0.8547	0.0172	2	0.8209	0.8885
005	Respiratory tuberculosis	518	572	0.9056	0.0201	2.2	0.8662	0.9450
006	Other tuberculosis	135	192	0.7031	0.0407	5.8	0.6233	0.7830
007	Whooping cough	*	*	*	*	*	*	*
008	Scarlet fever and erysipelas	*	*	*	*	*	*	*
009	Meningococcal infection	221	222	0.9955	0.0149	1.5	0.9663	1.0247
010	Septicemia	21,258	17,791	1.1949	0.0042	0.3	1.1867	1.2030
011	Syphilis	21	33	0.6364	0.1184	18.6	0.4043	0.8685
012	Acute poliomyelitis	*	*	*	*	*	*	*
013	Arthropod-borne viral encephalitis	*	*	*	*	*	*	*
014	Measles	*	*	*	*	*	*	*
015	Viral hepatitis	1,123	1,346	0.8343	0.0120	1.4	0.8109	0.8578
016	Human immunodeficiency virus (HIV) disease	25,089	23,586	1.0637	0.0018	0.2	1.0601	1.0673
017	Malaria	*	*	*	*	*	*	*
018	Other and unspecified infectious and parasitic diseases and their sequelae	2,865	2,607	1.0990	0.0154	1.4	1.0688	1.1291
019	Malignant neoplasms	464,688	461,544	1.0068	0.0002	0.0	1.0064	1.0072
020	Malignant neoplasms of lip, oral cavity and pharynx	5,927	6,172	0.9603	0.0040	0.4	0.9525	0.9681
021	Malignant neoplasm of esophagus	9,596	9,630	0.9965	0.0020	0.2	0.9926	1.0003
022	Malignant neoplasm of stomach	11,480	11,408	1.0063	0.0019	0.2	1.0025	1.0101
023	Malignant neoplasms of colon, rectum and anus	48,583	48,619	0.9993	0.0009	0.1	0.9975	1.0010
024	Malignant neoplasms of liver and intrahepatic bile ducts	9,732	10,102	0.9634	0.0023	0.2	0.9588	0.9679
025	Malignant neoplasm of pancreas	24,313	24,361	0.9980	0.0009	0.1	0.9963	0.9997
026	Malignant neoplasm of larynx	3,209	3,194	1.0047	0.0053	0.5	0.9943	1.0150
027	Malignant neoplasms of trachea, bronchus and lung	131,750	133,936	0.9837	0.0005	0.1	0.9827	0.9846
028	Malignant melanoma of skin	5,941	6,139	0.9677	0.0032	0.3	0.9614	0.9741
029	Malignant neoplasm of breast	38,102	37,891	1.0056	0.0010	0.1	1.0036	1.0075
030	Malignant neoplasm of cervix uteri	3,753	3,802	0.9871	0.0034	0.3	0.9805	0.9938
031	Malignant neoplasms of corpus uteri and uterus, part unspecified . . .	5,318	5,183	1.0260	0.0040	0.4	1.0182	1.0339
032	Malignant neoplasm of ovary	11,292	11,344	0.9954	0.0016	0.2	0.9923	0.9985
033	Malignant neoplasm of prostate	30,672	30,267	1.0134	0.0015	0.1	1.0105	1.0162
034	Malignant neoplasms of kidney and renal pelvis	9,521	9,521	1.0000	0.0022	0.2	0.9957	1.0043
035	Malignant neoplasm of bladder	9,563	9,594	0.9968	0.0026	0.3	0.9916	1.0019
036	Malignant neoplasms of meninges, brain and other parts of central nervous system	10,039	10,359	0.9691	0.0025	0.3	0.9642	0.9740
037	Malignant neoplasms of lymphoid, hematopoietic and related tissue	44,715	44,530	1.0042	0.0012	0.1	1.0019	1.0064
038	Hodgkin's disease	1,021	1,036	0.9855	0.0089	0.9	0.9680	1.0030
039	Non-Hodgkin's lymphoma	17,924	18,326	0.9781	0.0018	0.2	0.9745	0.9817
040	Leukemia	16,600	16,405	1.0119	0.0019	0.2	1.0083	1.0155
041	Multiple myeloma and immunoproliferative neoplasms	9,099	8,763	1.0383	0.0030	0.3	1.0324	1.0443
042	Other and unspecified malignant neoplasms of lymphoid, hematopoietic and related tissue	*	*	*	*	*	*	*
043	All other and unspecified malignant neoplasms	51,182	45,492	1.1251	0.0021	0.2	1.1210	1.1292
044	In situ neoplasms, benign neoplasms and neoplasms of uncertain or unknown behavior	9,263	5,532	1.6744	0.0164	1.0	1.6422	1.7067
045	Anemias	3,059	3,200	0.9559	0.0077	0.8	0.9409	0.9710
046	Diabetes mellitus	48,636	48,242	1.0082	0.0011	0.1	1.0060	1.0103
047	Nutritional deficiencies	3,215	2,763	1.1636	0.0165	1.4	1.1312	1.1960
048	Malnutrition	2,607	2,665	0.9782	0.0151	1.5	0.9487	1.0078
049	Other nutritional deficiencies	608	98	6.2041	0.5961	9.6	5.0358	7.3724
050	Meningitis	592	584	1.0137	0.0136	1.3	0.9871	1.0403
051	Parkinson's disease	10,404	10,392	1.0012	0.0028	0.3	0.9956	1.0067
052	Alzheimer's disease	29,707	19,121	1.5536	0.0071	0.5	1.5398	1.5675
053	Major cardiovascular diseases	796,919	798,435	0.9981	0.0002	0.0	0.9977	0.9985
054	Diseases of heart	615,564	624,405	0.9858	0.0002	0.0	0.9854	0.9863
055	Acute rheumatic fever and chronic rheumatic heart diseases	2,446	2,980	0.8208	0.0089	1.1	0.8034	0.8382
056	Hypertensive heart disease	17,322	21,577	0.8028	0.0028	0.3	0.7973	0.8083
057	Hypertensive heart and renal disease	2,170	2,027	1.0705	0.0160	1.5	1.0392	1.1019
058	Ischemic heart diseases	466,459	466,935	0.9990	0.0002	0.0	0.9985	0.9994
059	Acute myocardial infarction	178,125	180,169	0.9887	0.0003	0.0	0.9880	0.9893
060	Other acute ischemic heart diseases	2,667	2,638	1.0110	0.0117	1.2	0.9880	1.0340
061	Other forms of chronic ischemic heart disease	285,667	284,128	1.0054	0.0004	0.0	1.0046	1.0062

See footnotes at end of table.

Table 1. Estimated comparability ratios for 113 selected causes of death—Con.

List number	Cause of death[1]	Number of deaths allocated according to ICD–10[2]	Number of deaths allocated according to ICD–9[2]	Estimated comparability ratio	Standard error	Relative standard error	95 percent confidence limits Lower	95 percent confidence limits Upper
062	Atherosclerotic cardiovascular disease, so described.	64,354	61,362	1.0488	0.0016	0.2	1.0456	1.0519
063	All other forms of chronic ischemic heart disease	221,313	222,766	0.9935	0.0004	0.0	0.9927	0.9942
064	Other heart diseases	127,167	130,886	0.9716	0.0010	0.1	0.9696	0.9736
065	Acute and subacute endocarditis.	552	554	0.9964	0.0137	1.4	0.9695	1.0233
066	Diseases of pericardium and acute myocarditis	489	475	1.0295	0.0160	1.6	0.9981	1.0608
067	Heart failure.	44,297	42,554	1.0410	0.0013	0.1	1.0384	1.0435
068	All other forms of heart disease	81,829	87,303	0.9373	0.0014	0.2	0.9345	0.9401
069	Essential (primary) hypertension and hypertensive renal disease. . . .	11,958	10,684	1.1192	0.0050	0.4	1.1094	1.1291
070	Cerebrovascular diseases.	137,264	129,640	1.0588	0.0008	0.1	1.0572	1.0604
071	Atherosclerosis	13,894	14,417	0.9637	0.0025	0.3	0.9588	0.9686
072	Other diseases of circulatory system	18,239	19,289	0.9456	0.0021	0.2	0.9414	0.9498
073	Aortic aneurysm and dissection.	12,216	12,201	1.0012	0.0010	0.1	0.9992	1.0032
074	Other diseases of arteries, arterioles and capillaries.	6,023	7,088	0.8497	0.0053	0.6	0.8394	0.8601
075	Other disorders of circulatory system	2,984	2,899	1.0293	0.0172	1.7	0.9956	1.0631
076	Influenza and pneumonia	50,526	72,371	0.6982	0.0018	0.3	0.6947	0.7016
077	Influenza.	572	567	1.0088	0.0073	0.7	0.9945	1.0231
078	Pneumonia	49,954	71,804	0.6957	0.0018	0.3	0.6922	0.6992
079	Other acute lower respiratory infections	346	355	0.9746	0.0392	4.0	0.8978	1.0515
080	Acute bronchitis and bronchiolitis	265	355	0.7465	0.0264	3.5	0.6947	0.7983
081	Unspecified acute lower respiratory infection.	*	*	*	*	*	*	*
082	Chronic lower respiratory diseases.	94,326	90,022	1.0478	0.0009	0.1	1.0460	1.0496
083	Bronchitis, chronic and unspecified	913	2,320	0.3935	0.0107	2.7	0.3726	0.4145
084	Emphysema.	14,369	14,774	0.9726	0.0031	0.3	0.9666	0.9786
085	Asthma	4,217	4,718	0.8938	0.0061	0.7	0.8819	0.9057
086	Other chronic lower respiratory diseases.	74,827	68,210	1.0970	0.0014	0.1	1.0943	1.0998
087	Pneumoconioses and chemical effects	860	845	1.0178	0.0099	1.0	0.9983	1.0372
088	Pneumonitis due to solids and liquids	10,183	9,104	1.1185	0.0048	0.4	1.1092	1.1279
089	Other diseases of respiratory system	16,656	14,269	1.1673	0.0052	0.4	1.1572	1.1774
090	Peptic ulcer	3,574	3,686	0.9696	0.0045	0.5	0.9608	0.9784
091	Diseases of appendix	209	202	1.0347	0.0242	2.3	0.9873	1.0820
092	Hernia	658	633	1.0395	0.0154	1.5	1.0094	1.0696
093	Chronic liver disease and cirrhosis.	21,688	20,920	1.0367	0.0027	0.3	1.0314	1.0420
094	Alcoholic liver disease.	10,147	9,965	1.0183	0.0050	0.5	1.0085	1.0281
095	Other chronic liver disease and cirrhosis.	11,541	10,955	1.0535	0.0041	0.4	1.0454	1.0615
096	Cholelithiasis and other disorders of gallbladder	1,725	1,803	0.9567	0.0060	0.6	0.9450	0.9685
097	Nephritis, nephrotic syndrome and nephrosis.	24,939	20,242	1.2320	0.0044	0.4	1.2234	1.2407
098	Acute and rapidly progressive nephritic and nephrotic syndrome. . . .	161	249	0.6466	0.0342	5.3	0.5796	0.7136
099	Chronic glomerulonephritis, nephritis and nephropathy not specified as acute or chronic, and renal sclerosis unspecified	468	1,213	0.3858	0.0144	3.7	0.3575	0.4141
100	Renal failure	24,290	18,758	1.2949	0.0050	0.4	1.2852	1.3047
101	Other disorders of kidney.	20	22	0.9091	0.0867	9.5	0.7392	1.0790
102	Infections of kidney.	731	726	1.0069	0.0144	1.4	0.9786	1.0352
103	Hyperplasia of prostate.	326	327	0.9969	0.0159	1.6	0.9658	1.0280
104	Inflammatory diseases of female pelvic organs.	63	64	0.9844	0.0410	4.2	0.9040	1.0648
105	Pregnancy, childbirth and the puerperium.	*	*	*	*	*	*	*
106	Pregnancy with abortive outcome	*	*	*	*	*	*	*
107	Other complications of pregnancy, childbirth and the puerperium. . . .	*	*	*	*	*	*	*
108	Certain conditions originating in the perinatal period	10,184	9,555	1.0658	0.0033	0.3	1.0593	1.0724
109	Congenital malformations, deformations and chromosomal abnormalities.	5,950	7,025	0.8470	0.0055	0.6	0.8362	0.8577
110	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified.	16,940	17,732	0.9553	0.0034	0.4	0.9487	0.9620
111	All other diseases (Residual)	109,853	122,107	0.8996	0.0015	0.2	0.8968	0.9025
112	Accidents (unintentional injuries)	31,084	30,163	1.0305	0.0014	0.1	1.0278	1.0333
113	Transport accidents	17,547	17,586	0.9978	0.0006	0.1	0.9966	0.9990
114	Motor vehicle accidents	14,539	17,051	0.8527	0.0027	0.3	0.8473	0.8581
115	Other land transport accidents	*	*	*	*	*	*	*
116	Water, air and space, and other and unspecified transport accidents and their sequelae.	351	347	1.0115	0.0209	2.1	0.9706	1.0525
117	Nontransport accidents	13,537	12,577	1.0763	0.0035	0.3	1.0696	1.0831
118	Falls.	5,173	6,152	0.8409	0.0049	0.6	0.8313	0.8505
119	Accidental discharge of firearms	493	466	1.0579	0.0127	1.2	1.0331	1.0828
120	Accidental drowning and submersion.	283	284	0.9965	0.0127	1.3	0.9716	1.0213
121	Accidental exposure to smoke, fire and flames.	493	506	0.9743	0.0089	0.9	0.9568	0.9918
122	Accidental poisoning and exposure to noxious substances	*	*	*	*	*	*	*
123	Other and unspecified nontransport accidents and their sequelae. .	6,698	4,721	1.4188	0.0123	0.9	1.3947	1.4428

See footnotes at end of table.

Table 1. Estimated comparability ratios for 113 selected causes of death—Con.

List number	Cause of death[1]	Number of deaths allocated according to		Estimated comparability ratio	Standard error	Relative standard error	95 percent confidence limits	
		ICD–10[2]	ICD–9[2]				Lower	Upper
124	Intentional self-harm (suicide)	18,352	18,422	0.9962	0.0005	0.0	0.9952	0.9972
125	Intentional self-harm (suicide) by discharge of firearms	14,157	14,183	0.9982	0.0007	0.1	0.9968	0.9996
126	Intentional self-harm (suicide) by other and unspecified means and their sequelae	4,195	4,239	0.9896	0.0023	0.2	0.9850	0.9942
127	Assault (homicide)	12,287	12,308	0.9983	0.0006	0.1	0.9972	0.9994
128	Assault (homicide) by discharge of firearms	8,718	8,745	0.9969	0.0008	0.1	0.9953	0.9985
129	Assault (homicide) by other and unspecified means and their sequelae.	3,569	3,563	1.0017	0.0024	0.2	0.9969	1.0064
130	Legal intervention	*	*	*	*	*	*	*
131	Events of undetermined intent	*	*	*	*	*	*	*
132	Discharge of firearms, undetermined intent	*	*	*	*	*	*	*
133	Other and unspecified events of undetermined intent and their sequelae.	*	*	*	*	*	*	*
134	Operations of war and their sequelae	*	*	*	*	*	*	*
135	Complications of medical and surgical care.	*	*	*	*	*	*	*

* Figure does not meet standards of reliability or precision; see Technical notes.

0.0 Quantity more than zero but less than 0.05.

[1] Based on the Ninth and Tenth Revision categories shown in table B.

[2] ICD–10 is *International Classification of Diseases,* Tenth Revision, and ICD-9 is *International Classification of Diseases,* Ninth Revision.

Table 2. Estimated comparability ratios for 130 selected causes of infant death

List number	Cause of death[1]	Number of deaths allocated according to ICD–10[2]	Number of deaths allocated according to ICD–9[2]	Estimated comparability ratio	Standard error	Relative standard error	95 percent confidence limits Lower	95 percent confidence limits Upper
001	Certain infectious and parasitic diseases	284	387	0.7339	0.0339	4.6	0.6673	0.8004
002	Certain intestinal infectious diseases	*	*	*	*	*	*	*
003	Diarrhea and gastroenteritis of infectious origin	–	144	–	–	–	–	–
004	Tuberculosis.	*	*	*	*	*	*	*
005	Tetanus	*	*	*	*	*	*	*
006	Diptheria.	*	*	*	*	*	*	*
007	Whooping cough	*	*	*	*	*	*	*
008	Meningococcal infection	25	26	0.9615	0.0377	3.9	0.8876	1.0355
009	Septicemia	167	121	1.3802	0.0713	5.2	1.2403	1.5200
010	Congenital syphilis	*	*	*	*	*	*	*
011	Gonococcal infection.	*	*	*	*	*	*	*
012	Viral diseases.	62	62	1.0000	0.0757	7.6	0.8517	1.1483
013	Acute poliomyelitis.	*	*	*	*	*	*	*
014	Varicella (chickenpox).	*	*	*	*	*	*	*
015	Measles.	*	*	*	*	*	*	*
016	Human immunodeficiency virus (HIV) disease	23	22	1.0455	0.0465	4.4	0.9544	1.1365
017	Mumps	*	*	*	*	*	*	*
018	Other and unspecified viral diseases	35	36	0.9722	0.1255	12.9	0.7262	1.2182
019	Candidiasis	*	*	*	*	*	*	*
020	Malaria.	*	*	*	*	*	*	*
021	Pneumocystosis	*	*	*	*	*	*	*
022	All other and unspecified infectious and parasitic diseases	*	*	*	*	*	*	*
023	Neoplasms	73	72	1.0139	0.0420	4.1	0.9317	1.0961
024	Malignant neoplasms	48	46	1.0435	0.0544	5.2	0.9369	1.1501
025	Hodgkin's disease and non-Hodgkin's lymphomas	*	*	*	*	*	*	*
026	Leukemia	*	*	*	*	*	*	*
027	Other and unspecified malignant neoplasms	30	28	1.0714	0.0906	8.5	0.8939	1.2489
028	In situ neoplasms, benign neoplasms and neoplasms of uncertain or unknown behavior	25	26	0.9615	0.1131	11.8	0.7398	1.1833
029	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism.	35	50	0.7000	0.0803	11.5	0.5427	0.8573
030	Anemias.	*	*	*	*	*	*	*
031	Other diseases of blood and blood-forming organs	*	*	*	*	*	*	*
032	Certain disorders involving the immune mechanism	*	*	*	*	*	*	*
033	Endocrine, nutritional and metabolic diseases	112	129	0.8682	0.0555	6.4	0.7595	0.9770
034	Short stature, not elsewhere classified	*	*	*	*	*	*	*
035	Malnutrition and other nutritional deficiencies	*	*	*	*	*	*	*
036	Cystic fibrosis.	*	*	*	*	*	*	*
037	Volume depletion, disorders of fluid, electrolyte and acid-base balance.	40	53	0.7547	0.0852	11.3	0.5878	0.9217
038	All other endocrine, nutritional and metabolic diseases.	64	55	1.1636	0.0809	6.9	1.0051	1.3221
039	Diseases of the nervous system	305	286	1.0664	0.0263	2.5	1.0149	1.1180
040	Meningitis	70	70	1.0000	0.0404	4.0	0.9208	1.0792
041	Infantile spinal muscular atrophy, type I (Werdnig-Hoffman)	47	47	1.0000	0.0521	5.2	0.8978	1.1022
042	Infantile cerebral palsy	*	*	*	*	*	*	*
043	Anoxic brain damage, not elsewhere classified	29	30	0.9667	0.1269	13.1	0.7179	1.2155
044	Other diseases of nervous system	145	126	1.1508	0.0532	4.6	1.0466	1.2550
045	Diseases of the ear and mastoid process.	*	*	*	*	*	*	*
046	Diseases of the circulatory system	419	587	0.7138	0.0244	3.4	0.6659	0.7617
047	Pulmonary heart disease and diseases of pulmonary circulation	138	123	1.1220	0.0447	4.0	1.0342	1.2097
048	Pericarditis, endocarditis and myocarditis.	*	*	*	*	*	*	*
049	Cardiomyopathy	82	84	0.9762	0.0166	1.7	0.9436	1.0088
050	Cardiac arrest.	25	87	0.2874	0.0508	17.7	0.1878	0.3869
051	Cerebrovascular diseases.	77	163	0.4724	0.0510	10.8	0.3725	0.5723
052	All other diseases of circulatory system	88	123	0.7154	0.0519	7.3	0.6137	0.8172
053	Diseases of the respiratory system.	420	516	0.8140	0.0220	2.7	0.7709	0.8570
054	Acute upper respiratory infections	*	*	*	*	*	*	*
055	Influenza and pneumonia	231	303	0.7624	0.0261	3.4	0.7112	0.8135
056	Influenza	*	*	*	*	*	*	*
057	Pneumonia.	224	295	0.7593	0.0266	3.5	0.7072	0.8114
058	Acute bronchitis and acute bronchiolitis.	33	41	0.8049	0.0758	9.4	0.6563	0.9534
059	Bronchitis, chronic and unspecified	*	*	*	*	*	*	*
060	Asthma	*	*	*	*	*	*	*
061	Pneumonitis due to solids and liquids.	*	*	*	*	*	*	*
062	Other and unspecified diseases of respiratory system	117	127	0.9213	0.0632	6.9	0.7973	1.0452
063	Diseases of the digestive system.	278	167	1.6647	0.1084	6.5	1.4521	1.8772

See footnotes at end of table.

Table 2. Estimated comparability ratios for 130 selected causes of infant death—Con.

List number	Cause of death[1]	Number of deaths allocated according to		Estimated comparability ratio	Standard error	Relative standard error	95 percent confidence limits	
		ICD–10[2]	ICD–9[2]				Lower	Upper
064	Gastritis, duodenitis, and noninfective enteritis and colitis	137	47	2.9149	0.3879	13.3	2.1547	3.6751
065	Hernia of abdominal cavity and intestinal obstruction without hernia. .	*	*	*	*	*	*	*
066	All other and unspecified diseases of digestive system	84	86	0.9767	0.0708	7.3	0.8379	1.1156
067	Diseases of the genitourinary system	117	117	1.0000	0.0567	5.7	0.8889	1.1111
068	Renal failure and other disorders of kidney	102	98	1.0408	0.0658	6.3	0.9118	1.1699
069	Other and unspecified diseases of genitourinary system	*	*	*	*	*	*	*
070	Certain conditions originating in the perinatal period	10,047	9,495	1.0581	0.0032	0.3	1.0519	1.0643
071	Newborn affected by maternal factors and by complications of pregnancy, labor and delivery.	1,305	1,256	1.0390	0.0099	1.0	1.0196	1.0585
072	Newborn affected by maternal hypertensive disorders.	23	22	1.0455	0.0465	4.4	0.9544	1.1365
073	Newborn affected by other maternal conditions which may be unrelated to present pregnancy	*	*	*	*	*	*	*
074	Newborn affected by maternal complications of pregnancy	662	643	1.0295	0.0138	1.3	1.0024	1.0567
075	Newborn affected by incompetent cervix	205	201	1.0199	0.0188	1.8	0.9831	1.0567
076	Newborn affected by premature rupture of membranes.	314	307	1.0228	0.0136	1.3	0.9962	1.0494
077	Newborn affected by multiple pregnancy	104	103	1.0097	0.0507	5.0	0.9103	1.1091
078	Newborn affected by other maternal complications of pregnancy	39	32	1.2188	0.1655	13.6	0.8945	1.5430
079	Newborn affected by complications of placenta, cord, and membranes.	579	553	1.0470	0.0128	1.2	1.0219	1.0721
080	Newborn affected by complications involving placenta	306	285	1.0737	0.0174	1.6	1.0395	1.1079
081	Newborn affected by complications involving cord.	*	*	*	*	*	*	*
082	Newborn affected by chorioamnionitis	258	255	1.0118	0.0163	1.6	0.9799	1.0436
083	Newborn affected by other and unspecified abnormalities of membranes	*	*	*	*	*	*	*
084	Newborn affected by other complications of labor and delivery . . .	37	20	1.8500	0.3262	17.6	1.2107	2.4893
085	Newborn affected by noxious influences transmitted via placenta or breast milk	*	*	*	*	*	*	*
086	Disorders related to length of gestation and fetal malnutrition.	3,843	3,474	1.1062	0.0064	0.6	1.0936	1.1188
087	Slow fetal growth and fetal malnutrition	34	30	1.1333	0.1004	8.9	0.9366	1.3301
088	Disorders related to short gestation and low birth weight, not elsewhere classified	3,809	3,444	1.1060	0.0064	0.6	1.0934	1.1186
089	Extremely low birth weight or extreme immaturity	2,835	2,558	1.1083	0.0079	0.7	1.0927	1.1239
090	Other low birth weight or preterm	974	886	1.0993	0.0135	1.2	1.0729	1.1258
091	Disorders related to long gestation and high birth weight	*	*	*	*	*	*	*
092	Birth trauma	5	113	0.0442	0.0197	44.5	0.0056	0.0829
093	Intrauterine hypoxia and birth asphyxia	401	277	1.4477	0.0599	4.1	1.3303	1.5650
094	Intrauterine hypoxia	57	63	0.9048	0.1227	13.6	0.6643	1.1452
095	Birth asphyxia	344	214	1.6075	0.0763	4.7	1.4579	1.7571
096	Respiratory distress of newborn	917	894	1.0257	0.0131	1.3	1.0001	1.0513
097	Other respiratory conditions originating in the perinatal period	1,160	1,372	0.8455	0.0216	2.6	0.8032	0.8878
098	Congenital pneumonia	57	15	3.8000	0.9004	23.7	2.0352	5.5648
099	Neonatal aspiration syndromes	78	56	1.3929	0.1115	8.0	1.1743	1.6114
100	Interstitial emphysema and related conditions originating in the perinatal period.	146	121	1.2066	0.0595	4.9	1.0899	1.3233
101	Pulmonary hemorrhage originating in the perinatal period	212	145	1.4621	0.0751	5.1	1.3150	1.6092
102	Chronic respiratory disease originating in the perinatal period	243	214	1.1355	0.0327	2.9	1.0715	1.1995
103	Atelectasis	382	185	2.0649	0.1144	5.5	1.8406	2.2891
104	All other respiratory conditions originating in the perinatal period . .	42	636	0.0660	0.0101	15.2	0.0463	0.0858
105	Infections specific to the perinatal period	563	552	1.0199	0.0261	2.6	0.9688	1.0710
106	Bacterial sepsis of newborn	470	514	0.9144	0.0272	3.0	0.8611	0.9677
107	Omphalitis of newborn with or without mild hemorrhage	*	*	*	*	*	*	*
108	All other infections specific to the perinatal period	93	38	2.4474	0.3705	15.1	1.7211	3.1736
109	Hemorrhagic and hematological disorders of newborn	390	274	1.4234	0.0640	4.5	1.2979	1.5488
110	Neonatal hemorrhage.	319	222	1.4369	0.0698	4.9	1.3002	1.5737
111	Hemorrhagic disease of newborn	*	*	*	*	*	*	*
112	Hemolytic disease of newborn due to isoimmunization and other perinatal jaundice	*	*	*	*	*	*	*
113	Hematological disorders	*	*	*	*	*	*	*
114	Syndrome of infant of a diabetic mother and neonatal diabetes mellitus.	*	*	*	*	*	*	*
115	Necrotizing enterocolitis of newborn.	249	203	1.2266	0.0456	3.7	1.1371	1.3161
116	Hydrops fetalis not due to hemolytic disease	120	120	1.0000	0.0264	2.6	0.9483	1.0517
117	Other perinatal conditions.	1,092	954	1.1447	0.0192	1.7	1.1070	1.1823
118	Congenital malformations, deformations and chromosomal abnormalities.	3,400	3,751	0.9064	0.0057	0.6	0.8953	0.9176

See footnotes at end of table.

Table 2. Estimated comparability ratios for 130 selected causes of infant death—Con.

List number	Cause of death[1]	Number of deaths allocated according to		Estimated comparability ratio	Standard error	Relative standard error	95 percent confidence limits	
		ICD–10[2]	ICD–9[2]				Lower	Upper
119	Anencephaly and similar malformations.	299	299	1.0000	0.0	0.0	1.0000	1.0000
120	Congenital hydrocephalus.	62	91	0.6813	0.0552	8.1	0.5732	0.7895
121	Spina bifida	24	32	0.7500	0.0765	10.2	0.6000	0.9000
122	Other congenital malformations of nervous system	191	177	1.0791	0.0477	4.4	0.9856	1.1725
123	Congenital malformations of heart.	1,022	1,027	0.9951	0.0081	0.8	0.9793	1.0109
124	Other congenital malformations of circulatory system.	75	121	0.6198	0.0504	8.1	0.5210	0.7186
125	Congenital malformations of respiratory system	361	571	0.6322	0.0225	3.6	0.5882	0.6762
126	Congenital malformations of digestive system	*	*	*	*	*	*	*
127	Congenital malformations of genitourinary system	216	229	0.9432	0.0244	2.6	0.8955	0.9910
128	Congenital malformations and deformations of musculoskeletal system, limbs and integument	269	311	0.8650	0.0319	3.7	0.8024	0.9275
129	Down's syndrome	57	58	0.9828	0.0705	7.2	0.8446	1.1209
130	Edward's syndrome	277	278	0.9964	0.0080	0.8	0.9807	1.0121
131	Patau's syndrome	170	173	0.9827	0.0099	1.0	0.9632	1.0021
132	Other congenital malformations and deformations.	304	312	0.9744	0.0210	2.2	0.9332	1.0155
133	Other chromosomal abnormalities, not elsewhere classified.	57	53	1.0755	0.0783	7.3	0.9221	1.2289
134	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	2,799	2,732	1.0245	0.0042	0.4	1.0163	1.0327
135	Sudden infant death syndrome.	2,575	2,485	1.0362	0.0040	0.4	1.0284	1.0440
136	Other symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified.	224	247	0.9069	0.0270	3.0	0.8540	0.9598
137	All other diseases.	*	*	*	*	*	*	*
138	External causes of mortality.	441	444	0.9932	0.0098	1.0	0.9741	1.0124
139	Accidents (unintentional injuries).	292	285	1.0246	0.0107	1.0	1.0037	1.0454
140	Transport accidents	99	108	0.9167	0.0294	3.2	0.8590	0.9743
141	Motor vehicle accidents	85	98	0.8673	0.0368	4.2	0.7952	0.9395
142	Other and unspecified transport accidents	*	*	*	*	*	*	*
143	Falls	*	*	*	*	*	*	*
144	Accidental discharge of firearms	*	*	*	*	*	*	*
145	Accidental drowning and submersion.	*	*	*	*	*	*	*
146	Accidental suffocation and strangulation in bed.	*	*	*	*	*	*	*
147	Other accidental suffocation and strangulation	79	69	1.1449	0.0537	4.7	1.0396	1.2502
148	Accidental inhalation and ingestion of food or other objects causing obstruction of respiratory tract	32	29	1.1034	0.0810	7.3	0.9447	1.2622
149	Accidents caused by exposure to smoke, fire and flames	*	*	*	*	*	*	*
150	Accidental poisoning and exposure to noxious substances	*	*	*	*	*	*	*
151	Other and unspecified accidents	*	*	*	*	*	*	*
152	Assault (homicide).	146	154	0.9481	0.0179	1.9	0.9130	0.9831
153	Assault (homicide) by hanging, strangulation and suffocation	*	*	*	*	*	*	*
154	Assault (homicide) by discharge of firearms.	*	*	*	*	*	*	*
155	Neglect, abandonment and other maltreatment syndromes	*	*	*	*	*	*	*
156	Assault (homicide) by other and unspecified means	91	88	1.0341	0.0417	4.0	0.9524	1.1158
157	Complications of medical and surgical care	*	*	*	*	*	*	*
158	Other external causes.	*	*	*	*	*	*	*

* Figure does not meet standards of reliability or precision; see Technical notes.
– Quantity zero.
[1] Based on the Ninth and Tenth Revision categories shown in table C.
[2] ICD–10 is *Classification of Diseases*, Tenth Revision, and ICD–9 is *International Classification of Diseases,* Ninth Revision.

Technical notes

Sources of mortality data

Mortality data used for this report are based on death certificates filed in the 50 States and the District of Columbia. The National Center for Health Statistics (NCHS) receives this information through the Vital Statistics Cooperative Program (VSCP) and from copies of the original certificates received by NCHS from the State vital registration offices. In 1996, all the States and the District of Columbia participated in this program and submitted part or all of the mortality data for 1996 in electronic data files to NCHS.

Coding procedures

The underlying cause of death for each record in the 1996 mortality data was originally classified by ICD–9 (10). Since 1968, NCHS has coded the underlying cause of death using a computer-ized software program called Automated Classification of Medical Entities (ACME). Multiple cause-of-death codes serve as inputs to ACME, which uses the ICD rules to select the underlying cause of death (13). The ACME system, based on ICD–9 coding rules, was used to select the underlying cause of death for all 1996 death certificates. In addition, NCHS has developed two computer systems that provide inputs to ACME. Beginning with 1990 data, the Mortality Medical Indexing, Classification, and Retrieval (MICAR) system was introduced to automate coding multiple causes of death (12). This system assigns entity reference numbers (ERN's) corresponding to the medical entities listed on the death certificate to specific ICD codes, which can be read by ACME. In 1993, SuperMICAR, an enhancement of the MICAR system, was introduced. SuperMICAR permits total literal entry of the multiple cause-of-death text as reported by the certifier, and then converts these literal entries to ERN's. This information is then automatically coded by the MICAR and ACME systems. Records that are rejected, i.e., those that cannot be automatically processed by MICAR or SuperMICAR, are manually multiple-cause coded and then further processed by ACME. The NCHS automated systems have become a *de facto* international standard for automating mortality medical coding (18).

A major task of the comparability study was to reclassify 1996 mortality records by ICD–10. These records were reprocessed using the ICD–10 versions of the mortality medical software. MICAR-input files for each State used for processing the original ICD–9 data were used as input to the ICD–10 version of MICAR. The resulting output was divided into three files for each State: a) records successfully coded by MICAR, b) records rejected by MICAR, and c) records in which the manner of death was originally pending investigation, but not updated in the MICAR-input files. The records successfully coded by MICAR were then processed by ACME to obtain an ICD–10 underlying cause of death. The resulting ICD–10-underlying-cause codes were then matched to the 1996 U.S. mortality data file by State and certificate number to create the comparability file. Records without an ICD–10 code were then deleted from the file and sent as rejects for manual coding.

The comparability data were then analyzed to identify likely records for which the cause of death had been amended in the final 1996 mortality file. The following criteria was used to designate records as amended:

- Manner of death (coded "Natural", "Accident", "Suicide", "Homi-cide", "Pending investigation", or "Could not be determined"—see figure 1, item 29) on the ICD–10 part of the record was incon-sistent with the cause of death classified by ICD–9.
- ICD–10 cause of death was classified as Other ill-defined and unspecified causes of mortality (R99) and the ICD–9 cause of death did not have the comparable ICD–9 code (799.9).
- ICD–10 cause of death was an external event of undetermined intent and ICD–9 cause of death was something else.

These records were then removed from the comparability file and reallocated to State-specific data files with the intent of requesting the amended information from the States.

Comparison of selection and modification rules

Table I shows a comparison of the ICD–9 and ICD–10 rules for selecting the underlying cause of death. The Ninth Revision rules for selecting the underlying cause of death are presented and discussed in detail in volume I of the ICD–9 manual (9). The Tenth Revision rules are presented in volume 2 of the ICD–10 manual (6).

Reliability of comparability ratios

Comparability ratios and other comparability data were pre-sented only for causes of death for which the data were deemed reliable. Data not deemed reliable were replaced by asterisks in tables 1 and 2. The criteria for reliability were based on potential sample bias and on a close examination of how deaths classified by one revision were distributed according to the other. The following were considered in determining whether comparability data by cause should not be presented:

- The absolute number of deaths on which the comparability ratio was based. Generally, if the numerator or denominator of the comparability ratio for a particular cause had less than 20 deaths, the ratio was not presented. Data based on small numbers are more likely to be subject to sampling bias. Two important excep-tions are notable in table 2: Diarrhea and gastroenteritis of infec-tious origin and Birth trauma. The comparability ratios for both are based on very small numerators (0 and 5, respectively) and relatively large denominators (144 and 113, respectively). These data were retained to illustrate the dramatic changes occurring for these causes of death.
- The percent of deaths by cause from the 1996 mortality data file were included in the comparability file. If less than 50 percent of the deaths for a particular cause (classified by ICD–9) from the 1996 mortality file were included in the comparability file, com-parability data were not presented. Data for causes of death with disproportionately high rejection rates in the mortality medical software are more likely to be subject to sampling bias and are, therefore, excluded.
- An examination of how deaths classified by ICD–10 were dis-tributed according to ICD–9 and vice versa. This showed the source of increases or decreases due to the revision. Data were not presented for causes of death for which there were large-scale erroneous shifts of deaths from or to that particular cause.

Standard error of comparability ratios

Standard errors of the comparability ratios are calculated using PROC RATIO, a procedure in the SUDAAN statistical software designed to calculate variance estimates for the ratio of two sample means or

Table I. Comparison of ICD–9 and ICD–10 rules for selection of underlying cause for mortality tabulations

ICD–9[1]	ICD–10[1]
Selection Rules	
General Rule: Select the condition entered on the lowest-used line of Part I unless it is highly improbable that this condition could have given rise to all of the conditions above it.	**General Principle**: When more than one condition is entered on the certificate, select the condition entered alone on the lowest used line of part I only if it could have given rise to all of the conditions entered above it.
Rule 1: If there is a reported sequence terminating in the condition first entered on the certificate, select the underlying cause of this sequence. If there are more than one such sequence, select the underlying cause of the first-mentioned sequence	**Rule 1**: If the General Principle does not apply and there is a reported sequence terminating in the condition first entered on the certificate, select the originating cause of this sequence. If there is more than one sequence terminating in the condition mentioned first, select the originating cause of the first-mentioned sequence.
Rule 2: If there is no reported sequence terminating in the condition first entered on the certificate, select the first-mentioned condition.	**Rule 2**: If there is no reported sequence terminating in the condition first entered on the certificate, select this first-mentioned condition.
Rule 3: If the condition selected by the General Rule or Rules 1 or 2 can be considered a direct sequel of another reported condition, whether in Part I or Part II, select this primary condition. If there are two or more such primary conditions, select the first-mentioned of these.	**Rule 3**: If the condition selected by the General Principle or by Rule 1 or Rule 2 is obviously a direct consequence of another reported condition, whether in Part I or Part II, select this primary condition.
Modification Rules	
Rule 4, Senility: Where the selected underlying cause is classifiable to 797 (senility) and a condition classifiable elsewhere than to 780–799 is reported on the certificate, re-select the underlying cause as if the senility had not been reported, except to take account of the senility if it modifies the coding. **Rule 5, Ill-defined conditions**: Where the selected underlying cause is classifiable to 780–796, 798–799 (the ill-defined conditions), and a condition classifiable elsewhere than to 780–799 is reported on the certificate, re-select the underlying cause as if the ill-defined condition had not been reported, except to take account of the ill-defined condition if it modifies the coding.	**Rule A, Senility and other ill-defined conditions**: Where the selected cause is ill-defined and a condition classified elsewhere is reported on the certificate, re-select the cause of death as if the ill-defined condition had not been reported, except to take account of that condition if it modifies the coding. The following conditions are regarded as ill-defined: I46.9 (Cardiac arrest, unspecified); I95.9 (Hypotension, unspecified); I99 (Other and unspecified disorders of circulatory system); J96.0 (Acute respiratory failure); J96.9 (Respiratory failure, unspecified); P28.5 (Respiratory failure of newborn); R00–R94 or R96–R99 (Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified). [*Note that R95 (Sudden infant death) is not regarded as ill-defined.*]
Rule 6, Trivial conditions: Where the selected underlying cause is a trivial condition unlikely to cause death, proceed as follows: (a) if the death was the result of an adverse reaction to treatment of the trivial condition, select the adverse reaction; (b) if the trivial condition is not reported as the cause of a more serious condition, and a more serious unrelated condition is reported on the death certificate, re-select the underlying cause as if the trivial condition had not been reported.	**Rule B, Trivial conditions**: Where the selected cause is a trivial condition unlikely to cause death and a more serious condition (any condition except an ill-defined or another trivial condition) is reported, re-select the underlying cause as if the trivial condition had not been reported. If the death was the result of an adverse reaction to treatment of the trivial condition, select the adverse reaction.
Rule 7, Linkage: Where the selected underlying cause is linked by a provision in the classification or in the Notes for use in primary medical coding on pages 713–721 with one or more of the other conditions on the certificate, code the combination. Where the linkage provision is only for the combination of one condition specified as due to another, code the combination only when the correct causal relationship is stated or can be inferred from application of the selection rules. Where a conflict in linkages occurs, link with the condition that would have been selected if the cause initially selected had not been reported. Apply any further linkage that is applicable.	**Rule C, Linkage**: Where the selected cause is linked by a provision in the classification in the Notes for use in underlying cause mortality coding with one or more of the other conditions on the certificate, code the combination. Where the linkage provision is only for the combination of one condition specified as due to another, code the combination only when the correct causal relationship is stated or can be inferred from application of the selection rules. Where a conflict in linkages occurs, link with the condition that would have been selected if the cause initially selected had not been reported. Apply any further linkage that is applicable.
Rule 8, Specificity: Where the selected underlying cause describes a condition in general terms and a term which provides more precise information about the site or nature of this condition is reported on the certificate, prefer the more informative term. This rule will often apply when the general term can be regarded as an adjective qualifying the more precise term.	**Rule D, Specificity**: Where the selected cause describes a condition in general terms and a term that provides more precise information about the site or nature of this condition is reported on the certificate, prefer the more informative term. This rule will often apply when the general term becomes an adjective, qualifying the more precise term.
Rule 9, Early and late stages of disease: Where the selected cause is an early stage of a disease and a more advanced stage of the same disease is reported on the certificate, code to the more advanced stage. This rule does not apply to a "chronic" form reported as due to an "acute" form unless the classification gives special instructions to that effect.	**Rule E, Early and late stages of disease**: Where the selected cause is an early stage of a disease and a more advanced stage of the same disease is reported on the certificate, code to the more advanced stage. This rule does not apply to a "chronic" form reported as due to an "acute" form unless the classification gives special instructions to that effect.

See footnotes at end of table.

Table I. Comparison of ICD–9 and ICD–10 rules for selection of underlying cause for mortality tabulations—Con.

ICD–9[1]	ICD–10[1]
Rule 10, Late effects: Where the selected underlying cause is an early form of a condition for which the classification provides a separate late effects category and there is evidence that death occurred from residual effects of this condition rather than in its active phase, code to the appropriate late effects category. The following late effects categories, including those in the Supplementary E codes, have been provided: 137, 138, 139, 268.1, 326, 438, 905–909, E929, E959, E969, E977, E989, and E999.	**Rule F, Sequelae**: Where the selected cause is an early form of a condition for which the classification provides a separate "Sequela of..." category, and there is evidence that death occurred from residual effects of this condition rather than from those of its active phase, code to the appropriate "Sequela of..." category. "Sequela of..." categories are as follows: B90–B94, E64–E68, G09, I69, O97 and Y85–Y89.
Rule 11, Old pneumonia, influenza, and maternal conditions: Where the selected underlying cause is pneumonia or influenza (480–487) and there is evidence that the date of onset was one year or more prior to death or a resultant chronic condition is reported, re-select the underlying cause as if the pneumonia or influenza had not been reported. Where the selected underlying cause is a maternal cause (630–676) and there is evidence that death occurred more than 42 days after termination of pregnancy or a resultant chronic condition is reported, reselect the underlying cause as if the maternal cause had not been reported. Take into account the pneumonia, influenza or maternal condition if it modifies the coding.	No corresponding rule
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.	No corresponding rule

[1]ICD–9 is *International Classification of Diseases,* Ninth Revision, and ICD–10 is *International Classification of Diseases,* Tenth Revision.

sample totals (14). Variance estimation for the comparability ratios is based on a first-order Taylor series approximation of the deviations of estimates from their expected values (19). The general approach taken by PROC RATIO is to form the Taylor series linearization for the ratio estimate. Once the linearized values are calculated, they are substituted into an appropriate formula for computing the variance. A detailed discussion of the underlying principles used in Taylor series variance estimation and detailed formulas used by PROC RATIO for these calculations can be found in *Statistical Methods and Mathematical Algorithms Used in SUDAAN* (19).

Statistical analysis using comparability ratios

To determine if the change in death rates between 1998 and 1999 is statistically significant, the statistical analysis is similar to that used within the same revision (20,21). Statistical methods dealing with interrevision analyses, however, explicitly incorporate comparability ratios in their procedures because comparability ratios are also subject to random variability. The cause-specific comparability ratio (C_i) will be applied to rates computed using data from an initial year based on ICD–9 ($R_{i,ICD-9}$) to adjust for the quantitative shift that has taken place due to the introduction of the more recent Tenth Revision. This resulting value, $R_{i,ICD-9}^{CM} = C_i \cdot R_{i,ICD-9}$, is known from here on as a "comparability- modified" death rate. The interrevision methods are discussed in detail in the NCHS publication *A Guide to State Implementation of ICD–10 for Mortality, Part II: Applying Comparability Ratios* (22) available on the Internet at: http://www.cdc.gov/nchs/about/major/dvs/icd10des.htm. The formulas and procedures discussed in this section are highlights from this publication.

To be consistent with previous NCHS publications, the variability of most statistics is described in terms of the relative standard error (RSE). This is merely the ratio of the standard error of a point estimate to the point estimate itself, expressed as a percent. Thus:

$$\text{RSE}(\hat{\theta}) = 100\,\frac{S(\hat{\theta})}{\hat{\theta}}$$

where Theta ($\hat{\theta}$) stands for any given parameter of interest and $S(\hat{\theta})$ is the standard error of Theta.

Relative standard errors for the comparability-modified death rate and for the crude (not comparability-modified) death rate follow, respectively:

$$\text{RSE}(R_{i,ICD-9}^{CM}) = \text{RSE}(C_i \cdot R_{i,ICD-9})$$

$$= 100\sqrt{\left(\frac{\text{RSE}(R_{i,ICD-9})}{100}\right)^2 + \left(\frac{\text{RSE}(C_i)}{100}\right)^2 \left[1 + \left(\frac{\text{RSE}(R_{i,ICD-9})}{100}\right)^2\right]}$$

$$\text{RSE}(R_{i,ICD-10}) = \text{RSE}(D_{i,ICD-10}) = 100\sqrt{\frac{1}{D_{i,ICD-10}}}$$

where C_i is the comparability ratio for cause i, $R_{i,ICD-9}^{CM}$ is the comparability-modified death rate for cause i for the ICD–9 period, $R_{i,ICD-9}$ and $R_{i,ICD-10}$ are the death rates for cause i for the ICD–9 and ICD–10 periods, respectively, and $D_{i,ICD-10}$ is the death count for cause i for the ICD–10 period being considered. These formulas for variability are the basis for constructing confidence intervals and executing tests of hypotheses concerning the change of death rates across revisions of the ICD. The *Z*-test is the basic test used to assess whether the difference between two rates is statistically significant. Incorporating the variability of the comparability ratio,

$$Z = \frac{R_{i,ICD-9}^{CM} - R_{i,ICD-10}}{\sqrt{\begin{aligned}&C_i^2 R_{i,ICD-9}^2 \left\{\left(\frac{\text{RSE}(R_{i,ICD-9})}{100}\right)^2 + \left(\frac{\text{RSE}(C_i)}{100}\right)^2 \cdot \\ &\left[1 + \left(\frac{\text{RSE}(R_{i,ICD-9})}{100}\right)^2\right]\right\} + R_{i,ICD-10}^2 \left(\frac{\text{RSE}(R_{i,ICD-10})}{100}\right)^2\end{aligned}}}$$

The interrevision statistical methods that have been developed so far and that are included in Part II of the *Guide to State Implementation of ICD–10 for Mortality* consider analyses involving both crude and age-adjusted death rates, and also cover cases involving death rates that are based on small numbers, i.e., less than 100 deaths.

Contents

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