CENTER FOR HEALTH STATISTICS

DATA MATTERS

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MULTIPLE CAUSE OF DEATH IN CALIFORNIA, 1995

HIGHLIGHTS

The term "multiple cause of death" refers to the fact that most people die of more than a single cause of death. In the United States, up to 20 causes of death can be reported on the death certificate. These causes of death represent the sequence of medical conditions directly leading to death as well as other contributing medical conditions which the physician felt had a bearing on the death, but were not directly associated with the causal sequence. The totality of all of these conditions on the death certificate is called multiple cause of death.

Traditionally, mortality data are tabulated and analyzed using only a single cause of death, "the underlying cause of death". This report goes beyond the usual analysis of mortality data, and covers not only the underlying cause of death, but also the other causes of death reported on the death certificate. It includes an examination of the causes of death in terms of the "underlying cause", the "other than underlying cause", and "any mention", which is a composite of the underlying cause and the other than underlying cause. The following are the 1995 multiple cause of death highlights:

- A total of 735,028 causes of death were mentioned on the 224,213 death certificates among California residents, which are equivalent to an average of 3.3 causes per death. (Figure 1)

- Of the 224,213 resident deaths in California, 196,335 or 87.6 percent of the deaths had two or more causes reported on the death certificate, while 27,878 or 12.4 percent of the deaths reported only a single cause. (Figure 1)

- Analysis of the leading causes of death by the **underlying cause**, the **other than underlying cause**, and **any mention** revealed some type of heart disease as the number one cause of death in California. (Tables 1A-1C, Table 3, and Table 5)

- The rank ordering of causes of death depends heavily upon the scheme utilized to group specific diagnostic conditions into broad categories (Table 1A and Table 5), and whether or not the ranking is based on the **underlying cause** or **any mention** of a cause. (Table 6)

- Whenever a large proportion of deaths is due to a combination of multiple diseases or diagnostic conditions, then analysis of a single **underlying cause** of death excludes a considerable amount of pertinent data. A good example is diabetes mellitus where 75.1 percent of the deaths due to this cause was assigned as the **other than underlying cause**, and only 24.9 percent was assigned as the single **underlying cause** of death. (Table 1A)

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INTRODUCTION

Multiple cause of death data provide an alternative view of mortality compared to statistics based on only a single underlying cause. With life expectancy increasing among Americans, correlated increases are occurring in the number of diagnostic conditions a person has at the time of death.[1] Older people, in most cases, have multiple complications at the time of death rather than a single condition or cause.[2] As a result, whenever a large proportion of deaths is due to a combination of multiple diseases or diagnostic conditions, then analysis of a single underlying cause of death excludes a considerable amount of pertinent data and becomes increasingly less meaningful.

Researchers as far back as 1940 began to point out the "importance of tabulating multiple causes of death".[3] These early efforts were hampered by the lack of computer technologies currently available. Nevertheless, work persisted through the years because it was felt that analysis of multiple cause of death data yielded important information and insight into the course of mortality.[4] The following benefits have been associated with the study of multiple cause of death data [5]:

- disease combinations that seem to go with high mortality can be studied.
- non-fatal diseases which merely contribute to death can be better understood.
- increases or decreases in the prevalence of a given cause of death can be more accurately described.

In comparison to the analysis of a single cause of death, multiple cause of death data reveal more clearly the connection between mortality, age at death, and certain chronic diseases, such as diabetes mellitus.[6] In addition, multiple cause of death data show more substantive information pertaining to other key factors associated with multiple causes, including the decedent's gender and race/ethnicity.[7]

The coexistence of chronic conditions (e.g., comorbidity) is considered common in the older population. However, systematic evaluation of the prevalence, patterns, and impact of comorbidity in representative populations have been limited.[8] Studies related to comorbidity as it applies to mortality have also been limited, albeit, the use of multiple cause of death data in examining comorbidity appears to have potential. The study of comorbidity would be especially enlightening for those diagnostic categories which are mentioned more often as an "other than underlying cause of death". This would allow a more comprehensive analysis of these types of conditions and the effects of specific multiple causes of death.

This report presents tabulations of the total number of deaths due to **any mention** of the selected diagnostic categories. **Any mention** is comprised of the **underlying cause** and **other than underlying cause**, which are compared and contrasted. The purpose of this report is to examine the relative number of deaths due to any given diagnostic category (e.g., Diseases of the Heart) as an **underlying cause,** and as an **other than underlying cause.** Data are presented for the traditional ten leading causes of death, a non-traditional listing of the leading causes of death, and the 72 selected causes used by the National Center for Health Statistics (NCHS) including AIDS, Alzheimer's disease, injury by firearms, drug-induced deaths, and alcohol-induced deaths.

METHOD

Cause of death data presented in this report are based on diagnostic information reported on the death certificate by a medical certifier, usually the attending physician. The diagnoses are then codified according to the *International Classification of Diseases, Revision 9* (ICD-9) by nosologists.[9] The ICD-9 coding scheme classifies all known human diseases, injuries, and external causes at the time the list is adopted by the World Health Organization. Medical workers throughout the world contribute to its compilation, organization, and definition of diseases. The ICD-9 was adopted in 1975, and it was implemented for use beginning with deaths occurring in 1979.

Since 1968, NCHS has annually compiled data from all death certificates filed in the United States and made these data available through a series of public use tape files called "Multiple Cause of Death Files". These files include the International Classification of Disease codes for the underlying cause of death and for any contributing conditions, up to 20, that were reported on the death certificate (14 conditions before 1979). Also included on these files are demographic and geographic information related to the decedent.

The source of the data presented in this report was the 1995 Multiple Cause of Death File provided by NCHS. Cause of death data residing on this file are stored in three different formats: the entity axis; the record axis; and the underlying cause of death. The entity axis provides, in essence, an unaltered list of all 735,028 diagnostic conditions in ICD-9 coded form that were reported on the 224,213 death certificates registered in California. The record axis codes are derived from the entity axis codes through a computerized process called TRANSAX for "Translation of Axis". The TRANSAX program is used to convert the entity axis codes into record axis codes for record (or person) based analysis. This conversion process combines, modifies, and/or deletes the entity axis codes into a set of codes that best describe the overall diagnostic conditions reported on the death certificate. As a result, the 735,028 entity axis codes were reduced to 445,008 record axis codes. The entity axis codes are also processed through another computer program called ACME for "Automated Classification of Medical Entities". This program edits the entity axis codes and assigns the underlying cause of death by applying a predefined algorithm to these codes based on traditional ICD rules. Quality assurance of the aforementioned cause of death data are performed on an ongoing basis by nosologists who code the diagnostic conditions at the state level as well as nosologists at NCHS who periodically review and verify data on a sample of death certificates submitted by the states.[10]

Issues related to the validity and reliability of the single underlying cause of death data have been a continuous concern for public health researchers. This concern becomes increasingly important when analyzing multiple cause of death data, which are the sequence of conditions contributing to the morbid process that eminently resulted in death. Most of the data quality issues, as they relate to cause of death data, pertain to the varied procedures used by the certifiers to report the medical conditions on the death certificate. Some of the reporting variations may be attributed to: differences in the interpretation of the death certificate instructions among certifiers; differences in the level of detail used to report causes of death on the certificate among certifiers ; and differences in the medical opinions among certifiers in terms of what existing diagnostic conditions may be related to a death. Previous studies have shown that the aforementioned reporting problems have been identified in the analysis of multiple cause of death data related to Alzheimer's disease and alcohol-related mortality.[11,12] These problems are also inherent among nonfatal conditions such as obesity, epilepsy, and various mental health problems. Depending on the type of analysis, caution should be taken when examining

multiple causes of death, especially those that are rare causes of death or nonfatal in nature. In spite of these known limitations, cause of death data have rarely misled researchers. As stated by Kleinman, when "viewed in proper context and used with care, vital statistics represent an invaluable source of data on the nation's health"[13]

California resident death data, presented in Figure 1, were compiled using the 735,028 entity axis codes to quantify the number of causes listed on the 224,213 death certificates in 1995. The 445,008 record axis codes were used to quantify the number of deaths by **underlying** and **other than underlying cause** of death for each cause of death category shown in Tables 1A-6. A special computer algorithm was used to compile the record axis codes into the selected cause of death categories. The traditional ten leading causes of death presented in Table 1A are based on the ICD-9 groupings found in the annual report, *Vital Statistics of California 1995*.[14] Tables 1B and 1C are based on a set of ICD-9 groups, which are non-traditional, but provide an alternative view of the ten leading causes of death. Tables 2-6 are based on the standard 72 selected group causes of death developed by NCHS plus deaths due to acquired immune deficiency syndrome, Alzheimer's disease, injury by firearms, drug-induced deaths, and alcohol-induced deaths.

Further details regarding how diagnostic conditions are reported on the death certificate by the medical certifier, and how NCHS develops the Multiple Cause of Death Files can be found in the Appendix of this report.

RESULTS

Deaths by the Number of Causes Listed on the Death Certificate

In 1995, there were 224,213 deaths among residents of California according to the data compiled from the NCHS Multiple Cause of Death File. This count differs from what is shown in the California annual report *Vital Statistics of California 1995* (222,626) by 1,587 deaths, or less than 1.0 percent.[14] This insignificant difference is primarily due to the deaths among California residents who died in another state. These deaths are omitted from California's annual Death Statistical Master File because the death certificate data reallocated to California by other states cannot be feasibly processed. However, there are other significant differences in the data, namely, the results of the data based on multiple causes of death versus those based on a single underlying cause of death as presented in California's annual report. These differences are discussed later in the analyses.

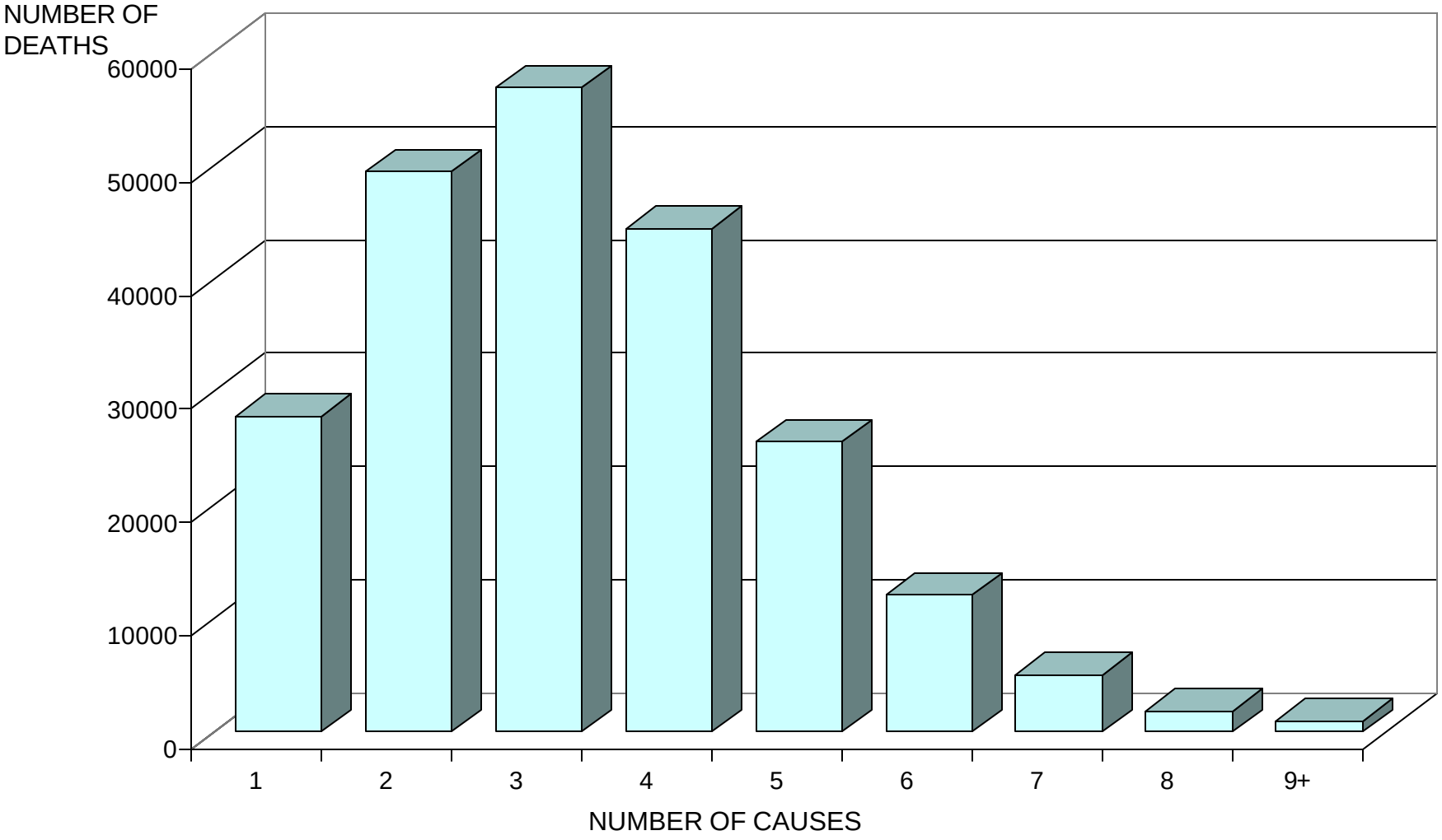
All death records have at least one cause of death. The number of causes that can be reported on a death record can vary up to 20 causes. Among California residents, the greatest number of causes reported on a death certificate was 14 causes in 1995. Two deaths had that many causes. One person was a 26 year-old male, while the other was a 50 year-old male. The 50 year-old male had the following 14 causes reported on his death certificate:

ICD-9 CODE	DIAGNOSTIC CONDITION
998.1	Hemorrhage or hematoma complicating a procedure
997.3	Respiratory complications (Mendelson's syndrome/pneumonia)
E879.8	Other (abnormal reaction of patient, or of later complication (blood transfusion))
786.3	Hemoptysis (cough with hemorrhage/pulmonary hemorrhage)
997.4	Gastrointestinal complications
E879.8	Other (abnormal reaction of patient, or of later complication (blood transfusion))
428.0	Congestive heart failure
359.4	Toxic myopathy
496	Chronic airways obstruction, not elsewhere classified
799.1	Respiratory Failure (cardiorespiratory failure/respiratory arrest)
E870.5	Aspiration of fluid or tissue, puncture and catheterization
540.0	With generalized peritonitis (acute appendicitis)
998.1	Hemorrhage or hematoma complicating a procedure
999.9	Other and unspecified complications of medical care, not elsewhere classified

Since the entity axis codes were used for this analysis, duplicate codes are allowable. Therefore, 2 of the 14 causes of death (998.1 and E879.8) reported on the certificate of the 50 year-old male were duplicate codes. It might be instructive for the reader to attempt to select the single underlying cause of death from the 14 causes of death. This may prove to be a difficult task. Later in the report, the underlying cause of death assigned by the ACME program will be given.

As shown in Figure 1, most of the death records had far fewer multiple causes of death than the 14 causes shown above. The average number was 3.3 causes per death record in 1995. Of the 224,213 California resident deaths, 19.8 percent (44,425) had four causes reported on the death certificate, while 25.4 percent (56,882) had three causes, and another 22.1 percent (49,457) had two causes. Only 12.4 percent (27,878) of the records reported a single cause of death, whereas 87.6 percent (196,335) of the records had two or more causes.

FIGURE 1
DEATHS BY THE NUMBER OF CAUSES LISTED ON THE DEATH CERTIFICATE
CALIFORNIA RESIDENTS, 1995



Source: National Center for Health Statistics, Multiple Cause of Death File.

Ten Leading Causes of Death (Traditional)

The ten leading causes of death, as reported in the *Vital Statistics of California 1995*, have been compiled for many years. This traditional table has been constructed to draw attention to the most important causes of death in terms of the number of deaths attributed to each diagnostic category, as an **underlying cause of death**. As shown in Table 1A, certain diagnostic conditions are combined into more or less large groups, such as diseases of the heart, whereas others stand alone as one ICD-9 code, such as chronic liver disease and cirrhosis. These categories have been reported for the past several years, and tend to change very little from one year to the next. Table 1A also shows the number and percent of deaths by the **underlying cause** and the **other than underlying cause**. Within each diagnostic category, the counts of **underlying causes** and the **other than underlying causes** are unduplicated. This means that the two counts are mutually exclusive and can be summed to equal the total the number of **any mention** of a specific diagnostic condition. For example, 68,329 deaths had diseases of the heart assigned as the **underlying cause**, and another 51,200 deaths had diseases of the heart assigned as the **other than underlying cause**. The sum of these two counts (119,529) is the total number of deaths that had **any mention** of diseases of the heart on the death certificates.

As shown in Table 1A, the percent of *any mention* as it pertains to the **underlying cause** (50.4) for all causes of death among Californians was essentially equal to the percent of **other than underlying cause** (49.6). However, proportional variations exist among the ten leading causes of death between the **underlying cause** and the **other than underlying cause**. The largest variations were among deaths due to suicide, homicide, acquired immune deficiency syndrome, malignant neoplasms, and diabetes mellitus. Virtually all of the deaths due to suicide (99.8 percent) and homicide (99.4 percent) were automatically assigned as an **underlying cause**. The majority of deaths due to acquired immune deficiency syndrome (91.6 percent), and malignant neoplasms (86.6 percent) were assigned as an **underlying cause**, and were respectively 10.9 and 6.5 times greater than their **other than underlying cause** percentages. In contrast, most of the deaths due to diabetes mellitus (75.1 percent) were assigned as an **other than underlying cause of death**. This percentage was 3.0 times greater than its **underlying cause** percentage. Diabetes mellitus is a good example of comorbidity, and the need for more in-depth analysis into the coexistence of chronic conditions using the multiple cause of death data. The diabetes mellitus data also show the limitations of analyzing only the single **underlying cause**, and not taking into consideration the **other than underlying causes**. Although diabetes mellitus had the highest inverse proportional difference between the **underlying cause** and the **other than underlying cause**, the majority of the deaths due to chronic obstructive pulmonary disease, and pneumonia and influenza were also assigned as the **other than underlying cause**.

Figure 2 illustrates the percent distribution of California's ten leading causes of death for the **underlying cause** and the **other than underlying cause** in 1995. This chart clearly shows that variations exist among the leading causes of death in terms of the relative number of causes selected as the **underlying cause** and as the **other than underlying cause**.

Further, the ten traditional categories shown in Table 1A and Figure 2 reflect a somewhat arbitrary grouping of diagnostic codes. For example, ICD-9 codes for "diseases of the digestive system" are not traditionally grouped together for analysis, while the ICD-9 codes for "diseases of the heart" are grouped together. With this in mind, careful consideration should be taken before formulating and analyzing specific groups of diagnostic codes.

TABLE 1A

TEN LEADING CAUSES OF DEATH BASED ON UNDERLYING CAUSE[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA, 1995

(BY PLACE OF RESIDENCE)

TRADITIONAL TEN LEADING CAUSES OF DEATH

	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
	Total of All Causes	001-799, E800-E999	445,008	224,213	220,795	50.4	49.6
1	Diseases of the Heart	390-398, 402, 404-429	119,529	68,329	51,200	57.2	42.8
2	Malignant Neoplasms	140-208	59,397	51,423	7,974	86.6	13.4
3	Cerebrovascular Disease	430-438	29,865	16,239	13,626	54.4	45.6
4	Chronic Obstructive Pulmonary Disease	490-496	25,538	10,792	14,746	42.3	57.7
5	Pneumonia and Influenza	480-487	25,315	10,556	14,759	41.7	58.3
6	Unintentional Injuries	E800-E949	14,545	9,253	5,292	63.6	36.4
7	Acquired Immune Deficiency Syndrome	042-044	7,044	6,455	589	91.6	8.4
8	Diabetes Mellitus	250	20,523	5,104	15,419	24.9	75.1
9	Suicide	E950-E959	3,703	3,694	9	99.8	0.2
10	Homicide	E960-E969	3,594	3,573	21	99.4	0.6
	All Other Causes	Residuals	135,955	38,795	97,160	28.5	71.5

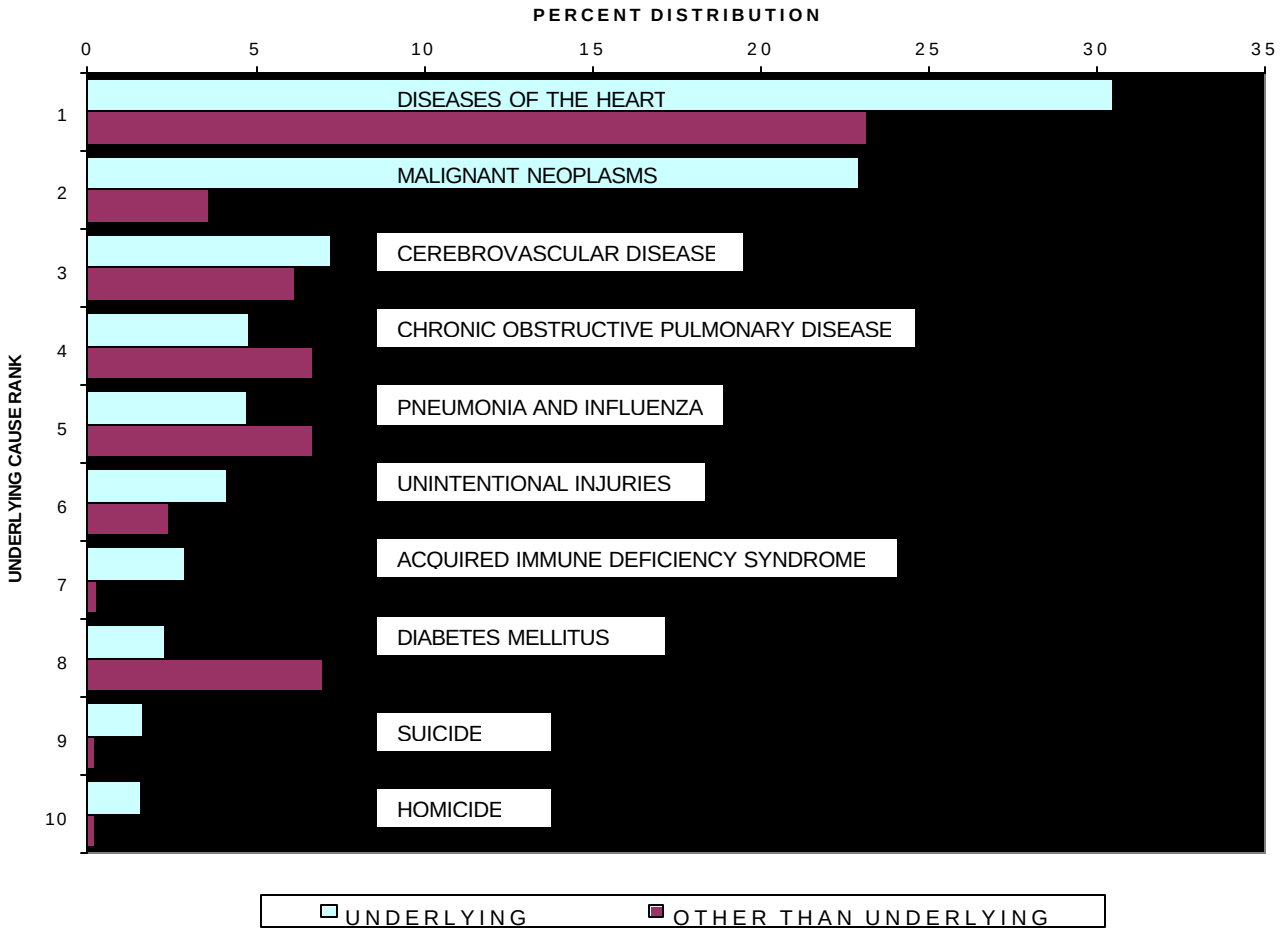
[1] Causes of death are based on the same ICD-9 groups as presented in the *Vital Statistics of California, 1995*, Table 5-9, p. 182.

[2] "Other Than Underlying Cause" is a compilation of the Immediate, Intermediate, and Contributing Causes of Death.

Note: Column 1 "Cause of Death" refers to diagnostic conditions.
Column 3 "Any Mention" is the sum of the "Underlying" and "Other Than Underlying" causes.
Column 4 "Underlying Cause" refers to the one single diagnostic condition which started the process of death.
Column 5 "Other Than Underlying" refers to the diagnostic conditions comprising those multiple causes which did not start the process of death.

Source: National Center for Health Statistics, Multiple Cause of Death File, 1995.

FIGURE 2
PERCENT DISTRIBUTION OF
THE TEN LEADING CAUSES OF DEATH
FOR UNDERLYING CAUSE AND OTHER THAN UNDERLYING CAUSE
CALIFORNIA RESIDENTS, 1995



Source: Table 1A

Ten Leading Causes of Death (Non-Traditional)

Table 1B depicts an alternative listing of the ten leading causes of death in California by including two non-traditional diagnostic categories, diseases of the digestive system and diseases of the nervous system. The data is arrayed using the traditional ten leading **underlying causes** of death along with the two non-traditional cause of death groups. The resulting table drops suicide and homicide as the ninth and tenth leading cause of death. The diagnostic group, diseases of the digestive system, moves into the list as the seventh leading cause of death and the diagnostic group, diseases of the nervous system, moves into the list as the tenth leading cause of death. All other diagnostic groups remain relatively unchanged in their order on the list.

As mentioned earlier, the grouping of diagnostic conditions shown in Table 1A is more or less arbitrary, or at least merely traditional. A comparison of the data in Table 1A with Table 1B clearly demonstrates that the list of the ten leading causes of death can be altered simply by the diagnostic conditions that are selected for inclusion and the method used to group these conditions.

TABLE 1B

TEN LEADING CAUSES OF DEATH BASED ON UNDERLYING CAUSE[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA, 1995

(BY PLACE OF RESIDENCE)

NON-TRADITIONAL TEN LEADING CAUSES OF DEATH

	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
	Total of All Causes	001-799, E800-E999	473,603	229,572	244,031	48.5	51.5
1	Diseases of the Heart	390-398, 402, 404-429	119,529	68,329	51,200	57.2	42.8
2	Malignant Neoplasms	140-208	59,397	51,423	7,974	86.6	13.4
3	Cerebrovascular Disease	430-438	29,865	16,239	13,626	54.4	45.6
4	Chronic Obstructive Pulmonary Disease	490-496	25,538	10,792	14,746	42.3	57.7
5	Pneumonia and Influenza	480-487	25,315	10,556	14,759	41.7	58.3
6	Unintentional Injuries	E800-E949	14,545	9,253	5,292	63.6	36.4
7	Diseases of the Digestive System	520-579	20,832	8,135	12,697	39.1	60.9
8	Acquired Immune Deficiency Syndrome	042-044	7,044	6,455	589	91.6	8.4
9	Diabetes Mellitus	250	20,523	5,104	15,419	24.9	75.1
10	Diseases of the Nervous System	320-389	15,060	4,491	10,569	29.8	70.2
	All Other Causes	Residuals	135,955	38,795	97,160	28.5	71.5

[1] Causes of death are based on the same ICD-9 groups as presented in the *Vital Statistics of California, 1995*. Table 5-9, p. 182.

[2] "Other Than Underlying Cause" is a compilation of the Immediate, Intermediate, and Contributing Causes of Death.

Note: Column 1 "Cause of Death" refers to diagnostic conditions.
Column 3 "Any Mention" is the sum of the "Underlying" and "Other Than Underlying" causes.
Column 4 "Underlying Cause" refers to the one single diagnostic condition which started the process of death.
Column 5 "Other Than Underlying" refers to the diagnostic conditions comprising those multiple causes which did not start the process of death.

Source: National Center for Health Statistics, Multiple Cause of Death File, 1995.

Table 1C shows the "non-traditional ten leading causes of death" based on the total number of **any mention** of a diagnostic condition. This new listing shows the leading causes of death with a different perspective by ranking the causes by the total number of **any mention** instead of the **underlying cause**. As a result, the diagnostic category, symptoms, signs, and ill-defined conditions, moves into the list as the third leading cause of death and acquired immune deficiency syndrome drops off the list. The rank order of the other leading causes of death in Table 1C remains relatively similar to the causes listed in Table 1B, except unintentional injuries, which went from rank six in Table 1B to rank ten in Table 1C.

Comparable to Table 1A and 1B, Table 1C includes some diagnostic conditions that encompass a rather large number of different ICD-9 codes. Such a category is diseases of the heart, the number one cause of death in all three of these tables. Researchers may question the ranking of diseases of the heart due to its categorical broadness, in that the number one ranking may simply be attributed to the large number of ICD-9 codes that are included in this category. However, the number of deaths from other broader categories was substantially lower than the number of deaths due to diseases of the heart. For example, the number of deaths involving **any mention** of diseases of the heart (119,529) was 8.2 times greater than the number of unintentional injuries (14,545), even though the category, unintentional injuries, is comprised of more ICD-9 codes.

As shown in Table 1C, malignant neoplasms had the highest proportion (86.6 percent) of *any mention* assigned as the **underlying cause**, followed by unintentional injuries (63.6 percent), and diseases of the heart (57.2 percent). At the other extreme, symptoms, signs, and ill-defined conditions had the highest proportion (95.3 percent) of *any mention* assigned as the **other than underlying cause**. Diabetes mellitus (75.1 percent) and diseases of the nervous system (70.2 percent) were also disproportionately coded as the **other than underlying cause**, and were the second and third highest proportions respectively. The later three diagnostic conditions, as the data suggest, merely contribute to some other diagnostic condition, and were not determined to be the **underlying cause**. As a result, symptoms, signs, and ill-defined conditions, and diseases of the nervous system were not ranked as one of the traditional ten leading causes of death based on the **underlying cause** shown in Table 1A.

Table 1C avoids the problem of "properly" selecting the **underlying cause**. Instead, the table measures the causes of death as a composite, **any mention**, rather than a single underlying cause imputed by a computer algorithm. The problem of selecting an **underlying cause** from a number of multiple causes has not been readily resolved (see Appendix for further discussion). Earlier in this report, we instructed the reader to attempt to select the single **underlying cause** for the 50 year-old male that had 14 causes of death listed on his death certificate. The underlying cause of death selected by the ACME program was ICD-9 code E870.5, "aspiration of fluid or tissue, puncture and catheterization (any, except heart catheterization)".

The data shown in Tables 1A, 1B, and 1C are all equally "correct". Each table basically presents data using various methods of categorizing the ten leading causes of death. These tables also demonstrate the potential use of studying the **other than underlying causes** conjointly with the **underlying cause** to obtain a more in-depth understanding of multiple causes and their effects upon one another.[8] Moreover, the study of multiple causes provides a more accurate portrayal of mortality when deaths are attributed to a number of concurrent diagnostic conditions.[4]

TABLE 1C

TEN LEADING CAUSES OF DEATH BASED ON ANY MENTION OF CAUSE[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA, 1995

(BY PLACE OF RESIDENCE)

NON-TRADITIONAL TEN LEADING ANY MENTION OF CAUSES

	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
	Total of All Causes	001-799, E800-E999	445,008	224,213	220,795	50.4	49.6
1	Diseases of the Heart	390-398, 402, 404-429	119,529	68,329	51,200	57.2	42.8
2	Malignant Neoplasms	140-208	59,397	51,423	7,974	86.6	13.4
3	Symptoms, Signs, & Ill-Defined Conditions	780-799	51,083	2,399	48,684	4.7	95.3
4	Cerebrovascular Disease	430-438	29,865	16,239	13,626	54.4	45.6
5	Chronic Obstructive Pulmonary Disease	490-496	25,538	10,792	14,746	42.3	57.7
6	Pneumonia and Influenza	480-487	25,315	10,556	14,759	41.7	58.3
7	Diseases of the Digestive System	520-579	20,832	8,135	12,697	39.1	60.9
8	Diabetes Mellitus	250	20,523	5,104	15,419	24.9	75.1
9	Diseases of the Nervous System	320-389	15,060	4,491	10,569	29.8	70.2
10	Unintentional Injuries	E800-E949	14,545	9,253	5,292	63.6	36.4
	All Other Causes	Residuals	63,321	37,492	25,829	59.2	40.8

[1] Causes of death are based on different ICD-9 groups as presented in the *Vital Statistics of California, 1995*. Table 5-9, p. 182.

[2] "Other Than Underlying Cause" is a compilation of the Immediate, Intermediate, and Contributing Causes of Death.

Note: Column 1 "Cause of Death" refers to diagnostic conditions.
Column 3 "Any Mention" is the sum of the "Underlying" and "Other Than Underlying" causes.
Column 4 "Underlying Cause" refers to the one single diagnostic condition which started the process of death.
Column 5 "Other Than Underlying" refers to the diagnostic conditions comprising those multiple causes which did not start the process of death.

Source: National Center for Health Statistics, Multiple Cause of Death File, 1995.

Selected Causes of Death (77 Causes)

Table 2 presents a more detailed list of diagnostic conditions than the ten leading causes of death. These diagnostic conditions are the standard 72 group causes of death developed and reported by NCHS. Acquired immune deficiency syndrome, Alzheimer's disease, injury by firearms, drug-induced deaths, and alcohol-induced deaths were also added to the list because these causes have become increasingly important in the past few years. The standard 72 group causes are arrayed in ascending order by ICD-9 code. The 5 additional group causes, which are not mutually exclusive of the standard 72 group causes, are added to the end of the table. Also included in this table are some of the important subtotals for various causes of death groups. For example, infectious & parasitic diseases are comprised of twelve subcategories including tuberculosis, which in turn, is comprised of two more subcategories.

Table 2 is similar to the Table 1 series, in that the total number of **any mention** and the number and percent of deaths due to the **underlying** and the **other than underlying cause** are presented for each of the diagnostic categories. This table can be used as a "look-up" table to locate a specific diagnostic condition, as a cause of death, and to assess the number of deaths due to that diagnostic condition as an **underlying cause** versus an **other than underlying cause**. For example, of the 224,213 California resident deaths in 1995, there were 59,397 persons who died with **any mention** of malignant neoplasms. In 51,423 or 86.6 percent of those deaths, malignant neoplasms was the **underlying cause of death**, while the remaining 7,974 or 13.4 percent of the deaths were assigned as the **other than underlying cause**.

This table can also be used to make comparisons between two or more diagnostic conditions. For example, out of the 224,213 deaths among Californians in 1995, there were 20,650 deaths due to any mention of hypertension with or without renal disease, of which 1,376 or 6.7 percent of those deaths were assigned as the **underlying cause**, and 19,274 or 93.3 percent of the deaths were assigned as the **other than underlying cause**. In comparison, deaths due to **any mention** of acute myocardial infarction had relatively the same number of deaths as hypertension with or without renal disease. However, of the 20,358 deaths due to **any mention** of acute myocardial infarction, 17,934 or 88.1 percent of the deaths were assigned as the **underlying cause**, while only 2,424 or 11.9 percent were assigned as the **other than underlying cause**. The difference between the two diagnostic conditions as it pertains to their **underlying cause** proportions is significant. On the other hand, if the data are analyzed by **any mention** of the diagnostic conditions, then hypertension with or without renal disease is equally as important as acute myocardial infarction as a cause of death. Hence, the principal difference in the two diagnostic conditions is attributed to the process in which the ACME computer program selects the **underlying cause** from the multiple causes listed on the death certificate. This further emphasizes the importance of studying multiple causes of death versus only a single underlying cause, and the impact that **other than underlying causes** can have upon **any mention** of certain diagnostic conditions. The following analyses of the standard 72 group causes plus the 5 additional group causes will substantiate the advantages of analyzing multiple causes of death, and the alternative approaches that can be used to study various diagnostic conditions.

TABLE 2

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA RESIDENTS, 1995

CAUSE OF DEATH IN ASCENDING ORDER OF ICD-9 CODE

	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION[3]	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
	Total, 72 Selected Causes	001-799, E800-E999	592,545	224,213	368,332	37.8	62.2
	Infectious & Parasitic Diseases*	001-139	18,464	8,696	9,768	47.1	52.9
1	Shigellosis & Amebiasis	004, 006	9	3	6	-	-
2	Certain Other Intestinal Infections	007-009	164	97	67	59.1	40.9
	Tuberculosis*	010-018	469	194	275	41.4	58.6
3	Respiratory Tuberculosis	010-012	349	152	197	43.6	56.4
4	Other Tuberculosis	013-018	126	42	84	33.3	66.7
5	Whooping Cough	033	3	3	0	-	-
6	Streptococcal Sore Throat, Scarlatina, and Erysipelas	034-035	2	1	1	-	-
7	Meningococcal Infection	036	34	32	2	94.1	5.9
8	Septicemia	038	8,962	446	8,516	5.0	95.0
9	Acute Poliomyelitis	045	0	0	0	-	-
10	Measles	055	1	1	0	-	-
11	Viral Hepatitis	070	1,086	605	481	55.7	44.3
12	Syphilis	090-097	28	4	24	-	-
13	All Other Infectious and Parasitic Diseases	001-003, 005, 020-032, 037, 039-044, 046-054, 056-066, 071-088, 098-139	8,504	7,310	1,194	86.0	14.0
	Malignant Neoplasms: Including Lymphatic & Hematopoietic Tissues*	140-208	59,397	51,423	7,974	86.6	13.4
14	Malignant Neoplasms: Lip/Oral/Pharynx	140-149	1,182	920	262	77.8	22.2
15	Malignant Neoplasms: Digestive Organs/Peritoneum	150-159	14,201	12,439	1,762	87.6	12.4
16	Malignant Neoplasms: Respiratory/Intrathoracic Organs	160-165	15,663	14,225	1,438	90.8	9.2
17	Malignant Neoplasms: Breast	174-175	5,335	4,290	1,045	80.4	19.6
18	Malignant Neoplasms: Genital Organs	179-187	8,050	5,807	2,243	72.1	27.9
19	Malignant Neoplasms: Urinary Organs	188-189	2,739	2,108	631	77.0	23.0
20	Malignant Neoplasms: All Other & Unspecified Sites	170-173, 190-199	17,384	6,360	11,024	36.6	63.4
21	Leukemia	204-208	2,547	1,997	550	78.4	21.6
22	Other Malignant Neoplasms of Lymphatic and Hematopoietic Tissues	200-203	4,252	3,277	975	77.1	22.9
23	Benign Neoplasms, Carcinoma In Situ, and Neoplasms of Uncertain Behavior and of Unspecified Nature	210-239	1,364	605	759	44.4	55.6
24	Diabetes Mellitus	250	20,523	5,104	15,419	24.9	75.1
25	Nutritional Deficiencies	260-269	3,279	128	3,151	3.9	96.1
26	Anemias	280-285	5,022	255	4,767	5.1	94.9
27	Meningitis	320-322	218	74	144	33.9	66.1
	Major Cardiovascular Diseases*	390-448	138,546	90,221	48,325	65.1	34.9
	Diseases of the Heart*	390-398, 402, 404-429	119,529	68,329	51,200	57.2	42.8
28	Rheumatic Fever and Rheumatic Heart Disease	390-398	1,158	543	615	46.9	53.1
29	Hypertensive Heart Disease	402	4,730	3,028	1,702	64.0	36.0
30	Hypertensive Heart and Renal Disease	404	477	310	167	65.0	35.0

TABLE 2 (continued)

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA RESIDENTS, 1995

CAUSE OF DEATH IN ASCENDING ORDER OF ICD-9 CODE

	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION[3]	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
	Ischemic Heart Disease*	410-414	58,422	46,342	12,080	79.3	20.7
31	Acute Myocardial Infarction	410	20,358	17,934	2,424	88.1	11.9
32	Other Acute and Subacute Forms of Ischemic Heart Disease	411	343	52	291	15.2	84.8
33	Angina Pectoris	413	373	48	325	12.9	87.1
34	Old Myocardial Infarction and Other Forms of Chronic Ischemic Heart Disease	412, 414	49,532	28,308	21,224	57.2	42.8
35	Other Diseases of Endocardium	424	4,091	1,654	2,437	40.4	59.6
36	All Other Heart Diseases	415-423, 425-429	97,568	16,452	81,116	16.9	83.1
37	Hypertension with or without Renal Disease	401, 403	20,650	1,376	19,274	6.7	93.3
	Cerebrovascular Diseases*	430-438	29,865	16,239	13,626	54.4	45.6
38	Intracerebral and Other Intracranial Hemorrhage	431-432	3,629	2,538	1,091	69.9	30.1
39	Cerebral Thrombosis and Unspecified Occlusion of Cerebral Arteries	434.0, 434.9	2,521	1,415	1,106	56.1	43.9
40	Cerebral Embolism	434.1	245	62	183	25.3	74.7
41	All Other and Late Effects of Cerebrovascular Diseases	430, 433, 435-438	24,486	12,224	12,262	49.9	50.1
42	Atherosclerosis	440	10,997	1,936	9,061	17.6	82.4
43	Other Diseases of Arteries, Arterioles, and Capillaries	441-448	5,317	2,341	2,976	44.0	56.0
44	Acute Bronchitis and Bronchiolitis	466	201	50	151	24.9	75.1
	Pneumonia and Influenza*	480-487	25,315	10,556	14,759	41.7	58.3
45	Pneumonia	480-486	25,234	10,504	14,730	41.6	58.4
46	Influenza	487	81	52	29	64.2	35.8
	Chronic Obstructive Pulmonary Diseases and Allied Conditions*	490-496	25,538	10,792	14,746	42.3	57.7
47	Bronchitis, Chronic and Unspecified	490-491	888	424	464	47.7	52.3
48	Emphysema	492	4,233	1,974	2,259	46.6	53.4
49	Asthma	493	1,494	652	842	43.6	56.4
50	Other Chronic Obstructive Pulmonary Diseases and Allied Conditions	494-496	19,051	7,742	11,309	40.6	59.4
51	Ulcer of Stomach and Duodenum	531-533	2,129	820	1,309	38.5	61.5
52	Appendicitis	540-543	105	47	58	44.8	55.2
53	Hernia of Abdominal Cavity and Intestinal Obstruction without Mention of Hernia	550-553, 560	1,961	520	1,441	26.5	73.5
54	Chronic Liver Disease and Cirrhosis	571	6,133	3,564	2,569	58.1	41.9
55	Cholelithiasis and Other Disorders of Gallbladder	574-575	720	306	414	42.5	57.5
	Nephritis, Nephrotic Syndrome, and Nephrosis*	580-589	13,102	1,161	11,941	8.9	91.1
56	Acute Glomerulonephritis and Nephrotic Syndrome	580-581	127	19	108	15.0	85.0
57	Chronic Glomerulonephritis, Nephritis and Nephropathy, Not Specified as Acute or Chronic, and Renal Sclerosis, and Unspecified	582-583, 587	592	160	432	27.0	73.0
58	Renal Failure, Disorders Resulting From Impaired Renal Function, and Small Kidney of Unknown Cause	584-586, 588-589	12,554	982	11,572	7.8	92.2
59	Infections of Kidney	590	295	148	147	50.2	49.8
60	Hyperplasia of Prostate	600	288	57	231	19.8	80.2

TABLE 2 (continued)

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA RESIDENTS, 1995

CAUSE OF DEATH IN ASCENDING ORDER OF ICD-9 CODE

	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION[3]	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
	Complications of Pregnancy, Childbirth, and the Peurperium*	630-676	59	44	15	74.6	25.4
61	Pregnancy With Abortive Outcome	630-639	3	3	0	-	-
62	Other Complications of Pregnancy, Childbirth, and the Peurperium	640-676	56	41	15	73.2	26.8
63	Congenital Anomalies	740-759	1,990	1,494	496	75.1	24.9
	Certain Conditions Originating in the Perinatal Period*	760-779	2,194	1,468	726	66.9	33.1
64	Birth Trauma, Intrauterine Hypoxia, Birth Asphyxia, and Respiratory Distress Syndrome	767-769	387	220	167	56.8	43.2
65	Other Conditions Originating in the Perinatal Period	760-766, 770-779	2,158	1,248	910	57.8	42.2
66	Symptoms, Signs, and Ill-Defined Conditions	780-799	51,083	2,399	48,684	4.7	95.3
67	All Other Diseases	240-246, 251-259, 270-279, 286-319, 323-326, 330-337, 340-389, 451-465, 467-479, 497-530, 534-539, 554-559, 561-570, 572-573, 576-579, 591-599, 601-629, 680-739	71,120	17,513	53,607	24.6	75.4
	Accidents and Adverse Effects*	E800-E949	14,545	9,253	5,292	63.6	36.4
68	Motor Vehicle Accidents	E810-E825	4,491	4,439	52	98.8	1.2
69	All Other Accidents and Adverse Effects	E800-E807, E826-E949	10,099	4,814	5,285	47.7	52.3
70	Suicide	E950-E959	3,703	3,694	9	99.8	0.2
71	Homicide and Legal Intervention	E960-E978	3,670	3,649	21	99.4	0.6
72	All Other External Causes	E980-E999	197	172	25	87.3	12.7
	Acquired Immune Deficiency Syndrome**	042-044	7,044	6,455	589	91.6	8.4
	Alzheimer's Disease**	331.0	4,372	1,720	2,652	39.3	60.7
	Injury by Firearms**	E922, E955.0-E955.4, E965.0-E965.4, E970, E985.0-E985.4	4,739	4,730	9	99.8	0.2
	Drug-Induced Deaths**	292, 304, 305.2-305.9, E850-E858, E950.0-E950.5, E962.0, E980.0-E980.5	3,088	2,317	771	75.0	25.0
	Alcohol-Induced Deaths**	291, 303, 305.0, 357.5, 425.5, 535.3, 571.0-571.3, 790.3, E860	4,032	4,032	0	100.0	0.0

* Additional categories that are not a part of NCHS' 72 cause of death groups.

** Included in selected categories within the NCHS' 72 cause of death groups.

[1] The seventy-seven categories include NCHS' 72 cause of death groups plus acquired immune deficiency syndrome, Alzheimer's disease, injury by fire-arms, drug-induced deaths, and alcohol-induced deaths.

[2] "Other than Underlying Cause" consists of the immediate, intermediate, and contributing causes of death.

[3] Percent not calculated for diagnostic conditions where "Any Mention" is less than 30 observations.

Source: National Center for Health Statistics, Multiple Cause of Death File, 1995

Table 3 shows the standard 72 group causes plus acquired immune deficiency syndrome, Alzheimer's disease, injury by firearms, drug-induced deaths, and alcohol-induced deaths ranked in descending order by the number of **underlying causes**. In the event of a tie, the causes are then ranked in descending order by **any mention**. The subtotals of the diagnostic categories presented in Table 2, which are not a part of the standard 72 group causes nor the 5 additional group causes, are excluded from this table (i.e., diseases of the heart, cerebrovascular diseases, etc.).

As shown in Table 3, the leading cause of death among California residents in 1995 was "old myocardial infarction/other chronic ischemic heart disease", which is a subcategory of diseases of the heart. A total of 28,308 persons died of this diagnostic condition or 11.6 percent of all deaths in California. Moreover, the number of deaths due to "old myocardial infarction/other chronic ischemic heart disease" was 57.8 percent higher than the second leading cause of death, acute myocardial infarction, which had 17,934 deaths. Like "old myocardial infarction/other chronic ischemic heart disease", acute myocardial infarction is also a subcategory of diseases of the heart. The third leading cause of death, all other diseases, encompasses all of the residual causes of death that are not mentioned in the other standard 71 causes of death. This group, however, does contain diseases such as multiple sclerosis, Huntington's chorea, Jakob-Creutzfeld disease, and Parkinson's disease to name a few well known but statistically less important diseases in terms of the number of deaths with which they are associated. The number of deaths due to all other diseases was 17,513. The diagnostic group, all other heart diseases, was the fourth leading cause with 16,452 deaths. The fifth and sixth leading causes of death were two different types of malignant neoplasms, "malignant neoplasms: respiratory/intrathoracic organs" with 14,225 deaths and "malignant neoplasms: digestive organs/peritoneum" with 12,439 deaths. The diagnostic group, "all other and late effects of cerebrovascular diseases", was the seventh leading cause of death with 12,224 deaths, while "pneumonia" was the eighth leading cause of death with 10,504 deaths. The ninth and tenth leading causes of death were "other chronic obstructive pulmonary diseases (C.O.P.D.) and allied conditions" and "all other infectious and parasitic diseases", which had 7,742 and 7,310 deaths respectively. This list of ten leading causes is considerably different than the traditional ten shown in Table 1A. For example, suicide and "homicide and legal intervention" are the ninth and tenth leading causes of death on Table 1A, whereas in Table 3, they are the twentieth and twenty-first leading causes of death.

Table 3 demonstrates that the grouping of ICD-9 codes into smaller diagnostic conditions, although based on **underlying cause** alone, has a marked effect on the ranking of the causes of death. In the discussion of Table 1C, a question was raised concerning the apparent relationship between the number of ICD-9 codes comprising a diagnostic condition and the number of deaths, in that conditions comprised of a greater number of ICD-9 codes will also experience a greater number of deaths. This assumption does not hold true in all cases as alluded to earlier. Among the standard 72 group causes, "old myocardial infarction/other chronic ischemic heart disease", which encompasses only two ICD-9 codes, was the number one cause of death in Table 3. Furthermore, the second ranked cause of death in Table 3, acute myocardial infarction, is comprised of only a single ICD-9 code.

TABLE 3

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA RESIDENTS, 1995

CAUSE OF DEATH IN DESCENDING ORDER BY THE NUMBER OF DEATHS FOR UNDERLYING CAUSE

RANK	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION[3]	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
	Total, 72 Selected Causes	001-799, E800-E999	615,811	243,459	372,352	39.5	60.5
1	Old Myocardial Infarction/Other Chronic Ischemic Heart Disease	412, 414	49,532	28,308	21,224	57.2	42.8
2	Acute Myocardial Infarction	410	20,358	17,934	2,424	88.1	11.9
3	All Other Diseases	240-246, ... , 680-739	71,120	17,513	53,607	24.6	75.4
4	All Other Heart Diseases	415-423, 425-429	97,568	16,452	81,116	16.9	83.1
5	Malignant Neoplasms: Respiratory/Intrathoracic Organs	160-165	15,663	14,225	1,438	90.8	9.2
6	Malignant Neoplasms: Digestive Organs/Peritoneum	150-159	14,201	12,439	1,762	87.6	12.4
7	All Other and Late Effects of Cerebrovascular Diseases	430, 433, 435-438	24,486	12,224	12,262	49.9	50.1
8	Pneumonia	480-486	25,234	10,504	14,730	41.6	58.4
9	Other C.O.P.D. and Allied Conditions	494-496	19,051	7,742	11,309	40.6	59.4
10	All Other Infectious and Parasitic Diseases	001-003, ... , 098-139	8,504	7,310	1,194	86.0	14.0
11	Acquired Immune Deficiency Syndrome**	042-044	7,044	6,455	589	91.6	8.4
12	Malignant Neoplasms: All Other & Unspecified Sites	170-173, 190-199	17,384	6,360	11,024	36.6	63.4
13	Malignant Neoplasms: Genital Organs	179-187	8,050	5,807	2,243	72.1	27.9
14	Diabetes Mellitus	250	20,523	5,104	15,419	24.9	75.1
15	All Other Accidents and Adverse Effects	E800-E807, E826-E949	10,099	4,814	5,285	47.7	52.3
16	Injury by Firearms**	E922, ... , E985.0-E985.4	4,739	4,730	9	99.8	0.2
17	Motor Vehicle Accidents	E810-E825	4,491	4,439	52	98.8	1.2
18	Malignant Neoplasms: Breast	174-175	5,335	4,290	1,045	80.4	19.6
19	Alcohol-Induced Deaths**	291, ... , E860	4,032	4,032	0	100.0	0.0
20	Suicide	E950-E959	3,703	3,694	9	99.8	0.2
21	Homicide and Legal Intervention	E960-E978	3,670	3,649	21	99.4	0.6
22	Chronic Liver Disease and Cirrhosis	571	6,133	3,564	2,569	58.1	41.9
23	Other Malignant Neoplasms of Lymphatic and Hematopoietic Tissues	200-203	4,252	3,277	975	77.1	22.9
24	Hypertensive Heart Disease	402	4,730	3,028	1,702	64.0	36.0
25	Intracerebral and Other Intracranial Hemorrhage	431-432	3,629	2,538	1,091	69.9	30.1
26	Symptoms, Signs, and Ill-Defined Conditions	780-799	51,083	2,399	48,684	4.7	95.3
27	Other Diseases of Arteries, Arterioles, and Capillaries	441-448	5,317	2,341	2,976	44.0	56.0
28	Drug-Induced Deaths**	292, ... , E980.0-E980.5	3,088	2,317	771	75.0	25.0
29	Malignant Neoplasms: Urinary Organs	188-189	2,739	2,108	631	77.0	23.0
30	Leukemia	204-208	2,547	1,997	550	78.4	21.6
31	Emphysema	492	4,233	1,974	2,259	46.6	53.4
32	Atherosclerosis	440	10,997	1,936	9,061	17.6	82.4
33	Alzheimer's Disease**	331.0	4,372	1,720	2,652	39.3	60.7
34	Other Diseases of Endocardium	424	4,091	1,654	2,437	40.4	59.6
35	Congenital Anomalies	740-759	1,990	1,494	496	75.1	24.9
36	Cerebral Thrombosis/Unspecified Occlusion of Cerebral Arteries	434.0, 434.9	2,521	1,415	1,106	56.1	43.9
37	Hypertension with or without Renal Disease	401, 403	20,650	1,376	19,274	6.7	93.3
38	Other Conditions Originating in the Perinatal Period	760-766, 770-779	2,158	1,248	910	57.8	42.2
39	Renal Failure, Disorders Resulting From Impaired Renal Function	584-586, 588-589	12,554	982	11,572	7.8	92.2
40	Malignant Neoplasms: Lip/Oral/Pharynx	140-149	1,182	920	262	77.8	22.2
41	Ulcer of Stomach and Duodenum	531-533	2,129	820	1,309	38.5	61.5
42	Asthma	493	1,494	652	842	43.6	56.4

TABLE 3 (continued)

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA RESIDENTS, 1995

CAUSE OF DEATH IN DESCENDING ORDER BY THE NUMBER OF DEATHS FOR UNDERLYING CAUSE

RANK	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION[3]	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
43	Benign, Carcinoma In Situ, and Uncertain Neoplasms	210-239	1,364	605	759	44.4	55.6
44	Viral Hepatitis	070	1,086	605	481	55.7	44.3
45	Rheumatic Fever and Rheumatic Heart Disease	390-398	1,158	543	615	46.9	53.1
46	Hernia and Intestinal Obstruction without Mention of Hernia	550-553, 560	1,961	520	1,441	26.5	73.5
47	Septicemia	038	8,962	446	8,516	5.0	95.0
48	Bronchitis, Chronic and Unspecified	490-491	888	424	464	47.7	52.3
49	Hypertensive Heart and Renal Disease	404	477	310	167	65.0	35.0
50	Cholelithiasis and Other Disorders of Gallbladder	574-575	720	306	414	42.5	57.5
51	Anemias	280-285	5,022	255	4,767	5.1	94.9
52	Birth Trauma/Intrauterine Hypoxia/Asphyxia/Respiratory Distress	767-769	387	220	167	56.8	43.2
53	All Other External Causes	E980-E999	197	172	25	87.3	12.7
54	Chronic Glomerulonephritis/Nephritis/Nephropathy/Renal Sclerosis	582-583, 587	592	160	432	27.0	73.0
55	Respiratory Tuberculosis	010-012	349	152	197	43.6	56.4
56	Infections of Kidney	590	295	148	147	50.2	49.8
57	Nutritional Deficiencies	260-269	3,279	128	3,151	3.9	96.1
58	Certain Other Intestinal Infections	007-009	164	97	67	59.1	40.9
59	Meningitis	320-322	218	74	144	33.9	66.1
60	Cerebral Embolism	434.1	245	62	183	25.3	74.7
61	Hyperplasia of Prostate	600	288	57	231	19.8	80.2
62	Other Acute and Subacute Forms of Ischemic Heart Disease	411	343	52	291	15.2	84.8
63	Influenza	487	81	52	29	64.2	35.8
64	Acute Bronchitis and Bronchiolitis	466	201	50	151	24.9	75.1
65	Angina Pectoris	413	373	48	325	12.9	87.1
66	Appendicitis	540-543	105	47	58	44.8	55.2
67	Other Tuberculosis (Not Respiratory)	013-018	126	42	84	33.3	66.7
68	Other Complications of Pregnancy, Childbirth, and the Peurperium	640-676	56	41	15	73.2	26.8
69	Meningococcal Infection	036	34	32	2	94.1	5.9
70	Acute Glomerulonephritis and Nephrotic Syndrome	580-581	127	19	108	15.0	85.0
71	Syphilis	090-097	28	4	24	-	-
72	Shigellosis & Amebiasis	004, 006	9	3	6	-	-
73	Whooping Cough	033	3	3	0	-	-
74	Pregnancy With Abortive Outcome	630-639	3	3	0	-	-
75	Strep Throat/Scarlatina/Erysipelas	034-035	2	1	1	-	-
76	Measles	055	1	1	0	-	-
77	Acute Poliomyelitis	045	0	0	0	-	-

** Included in selected categories within the NCHS' 72 cause of death groups.

[1] The seventy-seven categories include NCHS' 72 cause of death groups plus acquired immune deficiency syndrome, Alzheimer's disease, injury by fire-arms, drug-induced deaths, and alcohol-induced deaths.

[2] "Other than Underlying Cause" consists of the immediate, intermediate, and contributing causes of death.

[3] Percent not calculated for diagnostic conditions where "Any Mention" is less than 30 observations.

Source: National Center for Health Statistics, Multiple Cause of Death File, 1995.

Tables 4A and 4B respectively show the 77 group causes of death in descending order by the percent of **underlying cause** and the **other than underlying cause** relative to the total number of *any mention*. In the event of a tie, the causes are then ranked in descending order by **any mention**. As shown in Table 4A, all of the alcohol-induced deaths were assigned as the **underlying cause** of death, and as a result, it was the diagnostic condition with the highest proportion of *any mention* assigned as the **underlying cause** (100.0 percent). Injury by firearms and suicide were tied for the second highest proportion (99.8 percent) of *any mention* assigned as the **underlying cause**. However, suicide was the highest percentage of *any mention* assigned as the **underlying cause** among the standard 72 group causes, which excludes alcohol-induced deaths and injury by firearms. Other diagnostic conditions with 90 percent or more of their *any mention* assigned as the **underlying cause** include: homicide and legal intervention (99.4 percent); motor vehicle accidents (98.8 percent); meningococcal infection (94.1 percent); acquired immune deficiency syndrome (91.6 percent); and "malignant neoplasms: respiratory/intrathoracic organs" (90.8 percent). At the other extreme, the diagnostic condition in Table 4B with the highest proportion of *any mention* assigned as the **other than underlying cause** was nutritional deficiencies at 96.1 percent. Other diagnostic conditions with 90 percent or more of their *any mention* assigned as the **other than underlying cause** include: symptoms, signs, and ill-defined conditions (95.3 percent); septicemia (95.0 percent); anemias (94.9 percent); hypertension with or without renal disease (93.3 percent); and renal failure, disorders resulting from impaired renal function (92.2 percent). Most of the deaths due to these diagnostic conditions appear to merely go along with some other more definite cause, which is ultimately selected as the **underlying cause** of death.

Interesting questions can be raised concerning the data presented in Tables 4A and 4B. In the assignment of the underlying cause by the ACME program from the multiple causes listed on the death certificate, a few categories appear to be equitable in terms of whether or not they are assigned as the **underlying cause** or remain as an **other than underlying cause**. The diagnostic conditions that meet this criterion are those that have between 45 and 55 percent of their any mention assigned as the **underlying cause**. The following are the diagnostic conditions that meet this criterion: infections of the kidney; all other and late effects of cerebrovascular diseases; bronchitis, chronic and unspecified; all other accidents and adverse effects; rheumatic fever and rheumatic heart disease; and emphysema. This leads to the question: how can some diagnostic conditions be selected equally as either an **underlying cause** or as an **other than underlying cause**? A subsequent implied question is: why are some diagnostic conditions assigned more frequently as an underlying cause, while others are more often assigned as an **other than underlying cause**? For example, acquired immune deficiency syndrome is an **underlying cause** in 91.6 percent of the deaths in which that diagnostic condition is mentioned. In contrast, septicemia is an **underlying cause** in only 5.0 percent of the deaths in which that diagnostic condition is mentioned.

Questions like these have been raised by previous researchers.[5,16] The only brief answer lies in the fact that the constellation of diagnostic conditions on a death certificate affects the selection of a particular single diagnosis as the **underlying cause**. However, it is interesting that some diagnostic conditions are disproportionately selected as an **underlying cause,** regardless of the other multiple causes listed on the death certificate, whereas other diagnostic conditions are rarely selected as the **underlying cause**.

TABLE 4A

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1]
BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]
CALIFORNIA RESIDENTS, 1995

CAUSE OF DEATH IN DESCENDING ORDER BY THE PERCENT OF DEATHS FOR UNDERLYING CAUSE

RANK	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION[3]	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
	Total, 72 Selected Causes	001-799, E800-E999	533,859	245,310	288,549	46.0	54.0
1	Alcohol-Induced Deaths**	291, . . . , E860	4,032	4,032	0	100.0	0.0
2	Injury by Firearms**	E922, . . . , E985.0-E985.4	4,739	4,730	9	99.8	0.2
3	Suicide	E950-E959	3,703	3,694	9	99.8	0.2
4	Homicide and Legal Intervention	E960-E978	3,670	3,649	21	99.4	0.6
5	Motor Vehicle Accidents	E810-E825	4,491	4,439	52	98.8	1.2
6	Meningococcal Infection	036	34	32	2	94.1	5.9
7	Acquired Immune Deficiency Syndrome**	042-044	7,044	6,455	589	91.6	8.4
8	Malignant Neoplasms: Respiratory/Intrathoracic Organs	160-165	15,663	14,225	1,438	90.8	9.2
9	Acute Myocardial Infarction	410	20,356	17,934	2,424	88.1	11.9
10	Malignant Neoplasms: Digestive Organs/Peritoneum	150-159	14,201	12,439	1,762	87.6	12.4
11	All Other External Causes	E980-E999	197	172	25	87.3	12.7
12	All Other Infectious and Parasitic Diseases	001-003, . . . , 098-139	8,504	7,310	1,194	86.0	14.0
13	Malignant Neoplasms: Breast	174-175	5,335	4,290	1,045	80.4	19.6
14	Leukemia	204-208	2,547	1,997	550	78.4	21.6
15	Malignant Neoplasms: Lip/Oral/Pharynx	140-149	1,182	920	262	77.8	22.2
16	Other Malignant Neoplasms of Lymphatic and Hematopoietic Tissues	200-203	4,252	3,277	975	77.1	22.9
17	Malignant Neoplasms: Urinary Organs	188-189	2,739	2,108	631	77.0	23.0
18	Congenital Anomalies	740-759	1,990	1,494	496	75.1	24.9
19	Drug-Induced Deaths**	292, . . . , E980.0-E980.5	3,088	2,317	771	75.0	25.0
20	Other Complications of Pregnancy, Childbirth, and the Peurperium	640-676	56	41	15	73.2	26.8
21	Malignant Neoplasms: Genital Organs	179-187	8,050	5,807	2,243	72.1	27.9
22	Intracerebral and Other Intracranial Hemorrhage	431-432	3,629	2,538	1,091	69.9	30.1
23	Hypertensive Heart and Renal Disease	404	477	310	167	65.0	35.0
24	Influenza	487	81	52	29	64.2	35.8
25	Hypertensive Heart Disease	402	4,730	3,028	1,702	64.0	36.0
26	Certain Other Intestinal Infections	007-009	164	97	67	59.1	40.9
27	Chronic Liver Disease and Cirrhosis	571	6,133	3,564	2,569	58.1	41.9
28	Other Conditions Originating in the Perinatal Period	760-766, 770-779	2,158	1,248	910	57.8	42.2
29	Old Myocardial Infarction/Other Chronic Ischemic Heart Disease	412, 414	49,532	28,308	21,224	57.2	42.8
30	Birth Trauma/Intrauterine Hypoxia/Asphyxia/Respiratory Distress	767-769	387	220	167	56.8	43.2
31	Cerebral Thrombosis/Unspecified Occlusion of Cerebral Arteries	434.0, 434.9	2,521	1,415	1,106	56.1	43.9
32	Viral Hepatitis	070	1,086	605	481	55.7	44.3
33	Infections of Kidney	590	295	148	147	50.2	49.8
34	All Other and Late Effects of Cerebrovascular Diseases	430, 433, 435-438	24,486	12,224	12,262	49.9	50.1
35	Bronchitis, Chronic and Unspecified	490-491	888	424	464	47.7	52.3
36	All Other Accidents and Adverse Effects	E800-E807, E826-E949	10,099	4,814	5,285	47.7	52.3
37	Rheumatic Fever and Rheumatic Heart Disease	390-398	1,158	543	615	46.9	53.1
38	Emphysema	492	4,233	1,974	2,259	46.6	53.4
39	Appendicitis	540-543	105	47	58	44.8	55.2
40	Benign, Carcinoma In Situ, and Uncertain Neoplasms	210-239	1,364	605	759	44.4	55.6
41	Other Diseases of Arteries, Arterioles, and Capillaries	441-448	5,317	2,341	2,976	44.0	56.0
42	Asthma	493	1,494	652	842	43.6	56.4

TABLE 4A (continued)

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA RESIDENTS, 1995

CAUSE OF DEATH IN DESCENDING ORDER BY THE PERCENT OF DEATHS FOR UNDERLYING CAUSE

RANK	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION[3]	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
43	Respiratory Tuberculosis	010-012	349	152	197	43.6	56.4
44	Cholelithiasis and Other Disorders of Gallbladder	574-575	720	306	414	42.5	57.5
45	Pneumonia	480-486	25,234	10,504	14,730	41.6	58.4
46	Other C.O.P.D. and Allied Conditions	494-496	19,051	7,742	11,309	40.6	59.4
47	Other Diseases of Endocardium	424	4,091	1,654	2,437	40.4	59.6
48	Alzheimer's Disease**	331.0	4,372	1,720	2,652	39.3	60.7
49	Ulcer of Stomach and Duodenum	531-533	2,129	820	1,309	38.5	61.5
50	Malignant Neoplasms: All Other & Unspecified Sites	170-173, 190-199	17,384	6,360	11,024	36.6	63.4
51	Meningitis	320-322	218	74	144	33.9	66.1
52	Other Tuberculosis (Not Respiratory)	013-018	126	42	84	33.3	66.7
53	Chronic Glomerulonephritis/Nephritis/Nephropathy/Renal Sclerosis	582-583, 587	592	160	432	27.0	73.0
54	Hernia and Intestinal Obstruction without Mention of Hernia	550-553, 560	1,961	520	1,441	26.5	73.5
55	Cerebral Embolism	434.1	245	62	183	25.3	74.7
56	Acute Bronchitis and Bronchiolitis	466	201	50	151	24.9	75.1
57	Diabetes Mellitus	250	20,523	5,104	15,419	24.9	75.1
58	All Other Diseases	240-246, ..., 680-739	71,120	17,513	53,607	24.6	75.4
59	Hyperplasia of Prostate	600	288	57	231	19.8	80.2
60	Atherosclerosis	440	10,997	1,936	9,061	17.6	82.4
61	All Other Heart Diseases	415-423, 425-429	97,568	16,452	81,116	16.9	83.1
62	Other Acute and Subacute Forms of Ischemic Heart Disease	411	343	52	291	15.2	84.8
63	Acute Glomerulonephritis and Nephrotic Syndrome	580-581	127	19	108	15.0	85.0
64	Angina Pectoris	413	373	48	325	12.9	87.1
65	Renal Failure, Disorders Resulting From Impaired Renal Function	584-586, 588-589	12,554	982	11,572	7.8	92.2
66	Hypertension with or without Renal Disease	401, 403	20,650	1,376	19,274	6.7	93.3
67	Anemias	280-285	5,022	255	4,767	5.1	94.9
68	Septicemia	038	8,962	446	8,516	5.0	95.0
69	Symptoms, Signs, and Ill-Defined Conditions	780-799	51,083	2,399	48,684	4.7	95.3
70	Nutritional Deficiencies	260-269	3,279	128	3,151	3.9	96.1
71	Syphilis	090-097	28	4	24	-	-
72	Shigellosis & Amebiasis	004, 006	9	3	6	-	-
73	Whooping Cough	033	3	3	0	-	-
74	Pregnancy With Abortive Outcome	630-639	3	3	0	-	-
75	Strep Throat/Scarlatina/Erysipelas	034-035	2	1	1	-	-
76	Measles	055	1	1	0	-	-
77	Acute Poliomyelitis	045	0	0	0	-	-

** Included in selected categories within the NCHS' 72 cause of death groups.

[1] The seventy-seven categories include NCHS' 72 cause of death groups plus acquired immune deficiency syndrome, Alzheimer's disease, injury by fire-arms, drug-induced deaths, and alcohol-induced deaths.

[2] "Other than Underlying Cause" consists of the immediate, intermediate, and contributing causes of death.

[3] Percent not calculated for diagnostic conditions where "Any Mention" is less than 30 observations.

Source: National Center for Health Statistics, Multiple Cause of Death File, 1995.

TABLE 4B

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA RESIDENTS, 1995

CAUSE OF DEATH IN DESCENDING ORDER BY THE PERCENT OF DEATHS FOR OTHER THAN UNDERLYING CAUSE

RANK	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION[3]	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
	Total, 72 Selected Causes	001-799, E800-E999	615,811	243,459	372,352	39.5	60.5
1	Nutritional Deficiencies	260-269	3,279	128	3,151	3.9	96.1
2	Symptoms, Signs, and Ill-Defined Conditions	780-799	51,063	2,399	48,664	4.7	95.3
3	Septicemia	038	8,962	446	8,516	5.0	95.0
4	Anemias	280-285	5,022	255	4,767	5.1	94.9
5	Hypertension with or without Renal Disease	401, 403	20,650	1,376	19,274	6.7	93.3
6	Renal Failure, Disorders Resulting From Impaired Renal Function	584-586, 588-589	12,554	982	11,572	7.8	92.2
7	Angina Pectoris	413	373	48	325	12.9	87.1
8	Acute Glomerulonephritis and Nephrotic Syndrome	580-581	127	19	108	15.0	85.0
9	Other Acute and Subacute Forms of Ischemic Heart Disease	411	343	52	291	15.2	84.8
10	All Other Heart Diseases	415-423, 425-429	97,568	16,452	81,116	16.9	83.1
11	Atherosclerosis	440	10,997	1,936	9,061	17.6	82.4
12	Hyperplasia of Prostate	600	288	57	231	19.8	80.2
13	All Other Diseases	240-246, . . . , 680-739	71,120	17,513	53,607	24.6	75.4
14	Diabetes Mellitus	250	20,523	5,104	15,419	24.9	75.1
15	Acute Bronchitis and Bronchiolitis	466	201	50	151	24.9	75.1
16	Cerebral Embolism	434.1	245	62	183	25.3	74.7
17	Hernia and Intestinal Obstruction without Mention of Hernia	550-553, 560	1,961	520	1,441	26.5	73.5
18	Chronic Glomerulonephritis/Nephritis/Nephropathy/Renal Sclerosis	582-583, 587	592	160	432	27.0	73.0
19	Other Tuberculosis (Not Respiratory)	013-018	126	42	84	33.3	66.7
20	Meningitis	320-322	218	74	144	33.9	66.1
21	Malignant Neoplasms: All Other & Unspecified Sites	170-173, 190-199	17,384	6,360	11,024	36.6	63.4
22	Ulcer of Stomach and Duodenum	531-533	2,129	820	1,309	38.5	61.5
23	Alzheimer's Disease*^	331.0	4,372	1,720	2,652	39.3	60.7
24	Other Diseases of Endocardium	424	4,091	1,654	2,437	40.4	59.6
25	Other C.O.P.D. and Allied Conditions	494-496	19,051	7,742	11,309	40.6	59.4
26	Pneumonia	480-486	25,234	10,504	14,730	41.6	58.4
27	Cholelithiasis and Other Disorders of Gallbladder	574-575	720	306	414	42.5	57.5
28	Respiratory Tuberculosis	010-012	349	152	197	43.6	56.4
29	Asthma	493	1,494	652	842	43.6	56.4
30	Other Diseases of Arteries, Arterioles, and Capillaries	441-448	5,317	2,341	2,976	44.0	56.0
31	Benign, Carcinoma In Situ, and Uncertain Neoplasms	210-239	1,364	605	759	44.4	55.6
32	Appendicitis	540-543	105	47	58	44.8	55.2
33	Emphysema	492	4,233	1,974	2,259	46.6	53.4
34	Rheumatic Fever and Rheumatic Heart Disease	390-398	1,158	543	615	46.9	53.1
35	All Other Accidents and Adverse Effects	E800-E807, E826-E949	10,099	4,814	5,285	47.7	52.3
36	Bronchitis, Chronic and Unspecified	490-491	888	424	464	47.7	52.3
37	All Other and Late Effects of Cerebrovascular Diseases	430, 433, 435-438	24,486	12,224	12,262	49.9	50.1
38	Infections of Kidney	590	295	148	147	50.2	49.8
39	Viral Hepatitis	070	1,086	605	481	55.7	44.3
40	Cerebral Thrombosis/Unspecified Occlusion of Cerebral Arteries	434.0, 434.9	2,521	1,415	1,106	56.1	43.9
41	Birth Trauma/Intrauterine Hypoxia/Asphyxia/Respiratory Distress	767-769	387	220	167	56.8	43.2
42	Old Myocardial Infarction/Other Chronic Ischemic Heart Disease	412, 414	49,532	28,308	21,224	57.2	42.8

TABLE 4B (continued)

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA RESIDENTS, 1995

CAUSE OF DEATH IN DESCENDING ORDER BY THE PERCENT OF DEATHS FOR OTHER THAN UNDERLYING CAUSE

RANK	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION[3]	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
43	Other Conditions Originating in the Perinatal Period	760-766, 770-779	2,158	1,248	910	57.8	42.2
44	Chronic Liver Disease and Cirrhosis	571	6,133	3,564	2,569	58.1	41.9
45	Certain Other Intestinal Infections	007-009	164	97	67	59.1	40.9
46	Hypertensive Heart Disease	402	4,730	3,028	1,702	64.0	36.0
47	Influenza	487	81	52	29	64.2	35.8
48	Hypertensive Heart and Renal Disease	404	477	310	167	65.0	35.0
49	Intracerebral and Other Intracranial Hemorrhage	431-432	3,629	2,538	1,091	69.9	30.1
50	Malignant Neoplasms: Genital Organs	179-187	8,050	5,807	2,243	72.1	27.9
51	Other Complications of Pregnancy, Childbirth, and the Peurperium	640-676	56	41	15	73.2	26.8
52	Drug-Induced Deaths**	292, . . . , E980.0-E980.5	3,088	2,317	771	75.0	25.0
53	Congenital Anomalies	740-759	1,990	1,494	496	75.1	24.9
54	Malignant Neoplasms: Urinary Organs	188-189	2,739	2,108	631	77.0	23.0
55	Other Malignant Neoplasms of Lymphatic and Hematopoietic Tissues	200-203	4,252	3,277	975	77.1	22.9
56	Malignant Neoplasms: Lip/Oral/Pharynx	140-149	1,182	920	262	77.8	22.2
57	Leukemia	204-208	2,547	1,997	550	78.4	21.6
58	Malignant Neoplasms: Breast	174-175	5,335	4,290	1,045	80.4	19.6
59	All Other Infectious and Parasitic Diseases	001-003, . . . , 098-139	8,504	7,310	1,194	86.0	14.0
60	All Other External Causes	E980-E999	197	172	25	87.3	12.7
61	Malignant Neoplasms: Digestive Organs/Peritoneum	150-159	14,201	12,439	1,762	87.6	12.4
62	Acute Myocardial Infarction	410	20,358	17,934	2,424	88.1	11.9
63	Malignant Neoplasms: Respiratory/Intrathoracic Organs	160-165	15,663	14,225	1,438	90.8	9.2
64	Acquired Immune Deficiency Syndrome**	042-044	7,044	6,455	589	91.6	8.4
65	Meningococcal Infection	036	34	32	2	94.1	5.9
66	Motor Vehicle Accidents	E810-E825	4,491	4,439	52	98.8	1.2
67	Homicide and Legal Intervention	E960-E978	3,670	3,649	21	99.4	0.6
68	Suicide	E950-E959	3,703	3,694	9	99.8	0.2
69	Injury by Firearms**	E922, . . . , E965.0-E965.4	4,739	4,730	9	99.8	0.2
70	Alcohol-Induced Deaths**	291, . . . , E860	4,032	4,032	0	100.0	0.0
71	Syphilis	090-097	28	4	24	-	-
72	Shigellosis & Amebiasis	004, 006	9	3	6	-	-
73	Whooping Cough	033	3	3	0	-	-
74	Pregnancy With Abortive Outcome	630-639	3	3	0	-	-
75	Strep Throat/Scarlatina/Erysipelas	034-035	2	1	1	-	-
76	Measles	055	1	1	0	-	-
77	Acute Poliomyelitis	045	0	0	0	-	-

** Included in selected categories within the NCHS' 72 cause of death groups.

[1] The seventy-seven categories include NCHS' 72 cause of death groups plus acquired immune deficiency syndrome, Alzheimer's disease, injury by fire-arms, drug-induced deaths, and alcohol-induced deaths.

[2] "Other than Underlying Cause" consists of the immediate, intermediate, and contributing causes of death.

[3] Percent not calculated for diagnostic conditions where "Any Mention" is less than 30 observations.

Source: National Center for Health Statistics, Multiple Cause of Death File, 1995.

A substantial amount of pertinent information is excluded when analyzing a diagnostic condition using only the **underlying cause** of death, and disregarding the **other than underlying cause**. As a means of circumventing this problem, Table 5 represents an alternative view of "the cause of death". This table shows in descending rank order the number of **any mention** of a diagnosis for the standard 72 group causes of death plus the 5 additional group causes. **Any mention** is a compilation of the number of **underlying causes** and the **other than underlying causes of death**, which are each mutually exclusive of one another. As a result, the number of deaths due to a specific diagnostic condition can be studied without the burden of having to select either the **underlying cause** or the **other than underlying cause** as the basis for the analysis.

As shown in Table 5, the leading cause of death due to **any mention** of a diagnostic condition was all other heart diseases, which accounted for 97,568 deaths or 40.0 percent of the 243,459 deaths in 1995. Furthermore, this diagnostic category was assigned as the **other than underlying cause** approximately 5 times more than as an **underlying cause**. The second leading cause of death due to **any mention** was all other diseases. This category, as stated earlier in Table 3, contains a collection of various causes not necessarily related to one another. Nevertheless, it is a category that accounted for 71,120 deaths or 29.2 percent of the total number of deaths in California. All other diseases were assigned as the **other than underlying cause** approximately 3 times more than as an **underlying cause**. Symptoms, signs, and ill-defined conditions ranked third and accounted for 51,083 deaths or 20.9 percent of the total number of deaths. This category was assigned as the **other than underlying cause** 95.3 percent of the time, or 20 times more than the **underlying cause**. Due to this factor, symptoms, signs, and ill-defined conditions failed to make the list of the traditional ten leading causes of death in Table 1A. However, this diagnostic condition can still be considered as an important cause of death if analyzed from the **any mention** point of view. The fourth, fifth, and sixth leading causes of death due to **any mention** were "old myocardial infarction/other chronic ischemic heart disease", pneumonia, and "all other and late effects of cerebrovascular diseases", which accounted for 49,532, 25,234, and 24,486 deaths respectively. The proportion of deaths assigned as an **underlying cause** and as the **other than underlying cause** was relatively the same for all three of these diagnostic conditions. Hypertension with or without renal disease and diabetes mellitus ranked as the seventh and eighth leading cause of death due to **any mention**, and accounted for 20,650 and 20,523 deaths respectively. These two diagnostic conditions are similar to symptoms, signs, and ill-defined conditions, in that most of the deaths due to **any mention** of these conditions were assigned as the **other than underlying cause** (93.3 percent for hypertension with or without renal disease, and 75.1 percent for diabetes mellitus). Unlike symptoms, signs, and ill-defined conditions, diabetes mellitus did make the list of the traditional ten leading causes of death in Table 1A despite the fact that the majority of deaths involving **any mention** of this condition were assigned as the **other than underlying cause**. The ninth leading cause of death due to **any mention** was acute myocardial infarction, which accounted for 20,358 deaths. This diagnostic condition appears to be an excellent example of an archetypical "leading cause of death" because only a single ICD-9 code makes up this category, and over 85 percent of **any mention** of this diagnostic condition is an **underlying cause**. This is probably what most people have in mind when describing a leading cause of death, albeit most group causes of death do not meet the criteria. Consequently, the study of causes of death, including the study of multiple causes, is neither simple nor straightforward. Finally, the tenth leading cause of death due to **any mention** was "other C.O.P.D. and allied conditions", which accounted for 19,051 deaths or 7.8 percent of the total number of deaths in California.

TABLE 5

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA RESIDENTS, 1995

CAUSE OF DEATH IN DESCENDING ORDER BY THE NUMBER OF DEATHS FOR ANY MENTION

RANK	CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	NUMBER OF DEATHS			PERCENT OF ANY MENTION[3]	
			ANY MENTION	UNDERLYING CAUSE	OTHER THAN UNDERLYING	UNDERLYING CAUSE	OTHER THAN UNDERLYING
	Total, 72 Selected Causes	001-799, E800-E999	615,811	243,459	372,352	39.5	60.5
1	All Other Heart Diseases	415-423, 425-429	97,568	16,452	81,116	16.9	83.1
2	All Other Diseases	240-246, . . . , 680-739	71,120	17,513	53,607	24.6	75.4
3	Symptoms, Signs, and Ill-Defined Conditions	780-799	51,083	2,399	48,684	4.7	95.3
4	Old Myocardial Infarction/Other Chronic Ischemic Heart Disease	412, 414	49,532	28,308	21,224	57.2	42.8
5	Pneumonia	480-486	25,234	10,504	14,730	41.6	58.4
6	All Other and Late Effects of Cerebrovascular Diseases	430, 433, 435-438	24,486	12,224	12,262	49.9	50.1
7	Hypertension with or without Renal Disease	401, 403	20,650	1,376	19,274	6.7	93.3
8	Diabetes Mellitus	250	20,523	5,104	15,419	24.9	75.1
9	Acute Myocardial Infarction	410	20,358	17,934	2,424	88.1	11.9
10	Other C.O.P.D. and Allied Conditions	494-496	19,051	7,742	11,309	40.6	59.4
11	Malignant Neoplasms: All Other & Unspecified Sites	170-173, 190-199	17,384	6,360	11,024	36.6	63.4
12	Malignant Neoplasms: Respiratory/Intrathoracic Organs	160-165	15,663	14,225	1,438	90.8	9.2
13	Malignant Neoplasms: Digestive Organs/Peritoneum	150-159	14,201	12,439	1,762	87.6	12.4
14	Renal Failure, Disorders Resulting From Impaired Renal Function	584-586, 588-589	12,554	982	11,572	7.8	92.2
15	Atherosclerosis	440	10,997	1,936	9,061	17.6	82.4
16	All Other Accidents and Adverse Effects	E800-E807, E826-E949	10,099	4,814	5,285	47.7	52.3
17	Septicemia	038	8,962	446	8,516	5.0	95.0
18	All Other Infectious and Parasitic Diseases	001-003, . . . , 098-139	8,504	7,310	1,194	86.0	14.0
19	Malignant Neoplasms: Genital Organs	179-187	8,050	5,807	2,243	72.1	27.9
20	Acquired Immune Deficiency Syndrome**	042-044	7,044	6,455	589	91.6	8.4
21	Chronic Liver Disease and Cirrhosis	571	6,133	3,564	2,569	58.1	41.9
22	Malignant Neoplasms: Breast	174-175	5,335	4,290	1,045	80.4	19.6
23	Other Diseases of Arteries, Arterioles, and Capillaries	441-448	5,317	2,341	2,976	44.0	56.0
24	Anemias	280-285	5,022	255	4,767	5.1	94.9
25	Injury by Firearms**	E922, . . . , E985.0-E985.4	4,739	4,730	9	99.8	0.2
26	Hypertensive Heart Disease	402	4,730	3,028	1,702	64.0	36.0
27	Motor Vehicle Accidents	E810-E825	4,491	4,439	52	98.8	1.2
28	Alzheimer's Disease**	331.0	4,372	1,720	2,652	39.3	60.7
29	Other Malignant Neoplasms of Lymphatic and Hematopoietic Tissues	200-203	4,252	3,277	975	77.1	22.9
30	Emphysema	492	4,233	1,974	2,259	46.6	53.4
31	Other Diseases of Endocardium	424	4,091	1,654	2,437	40.4	59.6
32	Alcohol-Induced Deaths**	291, . . . , E860	4,032	4,032	0	100.0	0.0
33	Suicide	E950-E959	3,703	3,694	9	99.8	0.2
34	Homicide and Legal Intervention	E960-E978	3,670	3,649	21	99.4	0.6
35	Intracerebral and Other Intracranial Hemorrhage	431-432	3,629	2,538	1,091	69.9	30.1
36	Nutritional Deficiencies	260-269	3,279	128	3,151	3.9	96.1
37	Drug-Induced Deaths**	292, . . . , E980.0-E980.5	3,088	2,317	771	75.0	25.0
38	Malignant Neoplasms: Urinary Organs	188-189	2,739	2,108	631	77.0	23.0
39	Leukemia	204-208	2,547	1,997	550	78.4	21.6

State of California
Department of Health Services
Center for Health Statistics
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TABLE 5 (continued)

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1]

BY ANY MENTION OF CAUSE, UNDERLYING CAUSE, AND OTHER THAN UNDERLYING CAUSE[2]

CALIFORNIA RESIDENTS, 1995

CAUSE OF DEATH IN DESCENDING ORDER BY THE NUMBER OF DEATHS FOR ANY MENTION

The last table in this report, Table 6, summarizes the rank ordering of the 77 group causes. The rankings are based on the number of deaths by **any mention** and by the **underlying cause** as shown in Table 5 and Table 3 respectively. The group causes of death are in descending order by the number of **any mention**, and includes the corresponding rank for the **underlying cause**. Each method for ranking the causes of death portrays a different view of the important causes. For some diagnostic conditions, the difference is minimal between the two methods based on frequency of occurrence. For example, "all other and late effects of cerebrovascular diseases" is rank sixth as **any mention** of that cause and seventh as an **underlying cause**. Causes of death near the bottom of the list also tend to be similarly ranked by both methods. Examples of this latter case are whooping cough, strep throat/scarlatina/erysipelas, measles, and acute poliomyelitis.

In contrast, some causes of death vary markedly between the two methods. These causes tend to be those that have high proportions based on either the **underlying cause** or **other than the underlying cause** in relation to **any mention** of that diagnostic condition. For example, symptoms, signs, and ill-defined conditions is ranked third as **any mention** of that diagnostic condition and twenty-sixth as an **underlying cause**. Alcohol-induced deaths shows the opposite effect, and is ranked thirty-second as **any mention** of that diagnostic condition and nineteenth as an **underlying cause**. Although the rankings of some causes of death are markedly different between the frequencies of **any mention** and **underlying cause**, there is a greater correspondence among these ranks than what seems intuitively apparent.

Calculation of Spearman's Rank Correlation Coefficient is a statistical technique for quantifying how well two rankings agree. The rank order correlation of the 77 group causes by the two methods is +0.91. The possible range of values is from –1.00 to +1.00. These two extremes mean perfect negative correlation and perfect positive correlation, from complete opposition to complete congruence. No agreement at all would be signified by a value of 0.00. In this case, a value of +0.91 can be interpreted to mean that **any mention** and **underlying cause,** as sources of variation in the ranking of the 77 group causes, account for 82.8 percent of the variation and random effects account for only 17.2 percent. This indicates that the correspondence between the two ranks is high.

TABLE 6

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1] BY RANK AND NUMBER OF ANY MENTION OF CAUSE AND UNDERLYING CAUSE

CALIFORNIA RESIDENTS, 1995

CAUSE OF DEATH	INTERNATIONAL CLASSIFICATION OF DISEASES (9TH REVISION) CODE NUMBER	RANK		NUMBER OF DEATHS	
		ANY MENTION	UNDERLYING CAUSE	ANY MENTION	UNDERLYING CAUSE
Total, 72 Selected Causes	001-799, E800-E999			615,811	243,459
All Other Heart Diseases	415-423, 425-429	1	4	97,568	16,452
All Other Diseases	240-246, ... , 680-739	2	3	71,120	17,513
Symptoms, Signs, and Ill-Defined Conditions	780-799	3	26	51,083	2,399
Old Myocardial Infarction/Other Chronic Ischemic Heart Disease	412, 414	4	1	49,532	28,308
Pneumonia	480-486	5	8	25,234	10,504
All Other and Late Effects of Cerebrovascular Diseases	430, 433, 435-438	6	7	24,486	12,224
Hypertension with or without Renal Disease	401, 403	7	37	20,650	1,376
Diabetes Mellitus	250	8	14	20,523	5,104
Acute Myocardial Infarction	410	9	2	20,358	17,934
Other C.O.P.D. and Allied Conditions	494-496	10	9	19,051	7,742
Malignant Neoplasms: All Other & Unspecified Sites	170-173, 190-199	11	12	17,364	6,360
Malignant Neoplasms: Respiratory/Intrathoracic Organs	160-165	12	5	15,663	14,225
Malignant Neoplasms: Digestive Organs/Peritoneum	150-159	13	6	14,201	12,439
Renal Failure, Disorders Resulting From Impaired Renal Function	584-586, 588-589	14	39	12,554	982
Atherosclerosis	440	15	32	10,997	1,938
All Other Accidents and Adverse Effects	E800-E807, E826-E949	16	15	10,099	4,814
Septicemia	038	17	47	8,962	446
All Other Infectious and Parasitic Diseases	001-003, ... , 098-139	18	10	8,504	7,310
Malignant Neoplasms: Genital Organs	179-187	19	13	8,050	5,807
Acquired Immune Deficiency Syndrome**	042-044	20	11	7,044	6,455
Chronic Liver Disease and Cirrhosis	571	21	22	6,133	3,564
Malignant Neoplasms: Breast	174-175	22	18	5,335	4,290
Other Diseases of Arteries, Arterioles, and Capillaries	441-448	23	27	5,317	2,341
Anemias	280-285	24	51	5,022	255
Injury by Firearms**	E922, ... , E985.0-E985.4	25	16	4,739	4,730
Hypertensive Heart Disease	402	26	24	4,730	3,028
Motor Vehicle Accidents	E810-E825	27	17	4,491	4,439
Alzheimer's Disease**	331.0	28	33	4,372	1,720
Other Malignant Neoplasms of Lymphatic and Hematopoietic Tissues	200-203	29	23	4,252	3,277
Emphysema	492	30	31	4,233	1,974
Other Diseases of Endocardium	424	31	34	4,091	1,654
Alcohol-Induced Deaths**	291, ... , E860	32	19	4,032	4,032
Suicide	E950-E959	33	20	3,703	3,694
Homicide and Legal Intervention	E960-E978	34	21	3,670	3,649
Intracerebral and Other Intracranial Hemorrhage	431-432	35	25	3,629	2,538
Nutritional Deficiencies	260-269	36	57	3,279	128
Drug-Induced Deaths**	292, ... , E980.0-E980.5	37	28	3,088	2,317
Malignant Neoplasms: Urinary Organs	188-189	38	29	2,739	2,108
Leukemia	204-208	39	30	2,547	1,997
Cerebral Thrombosis/Unspecified Occlusion of Cerebral Arteries	434.0, 434.9	40	36	2,521	1,415

TABLE 6 (continued)

SELECTED CAUSES OF DEATH BASED ON SEVENTY-SEVEN CATEGORIES[1] BY RANK AND NUMBER OF ANY MENTION OF CAUSE AND UNDERLYING CAUSE

CALIFORNIA RESIDENTS, 1995

CONCLUSION

Analysis of death data by **any mention** of a diagnostic condition, rather than the **underlying cause** avoids some of the problems inherent in selecting one diagnosis from several multiple causes of death. The importance of a diagnostic condition and its ranking as a leading cause of death need not depend on arbitrary selection procedures that force the assignment of only a single diagnostic condition as the **underlying cause** of death.

Any list of leading causes of death depends not so much on the raw "facts", but on how the facts are organized. One expected source of variation is the manner in which the diagnostic conditions are grouped to comprise categories of diseases and injuries. Categories consisting of many ICD-9 codes tend to be reported among "the leading causes of death", but not always. When other diagnostic categories are constructed in which several ICD-9 codes are combined, such as diseases of the digestive system, then a rearrangement of the more traditional ordering of the leading causes of death occurs.

The leading causes of death, no matter how constructed, tend to be some type of heart disease. The traditional method, which utilizes the **underlying cause**, ranks the subcategory diseases of the heart (ICD-9 codes 390-398, 402, 404-429) in first place. Analysis of the 77 group causes of death, which is an alternative scheme, shows "old myocardial infarction/other chronic ischemic heart disease" as the number one **underlying cause** of death. If the frequencies of **any mention** of a diagnostic condition are used, then the category, all other heart diseases (ICD-9 codes 415-423, 425-429), becomes rank one among the 77 group causes of death.

The ranking of **any mention** of a cause of death tends to emphasize those diagnoses that are important, but are not usually presented as one of the leading causes of death. However, some categories are important as both an **underlying cause** and as **any mention** of a cause. Some examples are:

ICD-9 Codes	Diagnostic Category
415-423, 425-429	all other heart diseases
412, 414	old myocardial infarction/other chronic ischemic heart disease
480-486	pneumonia
430, 433, 435-438	all other and late effects of cerebrovascular diseases

Future research should focus on questions, such as "what diagnostic conditions tend to be associated with other diagnostic conditions most frequently", and "what effects do diagnostic conditions which are disproportionately assigned as an **other than underlying cause** have upon the **underlying cause** of death?"

APPENDIX

I. Technical Note on Processing Multiple Causes of Death Records

A facsimile of the cause of death item from the California death certificate is depicted in Figure 3 below. As shown in Item 107, "Death Was Caused By", there are four lines available for recording up to four levels of causes: Line (A) "Immediate Cause"; Lines (B,C) "Intermediate Causes"; and Line (D) "Underlying Cause".

FIGURE 3

	107. DEATH WAS CAUSED BY: (ENTER ONLY ONE CAUSE PER LINE FOR A, B, C, AND D)		TIME INTERVAL BETWEEN ONSET AND DEATH
CAUSE OF DEATH	IMMEDIATE CAUSE	(A)	
	DUE TO	(B)	
	DUE TO	(C)	
	DUE TO	(D)	
	112. OTHER SIGNIFICANT CONDITIONS CONTRIBUTING TO DEATH BUT NOT RELATED TO CAUSE GIVEN IN 107		

Ideally, the sequence of events leading to death, in terms of diagnosable conditions, begins with one underlying cause. The underlying cause is considered to be the basic, primary, ultimate, or first cause, the single condition that initiates the dying process. It directly leads to the conditions recorded on Lines B and C, the intermediate causes, which in turn give rise to the immediate or proximal condition that occurs just prior to death, mentioned on Line A. Cause of death, in this scheme, is a chain of diagnoses that can be traced backward through time, from the condition immediately causing the death to the one condition underlying the process. The conceptual model implies the causes are a connected series of conditions which are linked together to describe the dying process. In addition, Item 112 on the death certificate, "Other Significant Conditions…", includes another dimension that can be used to mention one or more contributing cause or causes, which are not part of the linear chain of conditions leading to death. The conditions listed in Item 107 along with the conditions listed in Item 112 are used conjointly to determine the underlying cause of death.

From the diagnostic labels written on the death certificate by the physician or medical certifier, the nosologist determines the appropriate International Classification of Disease code (ICD-9) for each diagnostic label written on the four lines. All the diagnostic codes on the death certificate are entered into the electronic record so that whatever codes are on the death certificate are exactly reproduced on the data tape. Then, after considerable computer processing, an electronic record with as many as twenty separate ICD-9 codes can be obtained for each death. The "computer processing" of multiple cause of death data is complex and convoluted. It involves not only computer editing and recoding of the data, but also intensive human intervention.

Information about diagnostic conditions on each death certificate is coded into an electronic medium (computer tape) and is essentially unaltered from the death certificate to an "entity axis" of multiple causes. The "entity axis" of conditions maintains as closely as possible the exact information that was shown on the certificate. Each diagnostic condition is seen as a medical entity without regard to other medical entities on either the same line of causes of death or on any of the other lines. These entity axis data serve two purposes. First, in those instances in which the medical certifier has not properly designated the underlying cause of death, a computer algorithm determines the assignment of the underlying cause. The computer program is called ACME, "Automated Classification of Medical Entities". The second purpose is to provide the basis for studying the etiology of diagnostic conditions as originally perceived by the medical classifier. Entity axis data preserve not only each diagnostic code, but also the location (Item 107. Lines A, B, C, or D and its respective position on that line; and Item 112) of the code as it is listed on the death certificate. Therefore, one is able to inspect the electronic representation of a death record and determine the location and order of each diagnosis, whether it is one of several immediate, intermediate, underlying, or contributing causes of death. The entity axis may have more than one underlying cause of death coded from Line D of Item 107. In some cases, the exact same diagnostic code may be repeated on the same line. In other instances, two diagnostic conditions may be in conflict with one another. For example, one code might show that there was "cirrhosis of the liver w/o mention of alcoholism" (ICD-9 codes 571.5), while another code listed on the certificate could indicate "alcohol dependence syndrome" (ICD-9 code 303). As a result, the entity axis cause of death is generally not useful for analysis of person-based statistics on multiple causes of death.

To circumvent this problem, a computer algorithm called TRANSAX, "Translation of Axis", is used to transform the entity axis to a "record axis" (person-based statistics) of multiple causes. The record axis codes take into account each of the other codes listed on a certificate, such that a coherent set of diagnostic conditions is created that best describes the relationships among the causes of death. For example, in the case of ICD-9 codes 571.5 and 303 described above, both codes would be combined and replaced by code 571.2, "alcoholic cirrhosis of the liver".

In addition to two or more codes being **combined** into one code on the record axis, one code may be **modified** by the presence of another. For example, when ICD-9 code 394.9, "diseases of the mitral valve not specified as rheumatic", is mentioned with code 398, "other heart disease specified as rheumatic", then code 394.9 is modified to 394.0, "diseases of the mitral valve specified as rheumatic", and code 398 is retained. Furthermore, some ICD-9 codes may be **deleted** in the presence of another code. If code 410.9, "acute myocardial infarction with mention of hypertension" appears on the death certificate with code 410.0, "acute myocardial infarction without mention of hypertension", then code 410.9 is deleted from the record axis coding of multiple causes of death. Finally, in the translation of axis from entity to record codes, only one of any **duplicated** ICD-9 code is retained.

For a more complete and detailed description of the processing of death certificate data, please see the National Center for Health Statistic's file documentation related to the creation of multiple cause of death tapes.[10]

Technical Note on the International Classification of Disease Codes

The *International Classification of Disease Codes, Ninth Revision,* (ICD-9) published by the World Health Organization uses a 4-digit coding scheme (0010-9999), which is used as a worldwide standard, to classify various causes of death. In this coding scheme, the first three digits of the code represent an ICD-9 cause of death category, and the last digit represents a subcategory, if applicable. ICD-9 codes 0010-7999 are unique codes, while codes 8000-9999 are not unique. In the case of the later codes, they can be either a nature of injury code (N-Code) or an external cause of injury code (E-Code). The data shown in Figure 1 utilize the entity axis, and both the N-Codes and the E-Codes for compiling the number of causes listed on each death certificate. All of the data represented in the tables and Figure 2 use the record axis and only the E-Codes for compiling the number of causes.

II. Technical Note on Terms Used with Multiple Cause of Death Data

To emphasize the difference between **cause of death as a diagnostic condition** and the dichotomy of **underlying cause of death** as separate from **other than underlying cause**, consider the following distinctions:

- A diagnostic condition, whether a single ICD-9 code or a group of ICD-9 codes, may either be an **underlying cause** or an **other than underlying cause**.

- An **underlying cause**, by definition, can consist of only a single diagnostic condition.

- An **other than underlying cause** can consist of many diagnostic conditions, and up to 20 may be retained in the multiple causes data.

- An **other than underlying cause** can be comprised of the immediate, intermediate, and contributing causes with either one, two, or all three levels applicable to a given death.

- **Any mention** of a diagnostic condition is an unduplicated count of an ICD-9 code or group of codes. For example, the first step for enumerating a diagnostic condition is by **underlying cause** (single cause). The records that were not counted in the first step are passed on to the second step. In this step, the diagnostic condition is compiled by **other than the underlying cause** (up to 20 causes). Records that contain more than one ICD-9 code for a specific diagnostic condition are only counted once.

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