Unsuitable Underlying Causes of Death for Assessing the Quality of Cause-of-death Reporting

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Abstract

Objectives—This report expands the measures used to evaluate cause-of-death data quality by presenting a novel list of unsuitable underlying causes of death (UCOD). This list is intended to facilitate the measurement of the quality of cause-of-death reporting by medical certifiers in terms of completeness, as assessed by a UCOD that is sufficiently specific.

Methods—A list of codes from the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision* was developed to classify unsuitable UCODs defined according to three main subtypes: unknown and ill-defined causes, immediate and intermediate causes, and nonspecific UCODs. Unsuitable UCODs and the three subtypes were examined using 2018 death certificate data for both U.S. residents and nonresidents in the 50 states and the District of Columbia. Differences in the frequency of unsuitable UCODs and the subtypes were tested by age group, place of death, and state of occurrence. Trends in unsuitable UCODs and the three subtypes were also investigated by analyzing death certificate data from 2010 to 2018.

Results—In 2018, 34.7% of all death records had an unsuitable UCOD: 2.2% had an unknown or ill-defined cause as the UCOD, 12.7% had an immediate or intermediate cause as the UCOD, and 19.8% had a nonspecific UCOD. Unsuitable UCODs and the subtypes varied by age group, place of death, state, and year. No trend in unsuitable UCODs from 2010 to 2013 was seen, but from 2013 to 2018, a decrease of 0.6% per year was observed, which is likely due to a similar decrease in nonspecific UCODs during the same time period.

Conclusion—This novel list of unsuitable UCOD codes can be used to assess the quality of cause-of-death data over time and by other various characteristics, with further applications for efforts to improve mortality data quality.

Keywords: mortality • data quality • National Vital Statistics System

Introduction

Cause-of-death data from death certificates have many important uses, both from administrative and public health perspectives. Timely, complete, and accurate cause-of-death reporting helps surviving family members obtain benefits and provides information about their family medical history, which can inform their own medical care. Cause-of-death data are also used to monitor public health, guide public health programs, and direct funding for both biomedical and clinical research (1). Physicians and other medical certifiers are primarily the individuals responsible for reporting causes of death on death certificates. Given the death certificate's role in clinical and public health, the quality of the data—defined by several dimensions including timeliness, completeness, and accuracy—reported by medical certifiers is critical.

Over the last several years, substantial improvements were made in the timeliness of registration and submission of death certificates to the National Center for Health Statistics (NCHS) through the National Vital Statistics System (NVSS), as defined by the percentage of death certificates submitted to NCHS within 10 days of the date of death (2). While improvement is still needed in this area, attention has shifted towards improving other aspects of mortality data quality. In the data quality literature, some have defined data quality as "data that are fit for use by data consumers" (3). Others have proposed conceptual frameworks of data quality that describe several of its properties, which include, but are not limited to, timeliness, accuracy, comparability, completeness, and relevance (4).

Assessments of the accuracy of cause-of-death statements require external data sources, such as autopsy or medical records,

which are often unavailable or unlinked to death certificates (5–8). In addition, such evaluations are not definitive because no truly objective measures of cause of death or a gold standard to use as the criterion for comparisons exist (8). Cause-of-death statements are based on medical opinion, so comparisons must allow for reasonable differences in medical opinion (5,7). Even if such data are available and allow for reasonable differences in medical opinion, these kinds of analyses often require manual record review. With over 2.8 million deaths per year in the United States, these analyses are not feasible on a national scale.

Incomplete reporting of the cause(s) of death (i.e., missing or nonspecific causes of death) affects mortality data's relevance and fitness for the uses outlined above. In addition, the completeness of cause-of-death statements is one aspect of data quality that is relatively more feasible to measure (5). Historically, one index of the quality of cause-of-death reporting is the proportion of death certificates coded to the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision* (ICD–10), Chapter XVIII—Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (ICD–10 codes R00–R99), referred to as the "R codes" (9). To evaluate and monitor cause-of-death data quality more effectively, quality indicators beyond the R codes may be useful. This report expands the measures used to evaluate cause-of-death data quality by presenting a novel list of unsuitable underlying causes of death (UCOD). This list of unsuitable UCOD codes is intended to facilitate the measurement of the quality of cause-of-death reporting by medical certifiers in terms of completeness, as assessed by a UCOD that is sufficiently specific.

Data Source and Methods

Data

The data in this report are based on information from death certificates registered from 2010 to 2018 in the 50 states and the District of Columbia for both residents and nonresidents (99.8% and 0.2% of deaths in 2018, respectively). Demographic and other personal information on death certificates is usually provided by funeral directors, and cause-of-death information is generally reported by physicians, medical examiners, or coroners. For each death certificate, all cause-of-death information is coded, and a UCOD is selected in accordance with the ICD–10 (10).

Cause of death

The underlying and contributing causes of death are reported in Part I and Part II of the death certificate (Figure 1). In Part I, the certifier should report the sequence of conditions or events that directly led to death starting with the immediate cause on the highest line, any intermediate causes on the lines below, and the UCOD on the lowest line used in Part I. UCOD is defined by the World Health Organization (WHO) as "(a) the disease or injury which initiated the train of morbid events leading directly to death, or (b) the circumstances of the accident or violence which produced the fatal injury" (11). The UCOD should always be reported on the lowest line used in Part I. Part II is for reporting other significant conditions that contributed to death, but were not a part of the sequence reported in Part I.

The immediate cause of death is the final disease, injury, or complication that directly caused the death and should always be

Figure 1. Immediate cause, intermediate cause, and underlying cause of death in Part I of the cause-of-death section

NOTE: This figure is a representation of a cause-of-death section in a typical electronic death registry system based on the 2003 U.S. Standard Certificate of Death.
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

reported on line a. An example of an immediate cause is "acute renal failure." Intermediate causes are the condition(s), if any, that led to the immediate cause of death, but are not the UCOD. Intermediate causes are in the chain of events to which the UCOD gave rise, so they can and should only be reported on the lines below the immediate cause and above the UCOD. If the UCOD was reported on line c. in Part I, an intermediate cause would be reported on line b. An example of an intermediate cause would be "hyperosmolar nonketotic coma." Neither immediate nor intermediate causes fit the WHO definition of a UCOD because they typically have multiple possible underlying etiologies and therefore should not be reported as the UCOD on the lowest line used in Part I.

An example of an appropriate UCOD leading to hyperosmolarity and resulting in acute renal failure would be "type 2 diabetes" because it satisfies the WHO definition of a UCOD and is a specific condition. This condition would be reported on line c., the lowest line used in Part I. In this scenario, the complete cause-of-death statement in Part I would be acute renal failure (immediate cause) due to hyperosmolar nonketotic coma (intermediate cause) due to type 2 diabetes (UCOD) (see Figure 2). This cause-of-death statement provides a clear chain of events that led to death, working from the immediate cause back to a specific UCOD. However, when an immediate or intermediate cause is reported without a UCOD, it results in that immediate or intermediate cause being coded as the UCOD. A coded UCOD of acute renal failure or hyperosmolar nonketotic coma, for example, would indicate incomplete reporting of the causes of death by the medical certifier, that is, a failure to report the actual UCOD.

When discussing the completeness of cause-of-death data, it is important to distinguish between the *reported* UCOD and the *coded* UCOD. The reported UCOD is the condition the certifier reported on the lowest line used in Part I of the death certificate, which may not correspond to the actual or coded UCOD. The coded UCOD is the condition that was selected as the UCOD, which is performed either by NCHS' automated coding system or by trained nosologists in accordance with the coding rules and decision tables associated with ICD–10 (11–14). This process makes possible the reporting of causes of death using the ICD–10 codes instead of the literal text provided by the certifier. While the literal text is still available to researchers for analysis, the official mortality statistics disseminated by NCHS are tabulated according to the coded UCOD. Sometimes the coded UCOD differs from the reported UCOD because another condition reported is better (i.e., more specific) for tabulation and statistical purposes (e.g., acute myocardial infarction rather than ischemic heart disease). Other times the coded UCOD may differ from the reported UCOD due to issues in certification, such as lack of specificity, sequencing errors, or reporting the UCOD in Part II (5). The coding rules are designed to compensate, to some extent, for such problems in cause-of-death reporting so that the coded UCOD is more likely to reflect the actual UCOD. However, these procedures cannot compensate for all problems in cause-of-death certification, such as failures to report complete or accurate information.

Figure 2. An example of a complete cause-of-death statement in Part I of the cause-of-death section

NOTE: This figure is a representation of a cause-of-death section in a typical electronic death registry system based on the 2003 U.S. Standard Certificate of Death.
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Development of the list of unsuitable UCODs and subtypes

The list of unsuitable UCODs is intended to provide the diseases and conditions (along with the corresponding ICD–10 codes) that likely indicate incomplete reporting of cause of death (see Technical Notes, "Conditions and ICD–10 codes for unsuitable underlying causes of death"). The development of the list of unsuitable UCODs and their categorization by subtype began with NCHS' review of cause-of-death quality literature to identify ICD–10 codes for unknown, mechanistic, ill-defined, immediate, intermediate, and nonspecific causes (15). Using the alphabetical index in Volume 3 of ICD–10 (16), codes for ambiguous conditions listed in the 2003 U.S. Standard Death Certificate instructions (17) and the *Physician's Handbook on Medical Certification of Death* (18) were also identified. Volume 1 of ICD–10 (10) was also reviewed to add any codes for conditions with "post" or "secondary" in the title, as these terms indicate that the condition was caused by another condition and thus by definition are immediate or intermediate causes. Any codes for major nonspecific conditions (e.g., Disorder of brain, unspecified; Disease of digestive system, unspecified) from ICD–10 Volume 1 (10) were also added. Codes in Table N, "Category Codes in the Tenth Revision Not to Be Used for Underlying Cause-of-Death Classification (Invalid Codes)," of Instruction Manual Part 9 (19) and Table H, "ICD–10 Trivial Conditions," of Instruction Manual Part 2c (14) were not included in the unsuitable UCODs list because these codes are not used in the United States in the coding of the UCOD or are not selected if there is any other condition reported on the death certificate.

From this review, three main subtypes of unsuitable UCODs were identified: unknown and ill-defined causes, immediate and intermediate causes, and nonspecific UCODs. The unknown and ill-defined subtype includes unknown causes of death; mechanisms of death; and Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified. Mechanisms of death (e.g., cardiac arrest, respiratory arrest) attest only to the condition or fact of death and do not provide any information on the cause(s) of death. Therefore, these conditions should never be reported as causes of death in Part I or Part II of the death certificate. Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified, are less well-defined conditions that can indicate two or more diseases or systems of the body (10) and thus do not clearly indicate a UCOD. UCODs coded to unknown and ill-defined conditions indicate that the certifier still needs to report an actual UCOD. Sudden infant death syndrome (R95) was not included in the unsuitable UCODs list because WHO does not consider this condition to be ill-defined (11).

Immediate and intermediate causes provide more information about the cause of a person's death than unknown and ill-defined causes. However, as noted previously, deaths that are ultimately assigned one of the codes for immediate and intermediate causes are missing critical information, that is, the actual UCOD. One example of an immediate or intermediate cause is acute renal failure. This condition can be reported on the higher lines in Part I but requires a UCOD to be reported on a line below because another condition must have caused the acute renal failure. The UCOD could be type 2 diabetes, an infection, an injury, or some other condition. The example shown in Figure 3 illustrates the problem with reporting an immediate or intermediate cause without the UCOD. If the UCOD is not provided by the certifier, the actual UCOD cannot be coded and acute renal failure must be selected as the UCOD.

Nonspecific UCODs refer to reported and coded UCODs that are not sufficiently specific to be useful for public health or research purposes and thus are incomplete data. For example, if a certifier reports "cancer" as the UCOD on the lowest line used in Part I, C80, "Malignant neoplasm, without specification of site," will be coded as the UCOD. Cancer satisfies the WHO definition of a UCOD, but it is lacking important specificity as to the primary site. A more complete cause-of-death statement would include additional information indicating the primary site, such as lung or stomach, so that a more specific code could be selected as the UCOD. Therefore, when a nonspecific cause of death is reported and coded as the UCOD, it indicates incomplete cause-of-death reporting by the certifier.

The subtypes of unsuitability are not equivalent in terms of the amount and utility of information provided. Relative to the other subtypes, nonspecific UCODs provide the most information about the UCOD, and unknown and ill-defined causes provide the least amount of information. Therefore, the subtypes can be ordered in terms of the amount of information they provide, in ascending order: 1) unknown and ill-defined causes, 2) immediate and intermediate causes, and 3) nonspecific UCODs. These subtypes were designed to be mutually exclusive. If an ICD–10 code is listed under one subtype, it is not included in the list for either of the other two subtypes. Codes that could conceivably meet the criteria for inclusion in two subtypes were included in the preceding subtype in order of unsuitability: unknown and ill-defined causes, immediate and intermediate causes, and nonspecific UCODs. For example, if a condition could be considered an immediate or intermediate cause and is also nonspecific, its code was included in the immediate and intermediate cause list. More explicitly, "kidney failure" is both nonspecific (as it does not specify acute or chronic) and is an immediate or intermediate cause of death. However, its code (N19) is included only in the immediate and intermediate subtype because reporting an immediate or intermediate cause and omitting an actual UCOD is more problematic than reporting a nonspecific UCOD.

The tentative list of unsuitable UCOD ICD–10 codes and their corresponding titles was distributed to eight reviewers, including physicians, medical examiners, nosologists, and other experts in mortality statistics, and their feedback was incorporated to create the final list of unsuitable UCODs. The final list consists of 298 cause categories: 4 unknown and ill-defined cause categories, 108 immediate and intermediate cause categories, and 186 nonspecific UCODs (see Technical Notes, "Conditions and ICD–10 codes for unsuitable underlying causes of death"). Frequencies were run for the full list of unsuitable UCOD categories. For tabulation and analytical purposes, an abbreviated tabulation list was created that features the most common unsuitable UCODs (Table A).

Figure 3. An example of an incomplete cause-of-death statement (only the immediate cause) in Part I of the cause-of-death section

CAUSE OF DEATH

Part I. Enter the chain of events–diseases, injuries, or complications that directly caused the death. Do not enter terminal events such as cardiac arrest or respiratory arrest. Do not use abbreviations.

Approximate interval between onset and death:

Immediate Cause (Final disease or condition resulting in death)

A. Acute renal failure

5 days

Due to (or as a consequence of):

Sequentially list conditions, if any, leading to the cause listed on line A. Enter the **Underlying Cause** (Disease or injury that initiated the events resulting in death) last.

B.

Due to (or as a consequence of):

C.

Due to (or as a consequence of):

D.

Due to (or as a consequence of):

Part II. Enter other significant conditions contributing to death, but not resulting in the underlying cause given in Part I.

Analyses

The frequencies of unsuitable UCODs and each subtype were calculated for 2018. In addition, cross tabulations and chi-square tests were conducted comparing unsuitable UCODs and the subtypes by age group (under 1 year, 1–4, 5–14, 15–24, 25–44, 45–64, 65–84, 85 and over, and age not stated), place of death (inpatient, emergency room [ER] or outpatient, dead on arrival, hospice facility, nursing home or long-term care facility [LTC], decedent's home, and other; see Technical Notes, "Place of death" for more detail), and state of occurrence. Previous work has demonstrated that the quality of cause-of-death data can vary by the decedent's age (15). Older decedents tend to have multiple chronic conditions, which may complicate the determination of the cause(s) of death and may affect the quality of certification. The quality of cause-of-death reporting may also vary by place of death because those who die at home and unattended may have inadequate medical records, or the certifier may not have access to the decedent's medical records. The type of certifier may vary by place of death; those who died unattended by a physician are often referred to the medical examiner or coroner, who is likely to order an autopsy and have those results available to them to determine the cause(s) of death. Additionally, the quality of cause-of-death reporting may vary by state. For example, other data quality analyses evaluating the specificity of drug overdose reporting have demonstrated that the percentage of drug overdose deaths with drugs specified varies by state of occurrence (20). All tests were statistically significant unless otherwise noted.

Trends in the percentage of unsuitable UCODs overall and each subtype were examined for 2010–2018 using the National Cancer Institute's Joinpoint software (Version 4.6.0.0) to fit linear weighted least-squares models. The percentage of unsuitable UCODs and standard errors were calculated from the data file by year, and no log transformation was done for ease of interpretation. Using the Grid search algorithm, the maximum number of joinpoints allowed was one (and only on an actual data year) and a minimum of two observations were required between a joinpoint and the end of the data. An uncorrelated errors model was run, and the method of model selection was data-dependent (to choose between BIC and BIC3 methods). An alpha level of 0.05 was used for all analyses.

Results

In 2018, 34.7% of deaths occurring in the 50 states and the District of Columbia had a UCOD code that would be considered unsuitable (Table B). Only 2.2% of all deaths had an unknown or ill-defined cause as the UCOD, while 12.7% had an immediate or intermediate cause as the UCOD, and 19.8% had a nonspecific UCOD. Among unknown and ill-defined causes, Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified were the most common (1.1% of all deaths), followed by cardiac arrest (0.6%) and respiratory failure, not elsewhere classified (0.4%). Among immediate and intermediate causes, heart failure (2.9%); acute renal failure, chronic kidney disease, and unspecified kidney failure (1.8%); and pneumonia, organism unspecified (1.5%) were the most common. For nonspecific

Table A. List of selected unsuitable underlying causes of death

Number	Cause of death (ICD–10 code)

Unknown and ill-defined causes

1   Cardiac arrest. . . . . (I46)
2   Respiratory failure, not elsewhere classified . . . . (J96)
3   Respiratory failure of newborn. . . . . (P28.5)
4   Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified . . . . (R00–R94, R96–R99)

Immediate and intermediate causes

5   Sepsis, unspecified . . . . (A41.9)
6   Secondary malignant neoplasm of respiratory and digestive organs. . . . . (C78)
7   Secondary malignant neoplasm of other sites . . . . (C79)
8   Other disorders of fluid, electrolyte and acid-base balance . . . . (E87)
9   Anoxic brain damage, not elsewhere classified . . . . (G93.1)
10 Pulmonary embolism. . . . . (I26)
11 Other secondary pulmonary hypertension . . . . (I27.2)
12 Cardiomyopathy, unspecified. . . . . (I42.9)
13 Atrial fibrillation and flutter . . . . (I48)
14 Other cardiac arrhythmias . . . . (I49)
15 Heart failure . . . . (I50)
16 Pneumonia, organism unspecified. . . . . (J18)
17 Hepatic failure, not elsewhere classified . . . . (K72)
18 Gastrointestinal haemorrhage, unspecified . . . . (K92.2)
19 Acute renal failure, chronic kidney disease, and unspecified kidney failure . . . .(N17–N19)
20 Urinary tract infection, site not specified . . . . (N39.0)
21 Other immediate and intermediate causes A48.0, A48.3, C77,
      D50.0, D62, D64.1, D64.9, D65, D69.5, D69.9, D75.1, E03.3, E16.1–E16.2, E21.1, E26.1, E73.1, E85.3, E86, F07.1–F07.2, G91.1, G91.3, G91.8–G91.9, G92,
      G93.3–G93.6, I15, I47, I80–I82, I95.8–I95.9, J80–J81, J86, J90, J93.8–J94, J98.1, J98.3, K52.9, K65–K66, K74.4, K75.0, K76.0–K76.2, K82.2, K92.0–K92.1,
      L02–L03, L89, M02, M10.4, M15.3, M16.4–M16.7, M17.2–M17.5, M18.2–M18.5, M19.1–M19.2, M41.5, M80.1, M80.3, M81.1, M81.3, M86, M87.3, N35.0–
      N35.1, O10.4, O62.1, P22, P50.9, P54.9, P90)

Nonspecific underlying causes of death

22 Malignant neoplasm, without specification of site . . . . (C80)
23 Unspecified diabetes mellitus. . . . . (E14)
24 Unspecified dementia. . . . . (F03)
25 Atherosclerotic cardiovascular disease, so described . . . . (I25.0)
26 Atherosclerotic heart disease. . . . . (I25.1)
27 Chronic ischaemic heart disease, unspecified . . . . (I25.9)
28 Cardiovascular disease, unspecified . . . . (I51.6)
29 Heart disease, unspecified . . . . (I51.9)
30 Stroke, not specified as haemorrhage or infarction . . . . (I64)
31 Cerebrovascular disease, unspecified . . . . (I67.9)
32 Sequelae of stroke, not specified as haemorrhage or infarction. . . . . (I69.4)
33 Liver disease, unspecified . . . . (K76.9)
34 Unspecified fall . . . . (W19)
35 Exposure to unspecified factor. . . . . (X59)
36 Other nonspecific underlying causes of death . . . . (A09, A49.9, A64, B34.9, B49, B64, B88.9-B89,
      B94.9, C26.0, C26.9, C39.0, C39.9, C57.9, C63.9, C68.9, C72.9, C75.9–C76, C96.9, D01.9, D02.4, D09.9, D13.9, D14.4, D15.9, D28.9, D29.9, D30.9, D33.9,
      D35.9, D36.9, D37.9, D38.6, D39.9, D40.9, D41.9, D43.9, D44.9, D47.9, D48.9, D68.9, D72.9, D73.9, D75.9, D84.9, D89.9, E07.9, E21.5, E23.7, E27.9, E28.9,
      E29.9, E31.9, E32.9, E34.9, E88.9, F06.9, F07.9, F09, F99, G31.9, G62.9, G72.9, G90.9, G93.9, G95.9, G96.9, H05.9, H44.9, H69.9, H73.9, H74.9, I28.9, I45.9,
      I51.8, I72.9, I77.9, I78.9, I87.9, I89.9, J22, J39.9, J70.9, J98.9, K22.9, K31.9, K38.9, K62.9, K63.9, K75.9, K82.9, K83.9, K86.9, K92.9, L27.9, M50.9, M51.9,
      M62.9, M72.9, M89.9, M94.9, N05, N28.9, N32.9, N36.9, N39.9, N42.9, N48.9, N50.9, N63, N64.9, N75.9, N83.9, O06, O24.9, O26.9, O41.9, O43.9, O71.9,
      O75.9, O90.9, O95, O96.9, O97.9, O98.9, P00.9, P01.9, P02.9, P03.9, P04.9, P28.9, P29.9, P35.9, P36.9, P37.9, P39.9, P61.9, P72.9, P74.9, P78.9, P83.9,
      P91.9, P94.9, P96.9, Q28.9, Q34.9, Q45.9, Q64.9, Q79.9, Q89.9, Q97.9, Q98.9, Q99.9, *U01.9, V99, W74, W84, X29, X57, X84, X90, Y09, Y34, Y35.7, Y36.9,
      Y57.9, Y59.9, Y69, Y83.9, Y84.9, Y89.9)

NOTE: ICD–10 is *International Classification of Diseases, 10th Revision.*

* An asterisk (*) preceding a cause-of-death code indicates it is not part of ICD–10.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Table B. Number and percentage of deaths for selected unsuitable underlying causes of death: United States, 2018

Number	Cause of death (ICD–10 code)	Deaths	Percent of total deaths
	All causes	2,846,305	100.0
	Unsuitable underlying causes of death	987,779	34.7
	Unknown and ill-defined causes	61,678	2.2
1	Cardiac arrest (I46)	17,512	0.6
2	Respiratory failure, not elsewhere classified (J96)	12,639	0.4
3	Respiratory failure of newborn (P28.5)	41	0.0
4	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00–R94, R96–R99)	31,486	1.1
	Immediate and intermediate causes	362,293	12.7
5	Sepsis, unspecified (A41.9)	38,310	1.3
6	Secondary malignant neoplasm of respiratory and digestive organs (C78)	3,425	0.1
7	Secondary malignant neoplasm of other sites (C79)	4,010	0.1
8	Other disorders of fluid, electrolyte and acid-base balance (E87)	5,929	0.2
9	Anoxic brain damage, not elsewhere classified (G93.1)	7,298	0.3
10	Pulmonary embolism (I26)	8,847	0.3
11	Other secondary pulmonary hypertension (I27.2)	7,622	0.3
12	Cardiomyopathy, unspecified (I42.9)	16,038	0.6
13	Atrial fibrillation and flutter (I48)	25,873	0.9
14	Other cardiac arrhythmias (I49)	9,604	0.3
15	Heart failure (I50)	83,687	2.9
16	Pneumonia, organism unspecified (J18)	43,291	1.5
17	Hepatic failure, not elsewhere classified (K72)	4,558	0.2
18	Gastrointestinal haemorrhage, unspecified (K92.2)	9,355	0.3
19	Acute renal failure, chronic kidney disease, and unspecified kidney failure (N17–N19)	50,489	1.8
20	Urinary tract infection, site not specified (N39.0)	11,658	0.4
21	Other immediate and intermediate causes (Residual)[1]	32,299	1.1
	Nonspecific underlying causes of death	563,808	19.8
22	Malignant neoplasm, without specification of site (C80)	28,327	1.0
23	Unspecified diabetes mellitus (E14)	50,278	1.8
24	Unspecified dementia (F03)	100,574	3.5
25	Atherosclerotic cardiovascular disease, so described (I25.0)	65,413	2.3
26	Atherosclerotic heart disease (I25.1)	164,721	5.8
27	Chronic ischaemic heart disease, unspecified (I25.9)	9,390	0.3
28	Cardiovascular disease, unspecified (I51.6)	8,413	0.3
29	Heart disease, unspecified (I51.9)	7,432	0.3
30	Stroke, not specified as haemorrhage or infarction (I64)	52,392	1.8
31	Cerebrovascular disease, unspecified (I67.9)	9,630	0.3
32	Sequelae of stroke, not specified as haemorrhage or infarction (I69.4)	10,724	0.4
33	Liver disease, unspecified (K76.9)	3,836	0.1
34	Unspecified fall (W19)	17,260	0.6
35	Exposure to unspecified factor (X59)	6,089	0.2
36	Other nonspecific underlying causes of death (Residual)[1]	29,329	1.0

… Category not applicable.

0.0 Quantity more than zero but less than 0.05.

[1]See Table A in this report for ICD–10 codes.

NOTE: ICD–10 is *International Classification of Diseases, 10th Revision.*

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

UCODs, atherosclerotic heart disease (5.8%), unspecified dementia (3.5%), and atherosclerotic cardiovascular disease, so described (2.3%) were the most common unsuitable UCODs.

Differences by age

In 2018, unsuitable UCODs varied by age group between infants (under 1 year) (17.2%) through ages 15–24 (7.6%), and then increased with advancing age (Figure 4). Older adult age groups (65–84 and 85 and over) had the highest percentages of unsuitable UCODs (33.8% and 45.0%, respectively). Unsuitable UCODs among younger age groups had a more even distribution of the three subtypes, while older age groups had more

immediate and intermediate causes and nonspecific UCODs (Table 1). Among decedents with an unknown age (0.01% of all deaths), 64.4% had an unsuitable UCOD and unknown and ill-defined was the most prevalent subtype (41.6%).

Differences by place of death

Unsuitable UCODs also varied by place of death in 2018 (Figure 5). For those who died in a hospital, the percentage of unsuitable UCODs were similar among inpatient (38.5%), ER or outpatient (38.8%), and dead on arrival (34.9%). The percentage of unsuitable UCODs varied more widely for those who died outside of a hospital. Decedents who died in places categorized as

Figure 4. Percentage of deaths with unsuitable underlying causes of death, by age and subtype: United States, 2018

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.
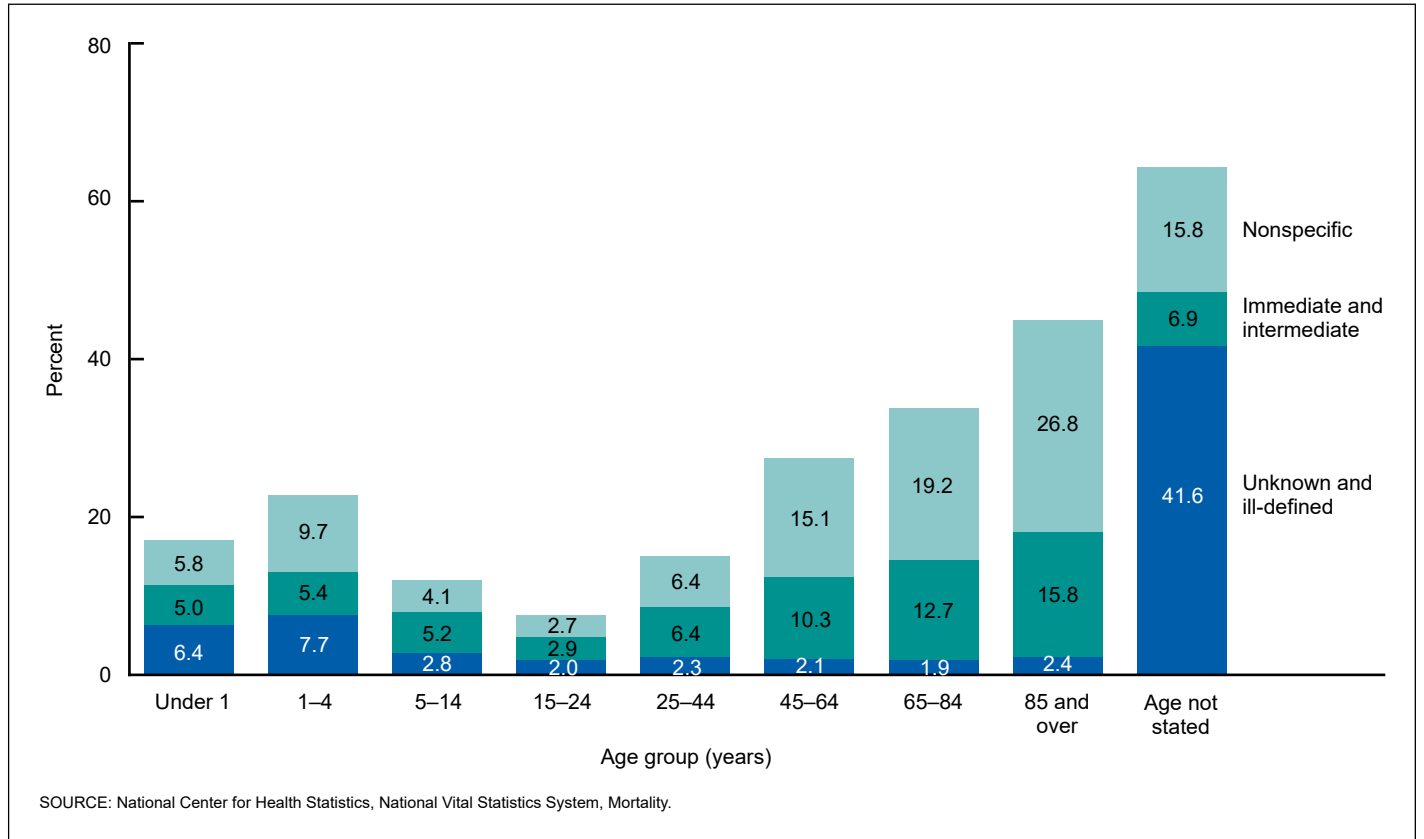
Figure 5. Percentage of deaths with unsuitable underlying causes of death, by place of death and subtype: United States, 2018

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.
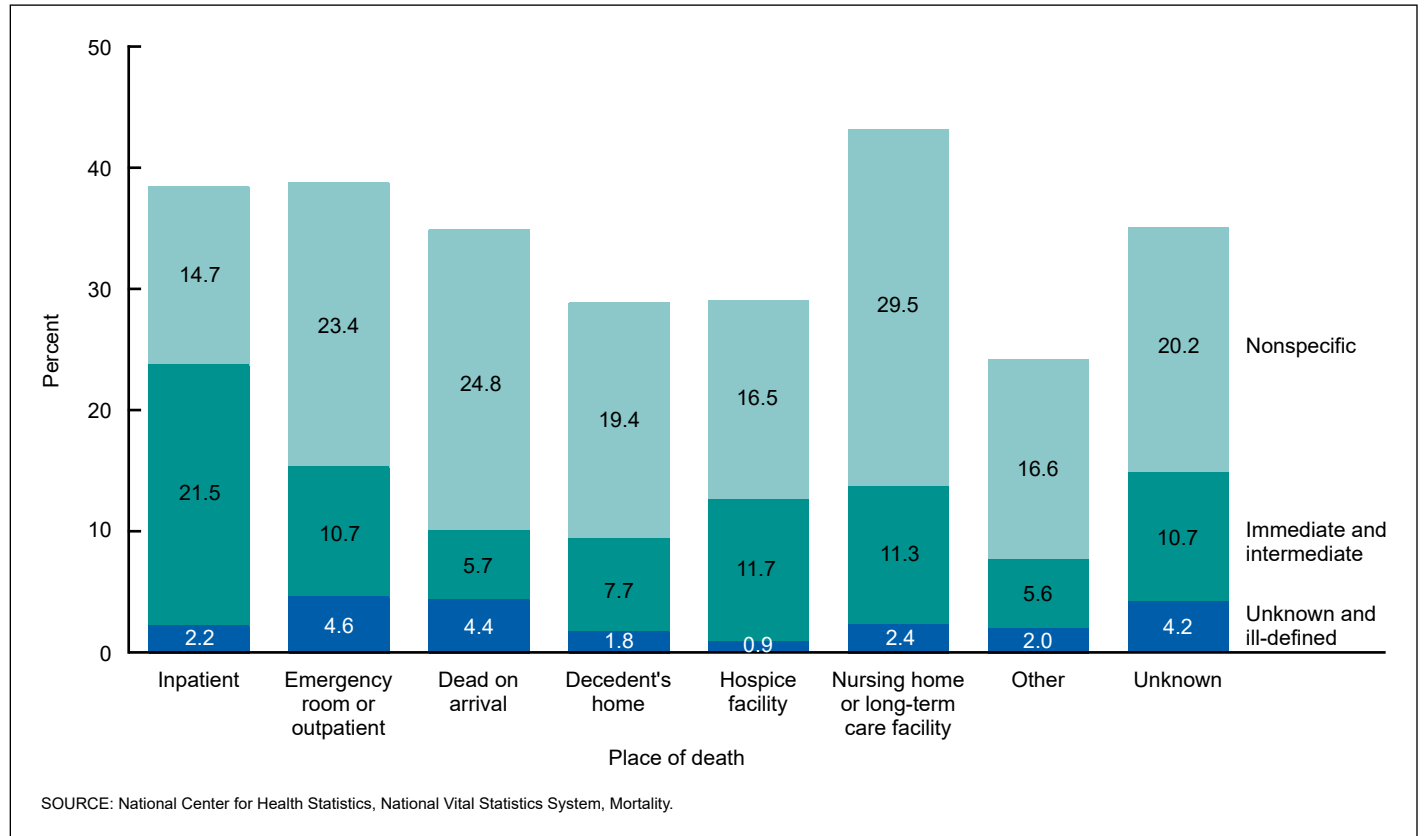
"Other" were the least likely to have an unsuitable UCOD (24.2%) and those who died in a nursing home or LTC facility were the most likely to have an unsuitable UCOD (43.1%). Decedents who died in an inpatient setting had a higher percentage of immediate and intermediate causes as the UCOD (21.5%) than nonspecific UCODs (14.7%), while those who died in all of the other settings had a higher percentage of nonspecific UCODs (ranging from 16.5% to 29.5%) (Table 2).

Differences by state of occurrence

In 2018, states also varied in the percentage of unsuitable UCODs, as well as in the percentages of the three subtypes (Table C). States with lower percentages of unsuitable UCODs included Washington (25.4%), South Dakota (26.2%), and Wyoming (27.6%). States with higher percentages of unsuitable UCODs included Massachusetts (40.8%), New Jersey (41.4%), and Connecticut (42.1%). Unknown or ill-defined causes ranged from 0.5% of deaths in California, Maryland, and South Dakota to 4.2% of deaths in New Jersey, 4.4% of deaths in Nevada, and 6.6% of deaths in Alabama. States with lower percentages of immediate or intermediate causes as the UCOD included Vermont (6.0%), Washington (7.9%), and Arizona (8.1%). States with higher percentages of immediate or intermediate causes as the UCOD included Alabama (15.6%), Mississippi (15.8%), and Louisiana (16.3%). The states with the lowest percentages of nonspecific UCODs were Wyoming (14.0%), South Dakota (15.6%), and Washington and Mississippi (both 16.1%). The states with the highest percentages of nonspecific UCODs were Montana (23.9%), New York (27.0%), and Rhode Island (27.2%).
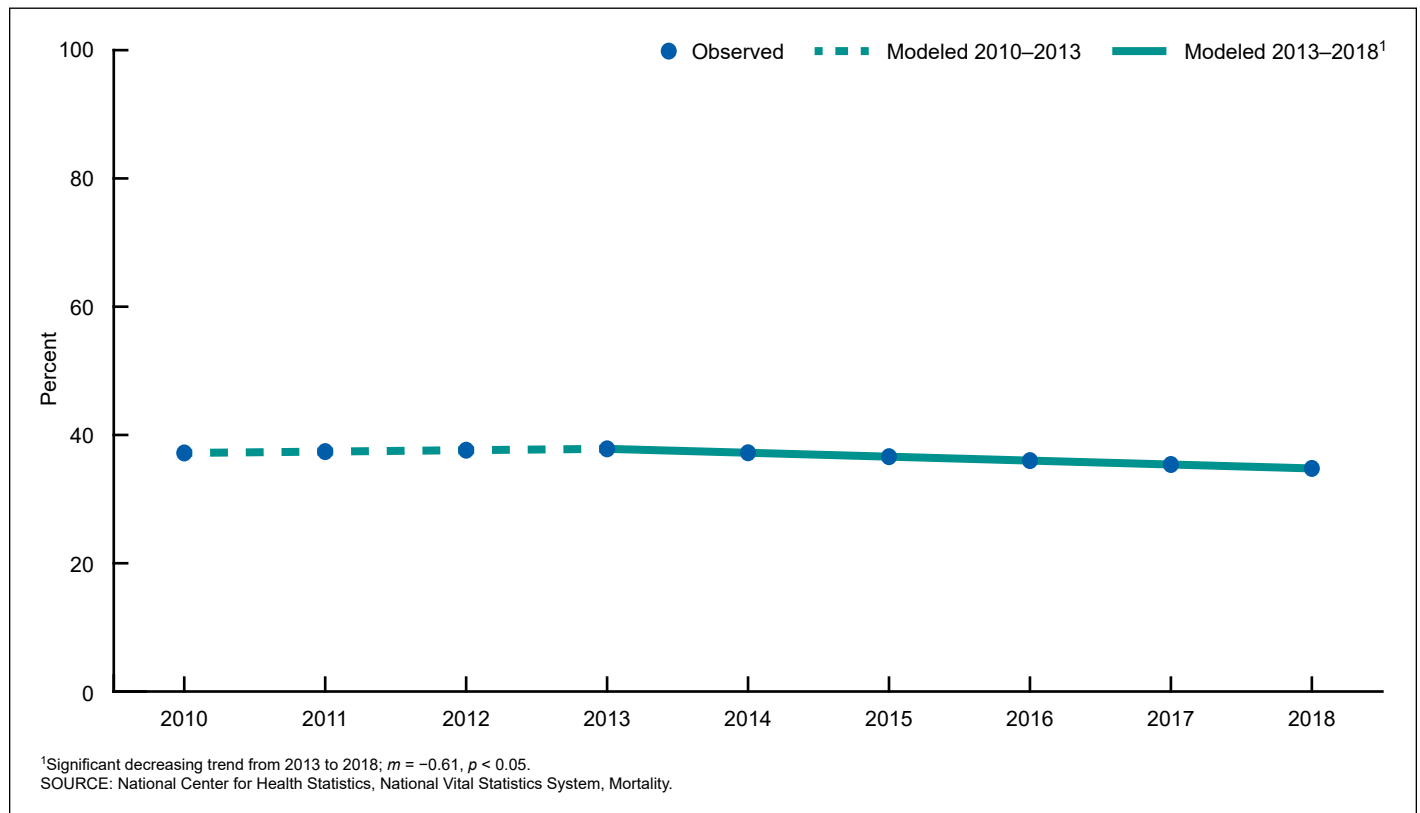
Differences by year

No change was seen in unsuitable UCODs from 2010 to 2013, but from 2013 to 2018, unsuitable UCODs decreased 0.61% per year (Figure 6). In other words, beginning in 2013, each year the percentage of unsuitable UCODs decreased by 0.61. This percentage translates to about 15,900 to 17,400 fewer deaths per year being reported with an unsuitable UCOD.

Although a decrease between 2010 and 2014 was seen, no statistically significant trend was noted in the percentage of unknown and ill-defined causes from 2010 to 2018 (Figure 7).

From 2010 to 2015, an increase in immediate and intermediate causes of about 0.16% was seen per year (Figure 8). This resulted in about 4,000 to 4,300 more deaths per year being reported with an immediate or intermediate cause as the UCOD. The trend in immediate and intermediate causes was stable from 2015 to 2018.

No change in nonspecific UCODs from 2010 to 2013 was seen, but from 2013 to 2018 a downward trend of about 0.62% per year was observed (Figure 9), meaning each year about 16,100 to 17,600 fewer deaths with a nonspecific UCOD were reported.

Figure 6. Percentage of deaths with unsuitable underlying causes of death, by year: United States, 2010–2018

[1]Significant decreasing trend from 2013 to 2018; $m = -0.61$, $p < 0.05$.
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Table C. Number and percentage of deaths with unsuitable underlying causes of death, by state of occurrence and subtype: United States, 2018

Area	Number of deaths	Unknown and ill-defined causes		Immediate and intermediate causes		Nonspecific UCODs		Unsuitable UCODs	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
Alabama.....................	53,296	3,497	6.6	8,335	15.6	9,075	17.0	20,907	39.2
Alaska	4,333	110	2.5	409	9.4	788	18.2	1,307	30.2
Arizona......................	60,200	1,739	2.9	4,875	8.1	11,564	19.2	18,178	30.2
Arkansas	31,822	345	1.1	3,775	11.9	5,346	16.8	9,466	29.7
California....................	270,088	1,435	0.5	28,950	10.7	47,368	17.5	77,753	28.8
Colorado	39,147	438	1.1	4,281	10.9	6,828	17.4	11,547	29.5
Connecticut	31,449	1,100	3.5	4,669	14.8	7,458	23.7	13,227	42.1
Delaware	9,482	72	0.8	1,160	12.2	2,072	21.9	3,304	34.8
District of Columbia	6,180	49	0.8	627	10.1	1,137	18.4	1,813	29.3
Florida	208,121	4,199	2.0	21,792	10.5	42,864	20.6	68,855	33.1
Georgia	85,746	2,890	3.4	13,166	15.4	13,967	16.3	30,023	35.0
Hawaii	11,543	231	2.0	1,574	13.6	2,545	22.0	4,350	37.7
Idaho	14,168	238	1.7	1,600	11.3	2,338	16.5	4,176	29.5
Illinois	106,880	2,259	2.1	16,045	15.0	21,735	20.3	40,039	37.5
Indiana......................	66,226	1,146	1.7	9,523	14.4	12,498	18.9	23,167	35.0
Iowa........................	30,190	580	1.9	3,352	11.1	6,670	22.1	10,602	35.1
Kansas......................	26,492	648	2.4	3,275	12.4	5,775	21.8	9,698	36.6
Kentucky	48,342	1,545	3.2	7,063	14.6	8,721	18.0	17,329	35.8
Louisiana	46,187	1,557	3.4	7,548	16.3	8,922	19.3	18,027	39.0
Maine.......................	14,548	104	0.7	1,487	10.2	3,438	23.6	5,029	34.6
Maryland	50,272	245	0.5	6,536	13.0	11,920	23.7	18,701	37.2
Massachusetts.................	60,038	1,497	2.5	8,914	14.8	14,061	23.4	24,472	40.8
Michigan	97,545	1,175	1.2	12,907	13.2	20,813	21.3	34,895	35.8
Minnesota	44,751	1,184	2.6	4,857	10.9	8,710	19.5	14,751	33.0
Mississippi...................	31,692	985	3.1	5,018	15.8	5,109	16.1	11,112	35.1
Missouri.....................	65,507	1,572	2.4	9,548	14.6	11,705	17.9	22,825	34.8
Montana.....................	9,986	150	1.5	1,224	12.3	2,385	23.9	3,759	37.6
Nebraska	17,166	338	2.0	2,250	13.1	3,290	19.2	5,878	34.2
Nevada......................	25,569	1,121	4.4	2,297	9.0	5,619	22.0	9,037	35.3
New Hampshire	12,509	252	2.0	1,490	11.9	2,763	22.1	4,505	36.0
New Jersey	74,833	3,114	4.2	11,541	15.4	16,357	21.9	31,012	41.4
New Mexico..................	18,440	202	1.1	1,942	10.5	3,693	20.0	5,837	31.7
New York	155,761	3,242	2.1	17,042	10.9	42,083	27.0	62,367	40.0
North Carolina	94,809	1,503	1.6	13,376	14.1	18,311	19.3	33,190	35.0
North Dakota	7,032	135	1.9	977	13.9	1,328	18.9	2,440	34.7
Ohio........................	124,631	4,276	3.4	16,363	13.1	24,572	19.7	45,211	36.3
Oklahoma....................	39,876	296	0.7	3,865	9.7	8,602	21.6	12,763	32.0
Oregon......................	36,208	480	1.3	3,744	10.3	5,958	16.5	10,182	28.1
Pennsylvania	136,049	4,373	3.2	20,763	15.3	29,157	21.4	54,293	39.9
Rhode Island	10,430	79	0.8	1,102	10.6	2,837	27.2	4,018	38.5

See footnotes at end of table.

Table C. Number and percentage of deaths with unsuitable underlying causes of death, by state of occurrence and subtype: United States, 2018—Con.

Area	Number of deaths	Unknown and ill-defined causes		Immediate and intermediate causes		Nonspecific UCODs		Unsuitable UCODs	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
South Carolina	49,556	1,184	2.4	6,710	13.5	8,845	17.8	16,739	33.8
South Dakota	8,114	37	0.5	824	10.2	1,266	15.6	2,127	26.2
Tennessee	74,850	1,750	2.3	8,792	11.7	13,935	18.6	24,477	32.7
Texas	204,992	4,775	2.3	28,698	14.0	36,922	18.0	70,395	34.3
Utah	19,019	384	2.0	2,865	15.1	3,216	16.9	6,465	34.0
Vermont	5,782	33	0.6	347	6.0	1,240	21.4	1,620	28.0
Virginia	68,449	1,399	2.0	10,095	14.7	12,669	18.5	24,163	35.3
Washington	56,919	782	1.4	4,504	7.9	9,157	16.1	14,443	25.4
West Virginia	22,901	559	2.4	2,882	12.6	4,919	21.5	8,360	36.5
Wisconsin	53,515	333	0.6	6,721	12.6	10,602	19.8	17,656	33.0
Wyoming	4,664	41	0.9	593	12.7	655	14.0	1,289	27.6

NOTE: UCOD is underlying cause of death.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Figure 7. Percentage of deaths with unknown and ill-defined causes as the underlying cause of death, by year: United States, 2010–2018

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.
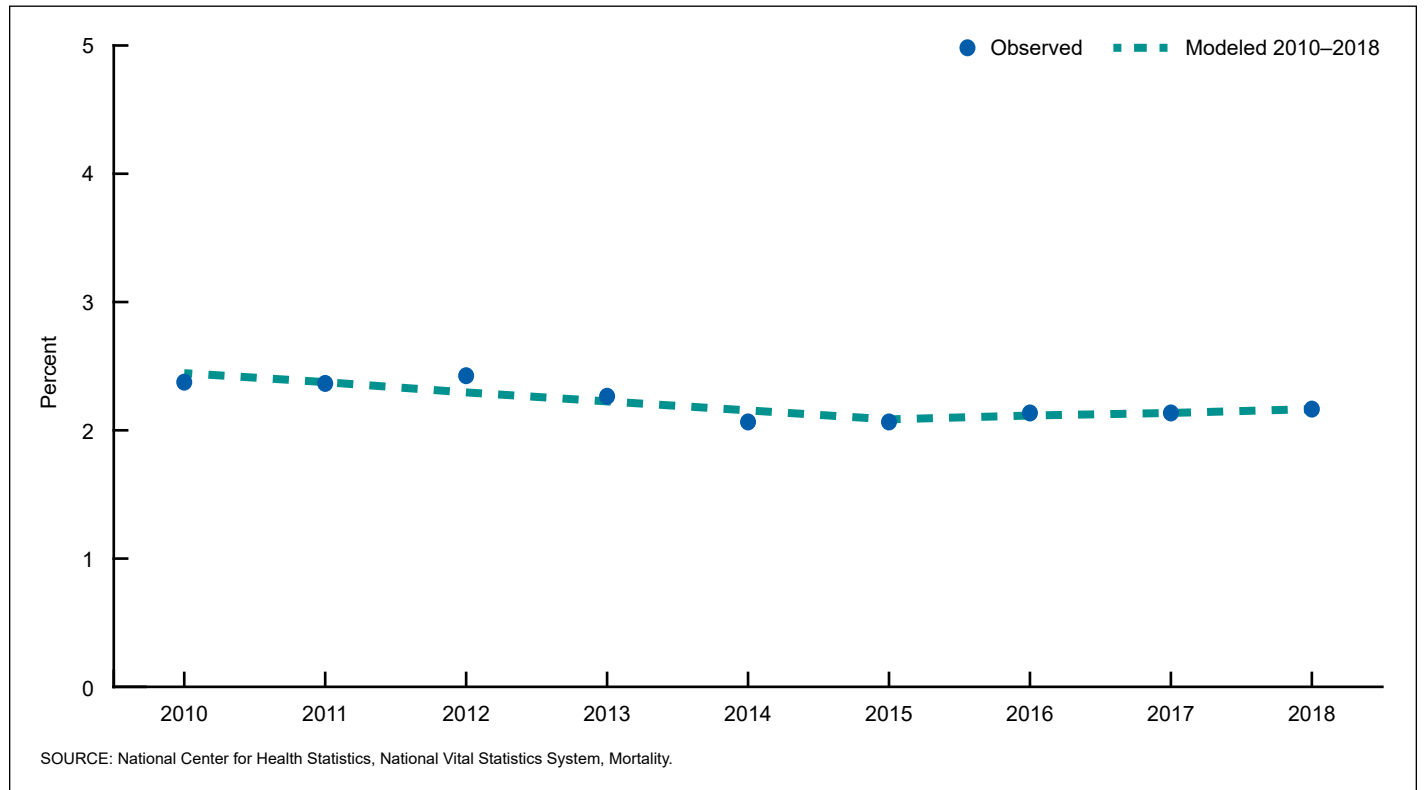
Figure 8. Percentage of deaths with immediate and intermediate causes as the underlying cause of death, by year: United States, 2010–2018

[1]Significant increasing trend from 2010 to 2015; $m = 0.16$, $p < 0.05$.
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.
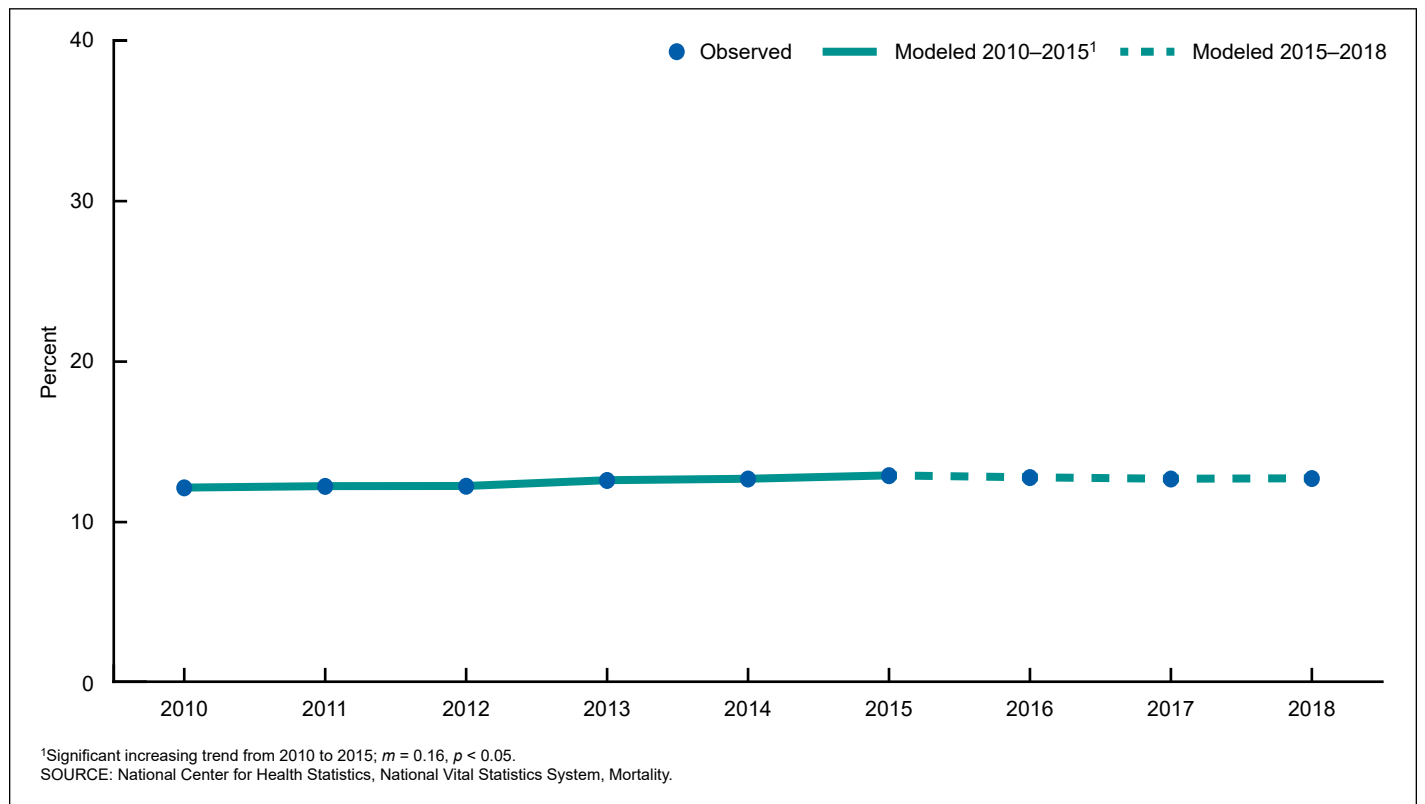
Figure 9. Percentage of deaths with nonspecific underlying causes of death, by year: United States, 2010–2018

[1]Significant decreasing trend from 2013 to 2018; $m = -0.62$, $p < 0.05$.
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.
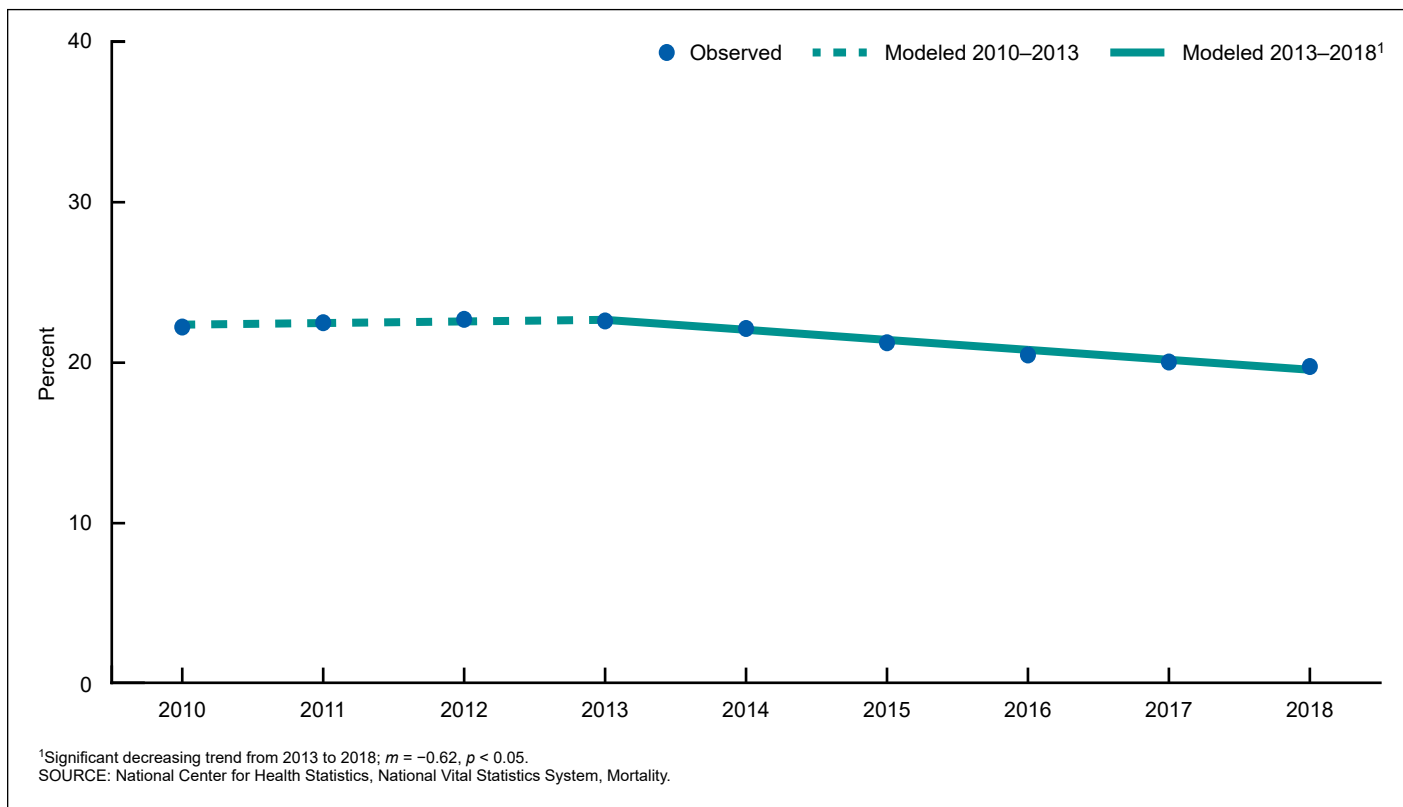
Discussion

In this report, a list of unsuitable UCODs along with the corresponding ICD–10 codes (Table A) is presented for the purposes of measuring and tracking the quality of cause-of-death data (i.e., completeness) over time and by other various characteristics. Unsuitable UCODs were also categorized according to three subtypes: unknown and ill-defined causes, immediate and intermediate causes, and nonspecific UCODs. In 2018, 34.7% of all deaths in the United States had an unsuitable UCOD. When examining deaths by subtype, 2.2% had an unknown or ill-defined cause as the UCOD, 12.7% had an immediate or intermediate cause as the UCOD, and 19.8% had a nonspecific UCOD. The prevalence of unsuitable UCODs varied by age group for those under 1 year to the age of 24, but for those aged 25 and over, unsuitable UCODs increased steadily with age. Decedents aged 85 and over had the highest percentage of unsuitable UCODs (45.0%), as well as those who died in a nursing home or LTC facility (43.1%). Older decedents tend to have multiple serious conditions, which may cause confusion among certifiers and lead to increased reporting of unsuitable UCODs. Also, many of the nonspecific UCODs in the list are conditions that often cause death among older adults. In addition, those who die in a nursing home or LTC facility are generally older adults and thus are more likely to have an unsuitable UCOD reported. Unsuitable UCODs overall also varied by state of occurrence, ranging from 25.4% to 42.1% of deaths. From 2010 to 2013, the trend in the percentage of deaths with unsuitable UCODs was stable, but from 2013 to 2018 the percentage decreased by 0.61 each year,

which was likely driven by declines in nonspecific UCODs during the same time period. From 2010 to 2018, no significant change was seen in the percentage of unknown and ill-defined causes, and immediate and intermediate causes increased slightly earlier in the period but then remained stable.

This list of unsuitable UCODs can be used to evaluate the quality of cause-of-death data beyond the R codes. Up until the time of this report, such a list appropriate for application in the United States has not been available. While other similar lists of ICD–10 codes exist, such as lists of purported "garbage codes" (15,21–24), many of the codes in these lists are for conditions that are considered trivial and, in the United States, trivial conditions are not allowed to be selected as the UCOD or are extremely rare. Therefore, portions of these lists of garbage codes are not relevant to U.S. mortality data. For more information on trivial conditions, see Instruction Manual Part 2c for Table H and its description and use (14).

Additionally, the garbage code lists are designed to evaluate the usefulness of cause-of-death statistics from a public health perspective and are often applied in redistributing causes of death for global comparisons (15,21–24). In contrast, this list of unsuitable UCODs is primarily intended to evaluate the quality of cause-of-death reporting, which can be leveraged to improve certification practices and ultimately the effectiveness of mortality data. Because these lists have expressly different purposes, ICD–10 codes that are appropriate to include in one list may not be appropriate to include in the other. For example, while deaths with a manner that is undetermined provide less useful information for public health practice than those with a

manner that was determined (i.e., accident, suicide, homicide, or natural), reporting a manner of death as undetermined does not indicate that the certification provided by the medical examiner or coroner was of poor quality. An undetermined manner of death indicates that insufficient evidence was available to the medical examiner or coroner to designate one manner of death over another. In such cases, certifying the manner of death as undetermined is appropriate given the available information. So, while ICD–10 codes indicating an undetermined manner of death are typically included in lists of garbage codes, they are not included in the list of unsuitable UCODs.

The unsuitable UCODs list is also not intended to be used as a standard by which vital registration offices reject death certificates prior to registration, although it could be used to develop real-time prompts for certifiers to provide additional information in electronic registration systems or to target particular certifiers for training. The purpose of the unsuitable UCODs list is to measure the quality of cause-of-death reporting, and ultimately to encourage medical certifiers to provide the best cause-of-death certifications possible.

There are a few important caveats about the list of unsuitable UCODs that should be considered. This list is subject to the nature of each ICD revision structure and given code categories, as well as expert opinion. The development of the unsuitable UCODs list included evaluations by eight reviewers consisting of physicians, medical examiners, nosologists, and other experts in mortality statistics to ensure the list was logical and comprehensive, while also not including inappropriate or unreasonable codes. Also note that many of the conditions included in the list are acceptable to report in a cause-of-death statement; it is when these conditions are the coded UCOD that more information should be provided, if possible. More specifically, it is acceptable for immediate and intermediate causes to be reported on higher lines in Part I, but the certifier should provide the UCOD that led to these conditions on the lowest line used in Part I. In addition, some nonspecific conditions are acceptable as the reported UCOD, but the certifier should provide additional information on the lines above it to specify how that condition led to death. This information allows for the selection of the more specific condition as the coded UCOD. For example, "Atherosclerotic heart disease" can be reported as the UCOD on the lowest line used in Part I, but ideally the medical certifier would also include its complications and sequelae, for example, myocardial infarction. The more specific manifestation of atherosclerotic heart disease, myocardial infarction, could then be selected as the coded UCOD (for tabulation purposes, myocardial infarction is a subcategory of the broader ischemic heart disease category). Finally, this list is only applicable to analyses assessing the completeness of cause-of-death data based on the coded UCOD. This list cannot be applied to assess the completeness of the multiple-cause information, such as in the cases of missing contributing causes (i.e., on other lines in Part I or in Part II), the nature of injury, or the specificity of drug overdose death reporting.

It is also important to recognize that the certifier sometimes does not have access to the information needed to provide the detail desired. As a result, an unsuitable UCOD may be the best possible UCOD given the available information. While it is unknown how often this is the case, the unsuitable UCODs list can still be used to encourage certifiers to provide additional information when it is possible.

This report presents a novel list of ICD–10 codes that provides a more detailed characterization of the quality of cause-of-death data compared with the conventional R codes. This list is intended to be used as a measure of the completeness of cause-of-death reporting as assessed by a UCOD that is sufficiently specific. The unsuitable UCODs list can be used to determine if mortality data quality is changing over time or varying by other characteristics (e.g., facility, certifier) to target interventions for improving mortality data quality most efficiently. It may also be applied to evaluate whether these interventions have been successful or not. This more comprehensive measure of cause-of-death data quality provides an additional tool needed in the quality improvement of cause-of-death information so that it can more effectively perform its administrative and public health functions, and ultimately better serve efforts to improve the health of the U.S. population.

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List of Detailed Tables

Table 1. Number and percentage of deaths with unsuitable underlying causes of death, by age and subtype: United States, 2018

Age group (years)	Number of deaths	Unknown and ill-defined causes		Immediate and intermediate causes		Nonspecific UCODs		Unsuitable UCODs	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
Less than 1	21,567	1,389	6.4	1,073	5.0	1,243	5.8	3,705	17.2
1–4.	3,846	298	7.7	209	5.4	373	9.7	880	22.9
5–14.	5,498	152	2.8	285	5.2	228	4.1	665	12.1
15–24.	30,336	606	2.0	867	2.9	832	2.7	2,305	7.6
25–44.	140,064	3,223	2.3	8,998	6.4	8,921	6.4	21,142	15.1
45–64.	542,151	11,312	2.1	55,730	10.3	81,860	15.1	148,902	27.5
65–84.	1,221,715	23,761	1.9	155,654	12.7	234,078	19.2	413,493	33.8
85 and over	880,825	20,811	2.4	139,456	15.8	236,225	26.8	396,492	45.0
Age not stated	303	126	41.6	21	6.9	48	15.8	195	64.4

NOTE: UCOD is underlying cause of death.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Table 2. Number and percentage of deaths with unsuitable underlying causes of death, by place of death and subtype: United States, 2018

Place of death	Number of deaths	Unknown and ill-defined causes		Immediate and intermediate causes		Nonspecific UCODs		Unsuitable UCODs	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
Inpatient.	822,289	18,482	2.2	176,904	21.5	121,125	14.7	316,511	38.5
Emergency room or outpatient.	177,727	8,260	4.6	19,054	10.7	41,653	23.4	68,967	38.8
Dead on arrival.	10,126	446	4.4	573	5.7	2,515	24.8	3,534	34.9
Decedent's home	891,780	15,952	1.8	68,375	7.7	172,603	19.4	256,930	28.8
Hospice facility.	221,780	2,068	0.9	25,910	11.7	36,572	16.5	64,550	29.1
Nursing home or long-term care facility	540,020	12,780	2.4	61,138	11.3	159,088	29.5	233,006	43.1
Other	182,013	3,666	2.0	10,278	5.6	30,137	16.6	44,081	24.2
Unknown	570	24	4.2	61	10.7	115	20.2	200	35.1

NOTE: UCOD is underlying cause of death.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Technical Notes

Nature and sources of data

Mortality data originate from information on death certificates registered for deaths occurring in the 50 states, the District of Columbia, and the five U.S. territories. The data in this report were based on mortality data for both residents and nonresidents in the 50 states and the District of Columbia (place of occurrence) between 2010 and 2018. All states have laws that make the registration of births and deaths compulsory, so it is believed that more than 99% of vital events in the United States are registered (25). The U.S. Standard Certificate of Death was revised in 2003 and is the model used by vital registration areas (17). While there can be variation in item wording and formatting by state, most of the items presented in this report are largely comparable and thus data from all the included states were combined. Demographic information on death certificates is generally provided by funeral directors, and medical information by physicians, medical examiners, and coroners. This information is submitted to the National Center for Health Statistics (NCHS) where it is coded according to the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision* (ICD–10) (10) and is the basis for mortality statistics. For more detail, see the Technical Notes in Deaths: Final Data for 2018 (9).

Cause-of-death classification

The mortality data presented in this report were classified in accordance with World Health Organization (WHO) regulations, which stipulate that member countries classify and code causes of death using the latest revision of the *International Statistical Classification of Diseases and Related Health Problems,* currently the 10th Revision (ICD–10) (10). ICD–10 provides a classification system for medical conditions, as well as the format of the death certificate, definitions, tabulation lists, and rules for coding causes of death and selecting the underlying cause of death (UCOD). Cause-of-death data presented in this publication were coded using procedures outlined in the NCHS Instruction Manuals (12–14). The Mortality Medical Indexing, Classification, and Retrieval system (MICAR), which automates the coding of multiple causes of death, and SuperMICAR, an enhancement of the MICAR system that allows for entry of the multiple cause-of-death literal text from the certifier (26), are used as inputs into the Automated Classification of Medical Entities system (ACME), which applies WHO rules to determine the UCOD (14). Generally, cause-of-death information from death certificates is automatically processed by SuperMICAR, MICAR, and then the ACME system. Records that cannot be automatically processed by MICAR are coded manually to assign the multiple-cause codes and then they are processed through the ACME system to select the UCOD. All cause-of-death tabulations in this report are based solely on the UCOD. More detail on cause-of-death classification can be found in the Technical Notes of Deaths: Final Data for 2018 (9).

Quality of processing cause of death

When there is evidence suggesting that changes in the coding rules will improve the quality of cause-of-death data, sometimes modifications are made prior to the implementation of a new revision of the ICD. However, midrevision coding changes may affect the comparability of data over time for certain causes of death. Caution should be exercised when interpreting trends in causes affected by coding rule changes. For more information, please see the Technical Notes of Deaths: Final Data for 2018 (9). In addition, details on classification and coding rule changes can be found in the NCHS Instruction Manuals (12–14).

Place of death

Place of death is used to determine who has jurisdiction for deaths that may legally require investigation by a medical examiner or coroner. Where the death is pronounced is considered the place where the death occurred (27). If the place of death is unknown, then the place where the body was found should be reported (28). Place of death consists of two main categories: hospital and somewhere other than a hospital. If the patient was pronounced dead in a hospital, the decedent's status at the hospital is reported as the place of death: inpatient, emergency room or outpatient, or dead on arrival. If the decedent was pronounced dead somewhere other than a hospital, then one of the following locations is reported: hospice facility, nursing home or long-term care facility, decedent's home, or other. A hospice facility is a licensed institution that provides hospice care (e.g., palliative and supportive care for the dying), but does not refer to hospice care that may be provided in other settings, such as a patient's home. A long-term care facility (e.g., nursing home, skilled nursing facility, convalescent care facility, extended care facility, intermediate care facility, residential care facility, or congregate care facility) is not a hospital, but provides patient care beyond custodial care. Decedent's home consists of independent living units, such as private homes, apartments, bungalows, and cottages. Other places can include licensed ambulatory or surgical centers; physician's offices; orphanages; prison wards; public buildings; birthing centers; facilities offering housing and custodial care, but not patient care (e.g., board and care home, group home, custodial care facility, or foster home); highway where a traffic accident occurred; or work (27).

Random variation

Because states have laws requiring the registration of all vital events occurring in the United States, mortality data in this report are not considered to be subject to sampling error. However, even complete counts of deaths may be affected by random variation, particularly for those that occur in small numbers. In the case of events with a small probability of occurrence, data should be interpreted with caution as differences may be attributable to random variability. For more detail, please see the Technical Notes of Deaths: Final Data for 2018 (9).

Conditions and ICD–10 codes for unsuitable underlying causes of death

1. Unknown and ill-defined causes
    1.1.   Cardiac arrest (I46)
    1.2.   Respiratory failure, not elsewhere classified (J96)
    1.3.   Respiratory failure of newborn (P28.5)
    1.4.   Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
            (R00–R94, R96–R99)

2. Immediate and intermediate causes
    2.1.   Sepsis, unspecified (A41.9)
    2.2.   Gas gangrene (A48.0)
    2.3.   Toxic shock syndrome (A48.3)
    2.4.   Secondary and unspecified malignant neoplasm of lymph nodes (C77)
    2.5.   Secondary malignant neoplasm of respiratory and digestive organs (C78)
    2.6.   Secondary malignant neoplasm of other sites (C79)
    2.7.   Iron deficiency anaemia secondary to blood loss (chronic) (D50.0)
    2.8.   Acute posthaemorrhagic anaemia (D62)
    2.9.   Secondary sideroblastic anaemia due to disease (D64.1)
    2.10.   Anaemia, unspecified (D64.9)
    2.11.   Disseminated intravascular coagulation [defibrination syndrome] (D65)
    2.12.   Secondary thrombocytopenia (D69.5)
    2.13.   Haemorrhagic condition, unspecified (D69.9)
    2.14.   Secondary polycythaemia (D75.1)
    2.15.   Postinfectious hypothyroidism (E03.3)
    2.16.   Other hypoglycaemia (E16.1)
    2.17.   Hypoglycaemia, unspecified (E16.2)
    2.18.   Secondary hyperparathyroidism, not elsewhere classified (E21.1)
    2.19.   Secondary hyperaldosteronism (E26.1)
    2.20.   Secondary lactase deficiency (E73.1)
    2.21.   Secondary systemic amyloidosis (E85.3)
    2.22.   Volume depletion (E86)
    2.23.   Other disorders of fluid, electrolyte and acid-base balance (E87)
    2.24.   Postencephalitic syndrome (F07.1)
    2.25.   Postconcussional syndrome (F07.2)
    2.26.   Obstructive hydrocephalus (G91.1)
    2.27.   Post-traumatic hydrocephalus, unspecified (G91.3)
    2.28.   Other hydrocephalus (G91.8)
    2.29.   Hydrocephalus, unspecified (G91.9)
    2.30.   Toxic encephalopathy (G92)
    2.31.   Anoxic brain damage, not elsewhere classified (G93.1)
    2.32.   Postviral fatigue syndrome (G93.3)
    2.33.   Encephalopathy, unspecified (G93.4)
    2.34.   Compression of brain (G93.5)
    2.35.   Cerebral oedema (G93.6)
    2.36.   Secondary hypertension (I15)
    2.37.   Pulmonary embolism (I26)
    2.38.   Other secondary pulmonary hypertension (I27.2)
    2.39.   Cardiomyopathy, unspecified (I42.9)
    2.40.   Paroxysmal tachycardia (I47)
    2.41.   Atrial fibrillation and flutter (I48)
    2.42.   Other cardiac arrhythmias (I49)
    2.43.   Heart failure (I50)
    2.44.   Phlebitis and thrombophlebitis (I80)
    2.45.   Portal vein thrombosis (I81)
    2.46.   Other venous embolism and thrombosis (I82)
    2.47.   Other hypotension (I95.8)
    2.48.   Hypotension, unspecified (I95.9)

2.49. Pneumonia, organism unspecified (J18)
2.50. Adult respiratory distress syndrome (J80)
2.51. Pulmonary oedema (J81)
2.52. Pyothorax (J86)
2.53. Pleural effusion, not elsewhere classified (J90)
2.54. Other pneumothorax (J93.8)
2.55. Pneumothorax, unspecified (J93.9)
2.56. Other pleural conditions (J94)
2.57. Pulmonary collapse (J98.1)
2.58. Compensatory emphysema (J98.3)
2.59. Noninfective gastroenteritis and colitis, unspecified (K52.9)
2.60. Peritonitis (K65)
2.61. Other disorders of peritoneum (K66)
2.62. Hepatic failure, not elsewhere classified (K72)
2.63. Secondary biliary cirrhosis (K74.4)
2.64. Abscess of liver (K75.0)
2.65. Fatty (change of) liver, not elsewhere classified (K76.0)
2.66. Chronic passive congestion of liver (K76.1)
2.67. Central haemorrhagic necrosis of liver (K76.2)
2.68. Perforation of gallbladder (K82.2)
2.69. Haematemesis (K92.0)
2.70. Melaena (K92.1)
2.71. Gastrointestinal haemorrhage, unspecified (K92.2)
2.72. Cutaneous abscess, furuncle and carbuncle (L02)
2.73. Cellulitis (L03)
2.74. Decubitus ulcer and pressure area (L89)
2.75. Reactive arthropathies (M02)
2.76. Other secondary gout (M10.4)
2.77. Secondary multiple arthrosis (M15.3)
2.78. Post-traumatic coxarthrosis, bilateral (M16.4)
2.79. Other post-traumatic coxarthrosis (M16.5)
2.80. Other secondary coxarthrosis, bilateral (M16.6)
2.81. Other secondary coxarthrosis (M16.7)
2.82. Post-traumatic gonarthrosis, bilateral (M17.2)
2.83. Other post-traumatic gonarthrosis (M17.3)
2.84. Other secondary gonarthrosis, bilateral (M17.4)
2.85. Other secondary gonarthrosis (M17.5)
2.86. Post-traumatic arthrosis of first carpometacarpal joints, bilateral (M18.2)
2.87. Other post-traumatic arthrosis of first carpometacarpal joint (M18.3)
2.88. Other secondary arthrosis of first carpometacarpal joints, bilateral (M18.4)
2.89. Other secondary arthrosis of first carpometacarpal joint (M18.5)
2.90. Post-traumatic arthrosis of other joints (M19.1)
2.91. Other secondary arthrosis (M19.2)
2.92. Other secondary scoliosis (M41.5)
2.93. Postoophorectomy osteoporosis with pathological fracture (M80.1)
2.94. Postsurgical malabsorption osteoporosis with pathological fracture (M80.3)
2.95. Postoophorectomy osteoporosis (M81.1)
2.96. Postsurgical malabsorption osteoporosis (M81.3)
2.97. Osteomyelitis (M86)
2.98. Other secondary osteonecrosis (M87.3)
2.99. Acute renal failure, chronic kidney disease, and unspecified kidney failure (N17–N19)
2.100. Post-traumatic urethral stricture (N35.0)
2.101. Postinfective urethral stricture, not elsewhere classified (N35.1)
2.102. Urinary tract infection, site not specified (N39.0)
2.103. Pre-existing secondary hypertension complicating pregnancy, childbirth and the puerperium (O10.4)
2.104. Secondary uterine inertia (O62.1)
2.105. Respiratory distress of newborn (P22)

2.106. Fetal blood loss, unspecified (P50.9)
2.107. Neonatal haemorrhage, unspecified (P54.9)
2.108. Convulsions of newborn (P90)

3. Nonspecific underlying causes of death
   3.1.   Other gastroenteritis and colitis of infectious and unspecified origin (A09)
   3.2.   Bacterial infection, unspecified (A49.9)
   3.3.   Unspecified sexually transmitted disease (A64)
   3.4.   Viral infection, unspecified (B34.9)
   3.5.   Unspecified mycosis (B49)
   3.6.   Unspecified protozoal disease (B64)
   3.7.   Infestation, unspecified (B88.9)
   3.8.   Unspecified parasitic disease (B89)
   3.9.   Sequelae of unspecified infectious or parasitic disease (B94.9)
   3.10. Intestinal tract, part unspecified (C26.0)
   3.11. Ill-defined sites within the digestive system (C26.9)
   3.12. Upper respiratory tract, part unspecified (C39.0)
   3.13. Ill-defined sites within the respiratory system (C39.9)
   3.14. Female genital organ, unspecified (C57.9)
   3.15. Male genital organ, unspecified (C63.9)
   3.16. Urinary organ, unspecified (C68.9)
   3.17. Central nervous system, unspecified (C72.9)
   3.18. Endocrine gland, unspecified (C75.9)
   3.19. Malignant neoplasm of other and ill-defined sites (C76)
   3.20. Malignant neoplasm, without specification of site (C80)
   3.21. Malignant neoplasm of lymphoid, haematopoietic and related tissue, unspecified (C96.9)
   3.22. Digestive organ, unspecified (D01.9)
   3.23. Respiratory system, unspecified (D02.4)
   3.24. Carcinoma in situ, unspecified (D09.9)
   3.25. Ill-defined sites within the digestive system (D13.9)
   3.26. Respiratory system, unspecified (D14.4)
   3.27. Intrathoracic organ, unspecified (D15.9)
   3.28. Female genital organ, unspecified (D28.9)
   3.29. Male genital organ, unspecified (D29.9)
   3.30. Urinary organ, unspecified (D30.9)
   3.31. Central nervous system, unspecified (D33.9)
   3.32. Endocrine gland, unspecified (D35.9)
   3.33. Benign neoplasm of unspecified site (D36.9)
   3.34. Digestive organ, unspecified (D37.9)
   3.35. Respiratory organ, unspecified (D38.6)
   3.36. Female genital organ, unspecified (D39.9)
   3.37. Male genital organ, unspecified (D40.9)
   3.38. Urinary organ, unspecified (D41.9)
   3.39. Central nervous system, unspecified (D43.9)
   3.40. Endocrine gland, unspecified (D44.9)
   3.41. Neoplasm of uncertain or unknown behaviour of lymphoid, haematopoietic and related tissue, unspecified (D47.9)
   3.42. Neoplasm of uncertain or unknown behaviour, unspecified (D48.9)
   3.43. Coagulation defect, unspecified (D68.9)
   3.44. Disorder of white blood cells, unspecified (D72.9)
   3.45. Disease of spleen, unspecified (D73.9)
   3.46. Disease of blood and blood-forming organs, unspecified (D75.9)
   3.47. Immunodeficiency, unspecified (D84.9)
   3.48. Disorder involving the immune mechanism, unspecified (D89.9)
   3.49. Disorder of thyroid, unspecified (E07.9)
   3.50. Unspecified diabetes mellitus (E14)
   3.51. Disorder of parathyroid gland, unspecified (E21.5)
   3.52. Disorder of pituitary gland, unspecified (E23.7)
   3.53. Disorder of adrenal gland, unspecified (E27.9)

3.54.   Ovarian dysfunction, unspecified (E28.9)
3.55.   Testicular dysfunction, unspecified (E29.9)
3.56.   Polyglandular dysfunction, unspecified (E31.9)
3.57.   Disease of thymus, unspecified (E32.9)
3.58.   Endocrine disorder, unspecified (E34.9)
3.59.   Metabolic disorder, unspecified (E88.9)
3.60.   Unspecified dementia (F03)
3.61.   Unspecified mental disorder due to brain damage and dysfunction and to physical disease (F06.9)
3.62.   Unspecified organic personality and behavioural disorder due to brain disease, damage and dysfunction (F07.9)
3.63.   Unspecified organic or symptomatic mental disorder (F09)
3.64.   Mental disorder, not otherwise specified (F99)
3.65.   Degenerative disease of nervous system, unspecified (G31.9)
3.66.   Polyneuropathy, unspecified (G62.9)
3.67.   Myopathy, unspecified (G72.9)
3.68.   Disorder of autonomic nervous system, unspecified (G90.9)
3.69.   Disorder of brain, unspecified (G93.9)
3.70.   Disease of spinal cord, unspecified (G95.9)
3.71.   Disorder of central nervous system, unspecified (G96.9)
3.72.   Disorder of orbit, unspecified (H05.9)
3.73.   Disorder of globe, unspecified (H44.9)
3.74.   Eustachian tube disorder, unspecified (H69.9)
3.75.   Disorder of tympanic membrane, unspecified (H73.9)
3.76.   Disorder of middle ear and mastoid, unspecified (H74.9)
3.77.   Atherosclerotic cardiovascular disease, so described (I25.0)
3.78.   Atherosclerotic heart disease (I25.1)
3.79.   Chronic ischaemic heart disease, unspecified (I25.9)
3.80.   Disease of pulmonary vessels, unspecified (I28.9)
3.81.   Conduction disorder, unspecified (I45.9)
3.82.   Cardiovascular disease, unspecified (I51.6)
3.83.   Other ill-defined heart diseases (I51.8)
3.84.   Heart disease, unspecified (I51.9)
3.85.   Stroke, not specified as haemorrhage or infarction (I64)
3.86.   Cerebrovascular disease, unspecified (I67.9)
3.87.   Sequelae of stroke, not specified as haemorrhage or infarction (I69.4)
3.88.   Aneurysm and dissection of unspecified site (I72.9)
3.89.   Disorder of arteries and arterioles, unspecified (I77.9)
3.90.   Disease of capillaries, unspecified (I78.9)
3.91.   Disorder of vein, unspecified (I87.9)
3.92.   Noninfective disorder of lymphatic vessels and lymph nodes, unspecified (I89.9)
3.93.   Unspecified acute lower respiratory infection (J22)
3.94.   Disease of upper respiratory tract, unspecified (J39.9)
3.95.   Respiratory conditions due to unspecified external agent (J70.9)
3.96.   Respiratory disorder, unspecified (J98.9)
3.97.   Disease of oesophagus, unspecified (K22.9)
3.98.   Disease of stomach and duodenum, unspecified (K31.9)
3.99.   Disease of appendix, unspecified (K38.9)
3.100. Disease of anus and rectum, unspecified (K62.9)
3.101. Disease of intestine, unspecified (K63.9)
3.102. Inflammatory liver disease, unspecified (K75.9)
3.103. Liver disease, unspecified (K76.9)
3.104. Disease of gallbladder, unspecified (K82.9)
3.105. Disease of biliary tract, unspecified (K83.9)
3.106. Disease of pancreas, unspecified (K86.9)
3.107. Disease of digestive system, unspecified (K92.9)
3.108. Dermatitis due to unspecified substance taken internally (L27.9)
3.109. Cervical disc disorder, unspecified (M50.9)
3.110. Intervertebral disc disorder, unspecified (M51.9)

3.111.   Disorder of muscle, unspecified (M62.9)
3.112.   Fibroblastic disorder, unspecified (M72.9)
3.113.   Disorder of bone, unspecified (M89.9)
3.114.   Disorder of cartilage, unspecified (M94.9)
3.115.   Unspecified nephritic syndrome (N05)
3.116.   Disorder of kidney and ureter, unspecified (N28.9)
3.117.   Bladder disorder, unspecified (N32.9)
3.118.   Urethral disorder, unspecified (N36.9)
3.119.   Disorder of urinary system, unspecified (N39.9)
3.120.   Disorder of prostate, unspecified (N42.9)
3.121.   Disorder of penis, unspecified (N48.9)
3.122.   Disorder of male genital organs, unspecified (N50.9)
3.123.   Unspecified lump in breast (N63)
3.124.   Disorder of breast, unspecified (N64.9)
3.125.   Disease of Bartholin gland, unspecified (N75.9)
3.126.   Noninflammatory disorder of ovary, fallopian tube and broad ligament, unspecified (N83.9)
3.127.   Unspecified abortion (O06)
3.128.   Diabetes mellitus in pregnancy, unspecified (O24.9)
3.129.   Pregnancy-related condition, unspecified (O26.9)
3.130.   Disorder of amniotic fluid and membranes, unspecified (O41.9)
3.131.   Placental disorder, unspecified (O43.9)
3.132.   Obstetric trauma, unspecified (O71.9)
3.133.   Complication of labour and delivery, unspecified (O75.9)
3.134.   Complication of the puerperium, unspecified (O90.9)
3.135.   Obstetric death of unspecified cause (O95)
3.136.   Death from unspecified obstetric cause (O96.9)
3.137.   Death from sequelae of obstetric cause, unspecified (O97.9)
3.138.   Unspecified maternal infectious or parasitic disease complicating pregnancy, childbirth and the puerperium (O98.9)
3.139.   Fetus and newborn affected by unspecified maternal condition (P00.9)
3.140.   Fetus and newborn affected by maternal complication of pregnancy, unspecified (P01.9)
3.141.   Fetus and newborn affected by abnormality of membranes, unspecified (P02.9)
3.142.   Fetus and newborn affected by complication of labour and delivery, unspecified (P03.9)
3.143.   Fetus and newborn affected by maternal noxious influence, unspecified (P04.9)
3.144.   Respiratory condition of newborn, unspecified (P28.9)
3.145.   Cardiovascular disorder originating in the perinatal period, unspecified (P29.9)
3.146.   Congenital viral disease, unspecified (P35.9)
3.147.   Bacterial sepsis of newborn, unspecified (P36.9)
3.148.   Congenital infectious and parasitic disease, unspecified (P37.9)
3.149.   Infection specific to the perinatal period, unspecified (P39.9)
3.150.   Perinatal haematological disorder, unspecified (P61.9)
3.151.   Transitory neonatal endocrine disorder, unspecified (P72.9)
3.152.   Transitory metabolic disturbance of newborn, unspecified (P74.9)
3.153.   Perinatal digestive system disorder, unspecified (P78.9)
3.154.   Condition of integument specific to fetus and newborn, unspecified (P83.9)
3.155.   Disturbance of cerebral status of newborn, unspecified (P91.9)
3.156.   Disorder of muscle tone of newborn, unspecified (P94.9)
3.157.   Condition originating in the perinatal period, unspecified (P96.9)
3.158.   Congenital malformation of circulatory system, unspecified (Q28.9)
3.159.   Congenital malformation of respiratory system, unspecified (Q34.9)
3.160.   Congenital malformation of digestive system, unspecified (Q45.9)
3.161.   Congenital malformation of urinary system, unspecified (Q64.9)
3.162.   Congenital malformation of musculoskeletal system, unspecified (Q79.9)
3.163.   Congenital malformation, unspecified (Q89.9)
3.164.   Sex chromosome abnormality, female phenotype, unspecified (Q97.9)
3.165.   Sex chromosome abnormality, male phenotype, unspecified (Q98.9)
3.166.   Chromosomal abnormality, unspecified (Q99.9)
3.167.   Terrorism, unspecified (*U01.9)

3.168. Unspecified transport accident (V99)
3.169. Unspecified fall (W19)
3.170. Unspecified drowning and submersion (W74)
3.171. Unspecified threat to breathing (W84)
3.172. Contact with unspecified venomous animal or plant (X29)
3.173. Unspecified privation (X57)
3.174. Exposure to unspecified factor (X59)
3.175. Intentional self-harm by unspecified means (X84)
3.176. Assault by unspecified chemical or noxious substance (X90)
3.177. Assault by unspecified means (Y09)
3.178. Unspecified event, undetermined intent (Y34)
3.179. Legal intervention, means unspecified (Y35.7)
3.180. War operations, unspecified (Y36.9)
3.181. Drug or medicament, unspecified (Y57.9)
3.182. Vaccine or biological substance, unspecified (Y59.9)
3.183. Unspecified misadventure during surgical and medical care (Y69)
3.184. Surgical procedure, unspecified (Y83.9)
3.185. Medical procedure, unspecified (Y84.9)
3.186. Sequelae of unspecified external cause (Y89.9)

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