Certification of causes of death in Europe

Medical doctors' manual of cause-of-death certification

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Certification of causes of death in Europe

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Introduction

The objective of course is to improve the knowledge and skills in issuing death certificates and certifying causes of death. The course is addressed to medical doctors and representatives of medical professions, students of medical studies and other persons for whom the competences in cause-of-death certification are important on a daily basis.

Reliable information on causes of death provides the opportunity of:
- Proposing an effective health policy based on scientific knowledge,
- Planning effective prevention, screening and health-promoting programmes,
- Implementing policy programs that address the most important risk factors and population needs,
- Identifying solutions that decrease social and regional health inequalities.

Part I. Good practices in cause-of-death certification

Death certificate

In a death certificate, Part I (sections a) to d)) describes a chronological chain of events leading to death. The cause that initiated this chain of events leading to death is called **the underlying cause of death**. Part II includes all other (not listed in the precedent sections) important diseases, conditions and risk factors.

		Approximative interval between the onset and the death
Part I Disease or condition directly leading to death	a)_____ *due to (as consequence of):* b)_____ *due to (as consequence of):* c)_____ *due to (as consequence of):* d)_____	_____ _____ _____ _____
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	_____ _____	_____ _____

In a correctly filled in death certificate all causes of death constitute a logical, chronologically ordered chain of interrelated events that lead to the direct cause of death. Conditions described in the upper line result from causes described below and chronologically follow these causes. These information are important for medical doctors who validate the underlying cause of death and define its code according to the *International Statistical Classification of Diseases* and Related Health Problems.

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Three types of chain of events leading to death

1. A 3-link chain

A 63-year-old man, suffering from peptic ulcer disease for the last 15 years, had a perforation of ulcer. This condition developed into peritonitis one day later, and the man eventually died.

		Approximative interval between the onset and the death
Part I Disease or condition directly leading to death	a) *Acute peritonitis* *due to (as consequence of):* b) *Acute gastric ulcer with perforation* *due to (as consequence of):* c) *Peptic ulcer disease*	*2 days* *3 days* *15 years*

Comment: At the final stage of death registration, the underlying cause of death will be validated as gastric ulcer, chronic or unspecified with perforation (ICD code K25.5).
Source: Stawińska-Witoszyńska B., Gałęcki J., Wasilewski W., 2019, *Poradnik szkoleniowy dla lekarzy orzekających o przyczynach zgonów i wystawiających kartę zgonu*, PZH – NIZP, MZ, Warszawa, p. 13.

2. A 2-link chain

A 66-year-old woman has been suffering from atherosclerotic heart disease for the last 20 years. 1.5 years ago she was diagnosed with congestive heart failure that eventually led to death.

		Approximative interval between the onset and the death
Part I Disease or condition directly leading to death	a) *Congestive heart failure* *due to (as consequence of):* b) *Atherosclerotic heart disease* *due to (as consequence of):* c)_____ *due to (as consequence of):* d)_____	*1.5 years* *20 years* _____ _____
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Nicotinism* _____	*30 years* _____

Source: Stawińska-Witoszyńska…, op. cit. p. 12.

Comment: If the chain of events leading to death consists only of two conditions, then the cause initiating the chain of events leading to death is written in the second line.

3. A 1-link chain

A 23-year-old man suffocated because of hanging himself in a forest.

Part I Disease or condition directly leading to death	a) *Intentional self-harm by hanging, in a forest* *due to (as consequence of):* b)_____ *due to (as consequence of):* c)_____	**Approximative interval between the onset and the death** *several minutes* _____ _____

Comment: In some circumstances, when the direct cause of death is not a consequence of a disease or injury, the death certificate includes only the direct cause of death (other subsections are left empty). In this case, the condition or event written in the subsection of direct cause of death is recognized at subsequent stages of registration as the underlying cause of death.

The general rule for short chains of events: In two-link chains the underlying cause is written in the second line, while in one-link chains it is written in the first line. Thus, the underlying cause can be written in all lines, but it is always placed in the lowest filled-in line.

The importance of the underlying cause of death

Cause of death data, available at the World Health Organisation, concern only the underlying causes of death. According to the WHO, the underlying cause of death is the most important for the health policy because prevention of diseases and injuries is “the most efficient from the point of view of public health”.

Thanks to the progress in the digitalization of public statistic systems, an increasing number of countries collect and publish data about all causes of death listed in death certificates, as well as on other significant conditions contributing to death, but not related to the disease or condition causing it. This information allows advanced epidemiologic research concerning the complications of non-infectious diseases, and the role of risk factors and co-existing morbid conditions in mortality.

For instance, circulatory failure which is a consequence of other diseases, not necessarily cardiovascular diseases, constitutes an important public health problem in Europe. Other diseases, such as diabetes mellitus and asthma, are rarely registered as underlying causes of death but exert a considerable impact on the course of chronic diseases and the overall health condition of a patient.

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Practical tips concerning filling in death certificates

– The section concerning causes of death should be filled in descriptively, without abbreviations that could be incomprehensible for persons verifying the death certificate at the subsequent stages of registration;

– If the death certificate is filled in manually, causes of death should be written legibly, with capital letters, most preferably black ink;

– The line including direct cause of death needs to always to be filled in;

– Lines including causes of death should include only one disease, condition, circumstances or consequence of external cause of death;

– The causes of death should be listed according to chronological order of onset;

– The last line, describing other circumstances, should not include the same diseases and conditions that have been defined in the precedent lines;

– The causes of death may be accompanied by their code of International Statistical Classification of Diseases and Related Health Problems (ICD-10).

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Part II. International Statistical Classification of Diseases and Related Health Problems (ICD10)

The contents of ICD10

The classification of diseases includes all possible diseases and injuries leading to death, grouped according to a well-defined rule.

The arrangement of classification is:
- exhaustive, that is it includes all potential causes of death,
- exclusive, that is single causes of death belong only to one subgroup of causes.

Updates of the Classification are validated at international conferences of World Health Organisation representatives. An up-to-date ICD revision in English, together with a practical search tool are available here: https://icd.who.int/browse10/2019/en

Causes and health problems were grouped into 22 chapters in the following way:
- Most chapters relate to particular body systems,
- Several chapters refer to specific diseases and health problems that may affect either a whole body or many different sites,
- Chapter XIX is not used to determine causes of death
- Chapter XXII is reserved for new diseases, added after the ICD revision was published.

Chapter	Block	Title
I	A00-B99	Certain infectious and parasitic diseases
II	C00-D48	Neoplasms
III	D50-D89	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
IV	E00-E90	Endocrine, nutritional and metabolic diseases
V	F00-F99	Mental and behavioural disorders
VI	G00-G99	Diseases of the nervous system
VII	H00-H59	Diseases of the eye and adnexa
VIII	H60-H95	Diseases of the ear and mastoid process
IX	I00-I99	Diseases of the circulatory system
X	J00-J99	Diseases of the respiratory system
XI	K00-K93	Diseases of the digestive system
XII	L00-L99	Diseases of the skin and subcutaneous tissue
XIII	M00-M99	Diseases of the musculoskeletal system and connective tissue
XIV	N00-N99	Diseases of the genitourinary system
XV	O00-O99	Pregnancy, childbirth and the puerperium
XVI	P00-P96	Certain conditions originating in the perinatal period
XVII	Q00-Q96	Congenital malformations, deformations and chromosomal abnormalities
XVIII	R00-R99	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
XIX	S00-T98	Injury, poisoning and certain other consequences of external causes
XX	V01-Y98	External causes of morbidity and mortality
XXI	Z00-Z99	Factors influencing health status and contact with health services
XXII	U00-U99	Codes for special purposes

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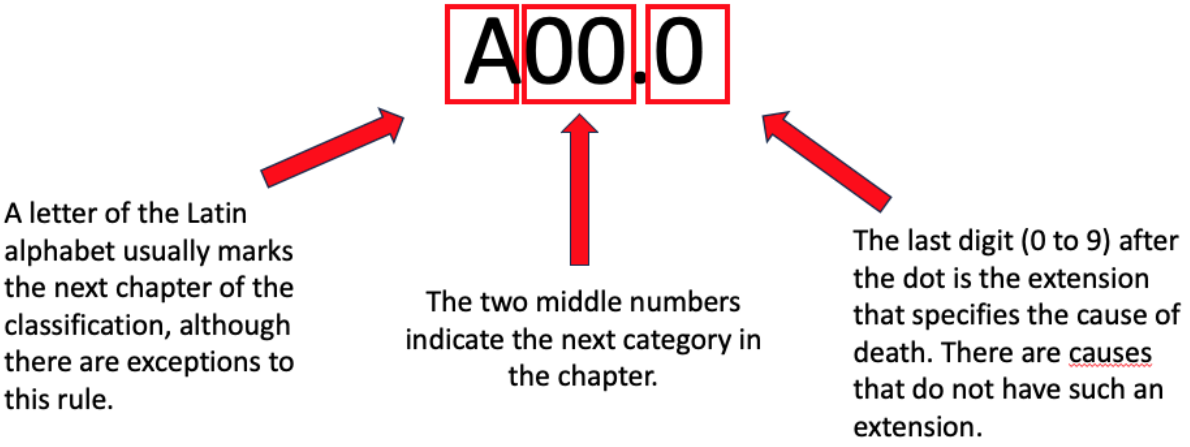
The ICD10 code

Each cause of death has been assigned a 3- or 4-digit alphanumeric code consisting of one letter (A-Y) followed by two or three digits.



Selected chapters of ICD10

In these four chapters of the Classification, the principles of grouping causes of death are not obvious and require additional explanation. This information specifies the fourth character of the code (extension).

In infectious diseases, it is important to define:

1) the pathogen causing the disease
2) organs affected
3) form of the disease
4) complications.

e.g., the pathogen causing the disease:

A37	**Whooping cough**
A37.0	Whooping cough due to *Bordetella pertussis*
A37.1	Whooping cough due to *Bordetella parapertussis*
A37.8	Whooping cough due to other *Bordetella* species
A37.9	Whooping cough, unspecified

In the case of neoplasms, it is important to determine the location of the primary tumor, e.g.

C40	**Malignant neoplasm of bone and articular cartilage of limbs**
C40.0	Scapula and long bones of upper limb
C40.1	Short bones of upper limb
C40.2	Long bones of lower limb
C40.3	Short bones of lower limb
C40.8	Overlapping lesion of bone and articular cartilage of limbs [See note 5 at the beginning of this chapter]
C40.9	Bone and articular cartilage of limb, unspecified

In case of diseases of circulatory system, it is necessary to precisely specify the location and type of the disease process, e.g.

I63	**Cerebral infarction** *Incl.:* occlusion and stenosis of cerebral and precerebral arteries (including truncus brachiocephalicus), resulting in cerebral infarction *Excl.:* sequelae of cerebral infarction (I69.3)
I63.0	Cerebral infarction due to thrombosis of precerebral arteries
I63.1	Cerebral infarction due to embolism of precerebral arteries
I63.2	Cerebral infarction due to unspecified occlusion or stenosis of precerebral arteries
I63.3	Cerebral infarction due to thrombosis of cerebral arteries
I63.4	Cerebral infarction due to embolism of cerebral arteries
I63.5	Cerebral infarction due to unspecified occlusion or stenosis of cerebral arteries
I63.6	Cerebral infarction due to cerebral venous thrombosis, nonpyogenic
I63.8	Other cerebral infarction
I63.9	Cerebral infarction, unspecified

Chapter XX includes external causes of death, that is accidents, injuries and poisonings. Accidents include:
– transport accidents (ICD codes V01-V99)
– other external causes of accidental injury (ICD codes W01-X59)

When reporting death due to an accident, it is important to indicate the circumstances of the accident as the underlying cause of death, whereas the type of injury can be described as consequences of the underlying cause.

In case of traffic accidents, the following should be specified:

- vehicle type: passenger car, delivery truck, motorcycle, bicycle, etc.
- accident victim: pedestrian, cyclist, vehicle driver, passenger, etc.
- nature of the accident: road (i.e. on a public road) or non-road (off a public road).

Depending on the type of accident, the fourth character of the code identifies the victim or the nature of the incident. These categories are defined at the beginning of Chapter XX.

Example of a transport accident:

V43 **Car occupant injured in collision with car, pick-up truck or van**

- .0 Driver injured in nontraffic accident
- .1 Passenger injured in nontraffic accident
- .2 Person on outside of vehicle injured in nontraffic accident
- .3 Unspecified car occupant injured in nontraffic accident
- .4 Person injured while boarding or alighting
- .5 Driver injured in traffic accident
- .6 Passenger injured in traffic accident
- .7 Person on outside of vehicle injured in traffic accident
- .9 Unspecified car occupant injured in traffic accident

The ICD code V43.5 means the driver of a car was injured in a road accident (collision with another car, delivery vehicle or truck).

Other external causes include falls, exposure to mechanical forces, drowning, deliberate self-harm, assaults, and complications of medical care. For these events, the place and other circumstances should be specified. For events such as poisoning, falls, and drowning, it should be determined whether they were accidental or intentional, e.g.:

X40 **Accidental poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics**

Incl.: 4-aminophenol derivatives
nonsteroidal anti-inflammatory drugs [NSAID]
pyrazolone derivatives
salicylates

X60 **Intentional self-poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics**

Incl.: 4-aminophenol derivatives
nonsteroidal anti-inflammatory drugs [NSAID]
pyrazolone derivatives
salicylates

Y10 **Poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics, undetermined intent**

Incl.: 4-aminophenol derivatives
nonsteroidal anti-inflammatory drugs [NSAID]
pyrazolone derivatives
salicylates

In the case of adverse effects of medical and surgical care, the following are distinguished:

- Adverse effects of drugs, pharmacological agents and biological substances used in treatment
- Accidents of patients during surgical and medical care
- Adverse incidents in diagnostic and therapeutic practice related to the use of medical devices
- Surgical and other medical procedures as the cause of the patient's abnormal response or subsequent complications, with no information about failure during the procedure.

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Part III. The most common errors in the certification of causes of death

Priority of causes of death

In determining the underlying cause of death, choose the disease or condition that most probably led to death. Primary disease takes precedence over complications, and more severe disease takes precedence over milder disease.

It is assumed that the following initial causes are the most important:

- the circumstances of accidents, injuries and poisonings with death (if an accident, injury or poisoning led to death, this initial cause should be found, regardless of any infectious diseases, circulatory system or cancer),

- infectious diseases (if possible, provide the etiological factors of the disease),

- malignant neoplasms (neoplastic disease remains the primary cause of death in people who died from a heart attack, ischemic stroke or pneumonia),

- diseases requiring surgery,

- complications of pregnancy, childbirth and the puerperium.

If an accident, injury or poisoning led to death, this initial cause should be indicated, regardless of any infectious diseases, circulatory system or cancer.

Error no. 1. Using so-called garbage codes

The most frequent error of medical doctors who fill in death certificates consists of using statistical categories for underlying causes of death that are not accepted by the WHO. These codes are so-called **garbage codes**.

The term of garbage codes was coined by epidemiologists, Christopher Murray and Alan Lopez (1996). It denotes all ICD codes that are not useful in the analyses of public health and mortality and that cannot provide specific recommendations for health policy. Garbage codes have low informative value and are eliminated from more detailed epidemiological and demographic studies. In such analyses, the deaths registered due to garbage codes are usually randomly redistributed across other, well-defined causes of death.

So-called garbage codes include:
– medical conditions that cannot or should not be considered as underlying causes of death because they indicate symptoms, signs or ill-defined conditions, such as respiratory arrest (ICD10 code: R09.2), senility (R54) or generalized and unspecified atherosclerosis (I70.9),
– medical conditions that indicate intermediate or immediate causes of death, such as heart failure (I50), acute and chronic renal failure (N17, N18), streptococcal and other septicaemia (A40, A41),
– medical conditions that remain insufficiently specified within larger groups of causes, such as malignant neoplasm of other and ill-defined sites (C76), stroke, not specified as haemorrhage or infarction (I64).

The WHO established two lists of garbage codes:

Short list:
- Ill-defined cancer sites: malignant neoplasm of other and ill-defined sites (C76), malignant neoplasm, without specification of site (C80) and malignant neoplasms of independent (primary) multiple sites (C97),
- Ill-defined cardiovascular diseases: cardiac arrest (I46), ventricular tachycardia (I47.2), ventricular fibrillation and flutter (I49.0), heart failure (I50), some complications and ill-defined descriptions of heart disease: myocarditis, unspecified (I51.4), myocardial degeneration (I51.5), cardiovascular disease, unspecified (I51.6), heart disease, unspecified (I51.9), generalized and unspecified atherosclerosis (I70.9),
- Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (all R codes),
- External events of undetermined intent (Y10-Y34, Y87.2).

Expanded list:
- All causes of death from the short list,
- Streptococcal and other sepsis (A40, A41),
- Disseminated intravascular coagulation [defibrination syndrome] (D65),
- Volume depletion (E86),
- Essential (primary) hypertension (I10),
- Pulmonary embolism without mention of acute cor pulmonale (I26.9),
- Other and unspecified disorders of circulatory system (I99),
- Pulmonary oedema (J81),
- Respiratory failure, not elsewhere classified (J96),
- Hepatic failure, not elsewhere classified (K72),
- Acute renal failure (N17), chronic kidney disease (N18), unspecified kidney failure (N19),
- Respiratory failure of newborn (P28.5),

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Examples of incorrect death certificates

Example 1. A 50-year-old man was admitted to the emergency room with severe sharp abdominal pain radiating to the chest and back. The man had a medical history of abdominal aortic aneurysm, which was diagnosed 5 years ago, due to atherosclerosis affecting the aorta (known for the last 10 years), hyperthyroidism and hypercholesterolemia. The man died soon after his admission.

Part I Disease or condition directly leading to death	a) *Aortic dissection* *due to (as consequence of):* b) *Abdominal aortic aneurysm* *due to (as consequence of):* c) *Generalized and unspecified atherosclerosis* *due to (as consequence of):*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*hyperthyroidism, hypercholesterolemia*

Comment: Generalized and unspecified atherosclerosis is a very general term that provides no specific guidelines for improvements in health policy concerning cardiovascular diseases. In this case, the atherosclerosis affecting the aorta was diagnosed and should be indicated as the underlying cause of death.

Part I Disease or condition directly leading to death	a) *Aortic dissection* *due to (as consequence of):* b) *Abdominal aortic aneurysm* *due to (as consequence of):* c) *Atherosclerosis of the aorta* *due to (as consequence of):*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*hyperthyroidism, hypercholesterolemia*

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Example 2. A 89-year-old man was treated in the hospital for recurrent cerebral infarction of embolic origin due to known atrial fibrillation. Two weeks later he was stable and was discharged from the hospital with a plan of rehabilitation in the following month. Two days later he died during his sleep. A recurrent ischemic stroke was postulated.

Part I Disease or condition directly leading to death	a) *Unattended death* *due to (as consequence of):* b) *Cerebral infarction* *due to (as consequence of):* c) *Atrial fibrillation* *due to (as consequence of):* d)_____
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	_____ _____ _____

Comment: Unattended death should not be used whenever additional information is available from medical documentation or the primary care physician of the deceased person. In this case, another cerebral infarction most probably took place. It is also a non-garbage code and should be indicated as the condition directly leading to death.

Part I Disease or condition directly leading to death	a) *Cerebral infarction due to thrombosis of precerebral arteries* *due to (as consequence of):* b) *Cerebral infarction* *due to (as consequence of):* c) *Atrial fibrillation* *due to (as consequence of):* d)_____
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	_____ _____ _____

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Example 3. An 87-year-old bedridden woman had a long history of chronic obstructive pulmonary disease and chronic pulmonary heart disease. The day before her death, she experienced dyspnea which was caused by a pulmonary embolism. The next day she developed ventricular fibrillation and eventually died.

Part I Disease or condition directly leading to death	a) *Ventricular fibrillation* *due to (as consequence of):* b) *Pulmonary embolism* *due to (as consequence of):* c) *Bed confinement status (bedridden)* *due to (as consequence of):* d) *Senility*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*chronic obstructive pulmonary disease, chronic pulmonary heart disease*

Comment: Senility should not be used as the condition that initiated the causal chain of morbid events leading to death. A so-described condition provides no specific guidance for health policy makers. In this case, pulmonary embolism entailed ventricular fibrillation and flutter and death. It is also the only non-garbage code indicated in the death certificate and as such should be indicated as the cause that initiated the chain of events leading to death.

Part I Disease or condition directly leading to death	a) *Ventricular fibrillation* *due to (as consequence of):* b) *Pulmonary embolism* *due to (as consequence of):*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*chronic obstructive pulmonary disease, chronic pulmonary heart disease*

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Error no. 2. Describing mode of death as a direct cause of death

The direct cause of death does not mean the mechanism or the mode of death. The descriptions of mechanisms and modes of death do not provide any valuable information explaining the morbid process and are not useful for stakeholders establishing health policy.

These descriptions should be avoided: asystole, cachexia, cardiac arrest, cardiac and respiratory failure, malaise and fatigue, multi-organ failure, natural death, respiratory arrest, syncope and collapse.

Cardiac arrest, which constitutes the final effect of every mortal disease, occurs due to the mechanical activity stopping the heart, mostly as a result of arrhythmia. This condition, if it lasts respectively long time, leads to respiratory arrest, irreversible damage to the central nervous system and, consequently, death. If the direct cause of death is described as renal failure, respiratory arrest or multi-organ failure, then it is required to describe the aetiology of this condition in the lines below.

Error no. 3. Lack of logical and chronological chain of events leading to death

As we discussed, in a correctly filled death certificate all morbid conditions and injuries constitute a logical, chronologically ordered chain of interrelated events. Whether the chain is two- or three-link, all morbid conditions result from causes written in lines directly below, and chronologically take place after the causes written in lines directly below.

Part I
Disease or condition
directly leading to death

a) *Peritonitis due to bile*
due to (as consequence of):

b) *Echinococcus granulosus infection of liver*
due to (as consequence of):

c) *Congestive heart failure*

Comment: Congestive heart failure cannot be considered as the cause of infection of the liver and, later on, of peritonitis due to bile.

Part I
Disease or condition
directly leading to death

a) *Cystic fibrosis, unspecified*
due to (as consequence of):

b) *Bronchiectasis*

Comment: In this case the order of causes is incorrect. Cystic fibrosis should be considered as a condition that initiated bronchiectasis.

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Part I Disease or condition directly leading to death	a) *Rupture of papillary muscle as current complication following acute myocardial infarction* *due to (as consequence of):* b) *Acute transmural myocardial infarction of anterior wall* *due to (as consequence of):* c) *Diverticular disease of large intestine without perforation or abscess*

Comment: In this case diverticular disease of large intestine should not be considered as a condition that provoked acute myocardial infarction and initiated the chain of events leading to death.

Error no. 4. Indicating the type of injury instead of the circumstances of the event

This is a serious and frequent error made by medical doctors filling in death certificates. The error consists of describing, as the underlying cause of death, a type of injury (ICD codes from S00 to T98) instead of **circumstances of the event that led to this injury** (ICD codes from V01 to Y98).

Types of injuries, such as:
– intracranial injury
– burns of the abdomen,
can be indicated as consequences of the underlying cause of death.

Circumstances of event, such as:
– injury of a pedestrian in a traffic collision with a car,
– poisoning
should be described as the underlying cause of death.

In case of poisoning, one should indicate if intentional or accidental, and the type of substance, i.e. medicaments, alcohol, chemic substances, gases and vapours.

Without precise information on circumstances of injury or accident, referring to statistical categories defined in the ICD Classification, the ICD10 code of the underlying cause of death cannot be defined and, later on, serve to establish effective health policy recommendations.

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Examples of incorrect death certificates

Example no. 1

Part I Disease or condition directly leading to death	a) *Intracranial haemorrhage* *due to (as consequence of):* b) *Fracture of skull and facial bones* *due to (as consequence of):* c) _____

Part I Disease or condition directly leading to death	a) *Intracranial haemorrhage* *due to (as consequence of):* b) *Fracture of skull and facial bones* *due to (as consequence of):* c) *Car occupant injured in collision with car, pick-up truck or van, driver injured in traffic accident*

Example no. 2

Part I Disease or condition directly leading to death	a) *Traumatic haemorrhage* *due to (as consequence of):* b) *Multiple organ trauma* *due to (as consequence of):* c) *Fall from high altitude*

Part I Disease or condition directly leading to death	a) *Traumatic haemorrhage* *due to (as consequence of):* b) *Multiple organ trauma* *due to (as consequence of):* c) *Fall out of building, home*

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Example no. 3

Part I
Disease or condition
directly leading to death

a) *Pulmonary embolism*
due to (as consequence of):

b) *Fracture of neck of femur*
due to (as consequence of):

c) _____

Part I
Disease or condition
directly leading to death

a) *Pulmonary embolism*
due to (as consequence of):

b) *Fracture of neck of femur*
due to (as consequence of):

c) *Fall from a ladder, at home*

Types of injuries, that is categories that **cannot** be indicated as underlying causes of death 	Circumstances of injuries, that is categories that **can** be used as underlying causes of death 
Fracture of neck of femur Burn involving larynx and trachea with lung Foreign body in respiratory tract Effects of electric current Toxic effect of alcohol: methanol	Fall from tree in a forest Explosion and rupture of boiler, at home Drowning and submersion while in natural water Exposure to electric transmission lines, at street Accidental poisoning by methanol, at home

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Error no. 5. Using trivial diseases as underlying causes of death

This is not a frequent error, yet, it should definitely be avoided. This error consists of indicating trivial diseases, with a relatively benign course, that cannot initiate or lead to death. Examples include strabismus or psoriasis.

Trivial diseases	Correct underlying causes
✗	✓
Lipoma of tight	Acute bronchitis
Allergic rhinitis caused by pollen	Systemic lupus erythematosus
Nasal septum deviation	Diabetes type 2
Head lice	Antifungal antibiotics causing adverse effects in therapeutic use

If death occurred due to complications of adverse reaction to medical treatment of a trivial disease, then this reaction should be indicated as the underlying cause of death, such as:

– Drugs, medicaments and biological substances causing adverse effects in therapeutic use, or

– Medical devices associated with adverse incidents in diagnostic and therapeutic use.

In this case, trivial disease should be mentioned in part II concerning other significant conditions contributing to death.

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Part IV. Case studies

Exercises with commentaries that facilitate understanding the rules of cause-of-death certification

Case no. 1.

A 75-year-old woman was admitted to the hospital with severe chest pain. She was diagnosed with malignant neoplasm of the sigmoid 3 months ago, after a colonoscopy due to persistent anaemia, but she refused surgery. On her recent admission, the nature of the pain, the troponin levels and the ECG findings were diagnostic of acute anterior wall myocardial infarction. She died one day later. The patient was obese and had a history of hypertension for the last 25 years.

Part I Disease or condition directly leading to death	a) *Acute anterior wall myocardial infarction* *due to (as consequence of):* b) *Long-term anaemia* *due to (as consequence of):* c) *Malignant neoplasm of the sigmoid*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*hypertension, obesity*

Comment: The patient's anaemia was caused by gastrointestinal bleeding from sigmoid cancer. We do not know how long the patient has been bleeding, but it is known that even a small reduction in the volume of circulating blood can reduce the flow through the coronary vessels and cause recurrent coronary ailments, and even heart attack.

Anaemia is one of the most common causes of acute coronary syndrome, and the most common type of anaemia is iron deficiency anaemia, which is the case here. Low levels of haemoglobin, an oxygen carrier, can cause coronary pain. In compensated anaemic individuals, heart rate and cardiac output increase, increasing oxygen demand and worsening coronary reserve.

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Case no. 2.

An 85-year-old woman was bedridden due to Alzheimer's disease. As a result, she developed pressure ulcers in the sacral region. Her past medical history was unremarkable except for hypercholesterolaemia. She was admitted to the hospital 5 days ago with fever due to an ulcer infection, which rapidly deteriorated to sepsis. She died in intensive care.

Part I Disease or condition directly leading to death	a) *Sepsis* *due to (as consequence of):* b) *Infected decubitus ulcers* *due to (as consequence of):* c) *Bed confinement status (bedridden)* *due to (as consequence of):* d) *Alzheimer's disease*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Hypercholesterolemia*

Comment: In the advanced stage of Alzheimer's disease, the patient is unable to perform normal daily activities, and due to problems with walking, he becomes a bedridden person and has problems with maintaining stool and urine. Comment: In the advanced stage of Alzheimer's disease, the patient is unable to carry out normal daily activities and, due to problems with walking, becomes bedridden and has problems with stool and urine management. Prolonged bedriddenness can lead to various types of infection, including urinary tract infections, pneumonia and pressure ulcers, which are common in people who are permanently immobilised. Infected pressure ulcers are a risk factor for the development of sepsis.

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Case no. 3.

An 80-year-old man was bedridden one month ago after an ischaemic stroke of the middle cerebral artery. Five years ago, the man was diagnosed with hypertension with congestive heart failure and atrial fibrillation. Being bedridden, the man developed aspiration pneumonia. He died 3 days later in intensive care.

Part I Disease or condition directly leading to death	a) *Aspiration pneumonia* *due to (as consequence of):* b) *Ischemic stroke of the middle cerebral artery* *due to (as consequence of):* c) *Hypertensive heart disease with (congestive) heart failure - hypertensive heart failure*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	

Comment: The patient had suffered from arterial hypertension for many years, leading to myocardial damage and circulatory failure. Isolated hypertension (i.e. without coronary artery disease) is one of the most common causes of heart failure. Hypertension is also a risk factor for atrial fibrillation, which the patient had and was at risk of having a stroke. Atrial fibrillation causes the blood to pool, which favours the formation of embolic material, or thrombi (especially in the left atrium). The thrombus may travel with the bloodstream from the left atrium to the cerebral artery and block it, causing an ischaemic stroke. Swallowing problems are common in patients who have had a stroke, and accidental ingestion of food into the airways can lead to aspiration pneumonia.

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Case no. 4.

A 70-year-old woman had a history of cerebral atherosclerosis for 10 years and renal failure for 5 years. Due to the atherosclerosis of the cerebral arteries, she developed vascular dementia a year ago. Last week she was hospitalised for aspiration pneumonia and eventually died.

Part I Disease or condition directly leading to death	a) *Aspiration pneumonia* *due to (as consequence of):* b) *Vascular dementia* *due to (as consequence of):* c) *Cerebral atherosclerosis*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Renal failure*

Comment: The result of cerebral atherosclerosis is narrowing of the cerebral vessels and reduced blood flow, leading to cerebral hypoxia. Cerebral atherosclerosis can lead to vascular dementia syndrome, which is characterised by cognitive impairment. As the condition worsens, the patient's ability to perform the simplest daily activities becomes impaired. The factors for the development of aspiration pneumonia in this patient, in addition to the underlying disease (possibly a recumbent patient), were age. Aspiration pneumonia often develops in the elderly due to age-related swallowing problems and a weakened cough reflex.

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Case no. 5.

A 65-year-old man with a history of heart failure and chronic obstructive pulmonary disease was admitted to hospital with symptoms suggestive of pneumonia during the COVID-19 pandemic. A nasopharyngeal swab showed COVID-19 infection. One week later, his condition deteriorated and he eventually developed ARDS. He died 2 days later in intensive care.

Part I Disease or condition directly leading to death	a) *ARDS* *due to (as consequence of):* b) *Interstitialis pneumonia* *due to (as consequence of):* c) *COVID-19 infection*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Heart failure, chronic obstructive pulmonary disease*

Comment: The ICD-10 code for COVID-19 infection is U07.1.

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Case no. 6.

A 25-year-old motorcyclist was involved in a car accident and injured his abdomen, but didn't seek medical attention at first. A few hours later, he was admitted to the emergency department with hypotension, pain in the left abdomen and pale skin. An ultrasound scan revealed a ruptured spleen, which caused severe bleeding. The man died shortly afterwards. He also had a history of type 1 diabetes mellitus.

Part I Disease or condition directly leading to death	a) *Hemorrhagic (hypovolemic) shock* *due to (as consequence of):* b) *Splenic rupture* *due to (as consequence of):* c) *Motorcycle driver injured in collision with car in traffic accident*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Type 1 diabetes mellitus*

Comment: The ICD-10 code V23 refers to a motorcyclist injured in a collision with a car, van or truck. The fourth character of the code, .4, refers to the driver injured in a road traffic accident. Definitions are given at the beginning of the section on road traffic accidents (codes V01-V99) of the ICD classification.

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Case no. 7.

A 23-year-old woman with a clear medical history presented to the emergency department with a stab wound to the left shoulder following a street fight. The attack caused a transection of the left subclavian artery, resulting in severe intrathoracic haemorrhage. She died shortly after admission.

Part I Disease or condition directly leading to death	a) *Intrathoracic hemorrhage* *due to (as consequence of):* b) *Transection of left subclavian artery* *due to (as consequence of):* c) *Assault by sharp object in a street fight*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	

Comment: The ICD-10 code X99 refers to an assault with a sharp object, while the fourth character of the code .4 refers to the place of the event: the street or pavement. Codes X85 - Y09 cover homicide, which is damage caused by another person with intent to injure or kill. The places of events are listed at the beginning of the chapter on external causes of death in the ICD.

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Case no. 8.

A 75-year-old man was admitted to the emergency department with ECG findings of third-degree atrioventricular block. Arterial blood gas showed severe hyperkalemia. The man died a few minutes later. His medical history included medication for hypothyroidism, type 2 diabetes mellitus and b-blockers and angiotensin converting enzyme inhibitors (ACEi) for poorly controlled primary (idiopathic) hypertension. The hyperkalemia is thought to have been caused by the ACEi and b-blockers.

Part I Disease or condition directly leading to death	a) *Third-degree atrio-ventricular block* *due to (as consequence of):* b) *Hyperkalemia* *due to (as consequence of):* c) *Adverse effect from therapeutic use of converting enzyme inhibitors (ACEi)*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*primary hypertension, hypothyroidism* *type 2 diabetes mellitus*

Comment: The underlying cause of death is an adverse effect of taking pharmacological agents (ICD codes Y40-Y59).

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Case no. 9.

A 65-year-old man was admitted to hospital with epileptic seizures. A CT scan revealed a malignant brain tumour. The man underwent surgery one month later. After the operation, he had an intracerebral haemorrhage as a complication of the operation and died one day later in intensive care. The man also had a history of myocardial infarction 5 years ago.

Part I Disease or condition directly leading to death	a) *Intracerebral hemorrhage* *due to (as consequence of):* b) *Surgery for malignant neoplasm of the brain*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*malignant neoplasm of the brain, past myocardial infarction*

Comment: No medical error was made during the operation. The underlying cause code is, therefore, to be taken from the section "Surgical and other medical management as the cause of the patient's abnormal response or subsequent complications, with no information on failure during the procedure" (ICD-10 codes Y83 – Y84). The disease or condition that caused the need for surgery or other treatment should listed in the section of 'Other significant circumstances contributing to death, but not related to disease or causing condition'.

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Case no. 10.

A 75-year-old woman was admitted to hospital and operated on for a subdural haemorrhage. According to her medical history, she had type 2 diabetes mellitus. 5 days after surgery, she was admitted to the ICU because of altered consciousness. On the third day in the ICU, she had a urinary tract infection, indicating sepsis, and died 1 day later.

Part I Disease or condition directly leading to death	a) *Sepsis* *due to (as consequence of):* b) *Urinary tract infection* *due to (as consequence of):* c) *Surgery due to subdural haemorrhage as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Subdural haemorrhage, type 2 diabetes mellitus*

Comment: The underlying cause of death is a postoperative complication, so the code for this cause is to be taken from the section "Surgical management and other medical management as the cause of an abnormal patient response or subsequent complications, with no information about surgical failure (Y83 – Y84)". A condition requiring surgical intervention should be listed in the section of 'Other significant circumstances contributing to death, but not related to disease or causing condition'.

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Case no. 11.

A 50-year-old man was due to undergo surgery for an inguinal hernia. Due to a medical error, he was poisoned with halothane during anaesthesia and developed malignant hyperthermia. He died a few hours later in intensive care.

Part I Disease or condition directly leading to death	a) *Malignant hyperthermia* *due to (as consequence of):* b) *Accidental poisoning by halothane during anesthesia for surgery*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Inguinal hernia*

Comment: The underlying cause of death was a medical error during anesthesia for surgery. A disease requiring surgical intervention should be listed in the section of 'Other significant circumstances contributing to death, but not related to disease or causing condition'.

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Exercises that require indicating the underlying cause of death

In each exercise, read the following description and indicate the underlying cause of death, that is a disease or injury that initiated the train of morbid events leading directly to death.

Case 1.
A 70-year-old woman presented to the Emergency Department with fever, chills, nausea and a stiff neck. These symptoms had started the day before. In hospital, the woman died of meningitis one hour after admission. There was no time for a lumbar puncture to take blood and cerebrospinal fluid to identify the pathogen. The woman was taking medication for type 2 diabetes mellitus and hypertension.

A) Meningitis due to other and unspecified causes, unspecified
B) Nonpyogenic meningitis due to other and unspecified causes
C) Chronic meningitis due to other and unspecified causes

Case 2.
A 21-year-old amateur footballer died unexpectedly during a football match. He had no other known medical conditions. The autopsy revealed that the man suffered from obstructive hypertrophic cardiomyopathy.

A) Obstructive hypertrophic cardiomyopathy
B) Dilated cardiomyopathy
C) Other restrictive cardiomyopathy

Case 3.
A 50-year-old man suddenly developed abdominal pain and died in the ambulance on the way to hospital. He had had hypertension for 30 years and in the last 3 years had developed an abdominal aortic aneurysm, which had been growing steadily. He also suffered from Crohn's disease.

A) Ruptured thoracic aortic aneurysm
B) Abdominal aortic aneurysm, without mention of rupture
C) Ruptured abdominal aortic aneurysm

Case 4.
A 60-year-old man had a history of hypercholesterolaemia and cerebral aneurysm of the middle cerebral artery (last 5 years). One day after a severe headache, he lost consciousness. The aneurysm had ruptured, causing a subarachnoid haemorrhage. The man died on the way to hospital.

A) Subarachnoid haemorrhage from middle cerebral artery
B) Subarachnoid haemorrhage from vertebral artery
C) Subarachnoid haemorrhage from anterior communicating artery

Case 5.
A 50-year-old man with chronic kidney disease due to poorly controlled hypertension for 10 years had been on dialysis for the last 6 months. He eventually died. He was also on medication for hypercholesterolaemia.

A) Hypertensive renal disease without renal failure
B) Hypertensive renal disease with renal failure (stage 5 chronic kidney disease or end stage renal disease)
C) Hypertensive heart and chronic kidney disease with heart failure

Case 6.
A 34-year-old woman with type 1 diabetes mellitus and chronic tubulo-interstitial nephritis was found unconscious on the floor of her bathroom. The woman had not previously taken care of her health and often ate irregularly. Doctors were unable to wake her from her diabetic coma and she died one hour after being admitted to hospital.

A) Type 1 diabetes mellitus with coma
B) Type 1 diabetes mellitus with ketoacidosis
C) Type 2 diabetes mellitus with coma

Case 7.
A 28-year-old man became infected with HIV through unprotected sexual intercourse and developed acquired immunodeficiency syndrome. He also had a history of sexually transmitted gonorrhoea and was diagnosed with Kaposi's sarcoma 1 month before admission. He was admitted to hospital with severe chest pain. The diagnosis was myocarditis caused by toxoplasma due to immunosuppression. He died the same day.

A) HIV disease resulting in cytomegaloviral disease
B) HIV disease resulting in candidiasis
C) HIV disease resulting in toxoplasma myocarditis

Case 8.
A 50-year-old woman was taking amitriptyline for depression and medication to control heart failure. She accidentally took a higher dose of amitriptyline and informed her daughter. She died at home before reaching hospital.

A) Accidental poisoning by exposure to antidepressants
B) Drugs, medicaments and biological substances causing adverse effects in therapeutic use (tricyclic and tetracyclic antidepressants)

Answers: 1) A; 2) A; 3) C; 4) A; 5) B; 6) A; 7) C; 8) A

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Exercises that require filling in all medical sections of death certificate

Case no. 1.

A 12-year-old girl was admitted to hospital with an intussusception of the small bowel secondary to a viral gastroenteritis one week before. The intussusception caused ischaemia and perforation of the bowel leading to acute peritonitis. She died a few hours later.

Part I Disease or condition directly leading to death	a) *Acute peritonitis* *due to (as consequence of):* b) *Intussusception of the small bowel* *due to (as consequence of):* c) *Viral intestinal infection (gastroenteritis), unspecified*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	

Case no. 2.

A 35-year-old man was admitted to hospital with signs of hepatic encephalopathy. He eventually progressed to coma and died a few hours later. The man had been diagnosed with cirrhosis of liver 1 year ago, which was attributed to chronic viral hepatitis B diagnosed 6 years ago. He also had a medical history of syphilis 15 years ago, but he had been cured at the early stage of the disease.

Part I Disease or condition directly leading to death	a) *Coma* *due to (as consequence of):* b) *Cirrhosis of liver* *due to (as consequence of):* c) *Chronic viral hepatitis B*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	

Case no. 3.

An 80-year-old man was diagnosed with squamous cell carcinoma of the left main bronchus 3 years ago. Three months ago he was admitted to hospital with seizures and a CT scan showed cerebral metastases. One day ago, the man was admitted to the ICU and diagnosed with intracerebral haemorrhage caused by the brain metastasis. The man died in intensive care. The man was also on medication for atherosclerotic heart disease with atrial fibrillation and hypercholesterolaemia.

Part I Disease or condition directly leading to death	a) *Intracerebral hemorrhage* *due to (as consequence of):* b) *Secondary malignant neoplasm of brain* *due to (as consequence of):* c) *Malignant neoplasm of bronchus and lung, main bronchus*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*atherosclerotic heart disease, atrial fibrillation, hypercholesterolemia*

Case no. 4.

A 75-year-old woman was diagnosed with breast cancer 2 years ago (central portion of right). One year ago she was diagnosed with hypertension and type 2 diabetes mellitus. Recently she was admitted to the hospital after feeling nausea and vomiting for a week. The CT scan showed metastases in the cerebellum, which were attributed to the breast cancer. The metastasis caused an intracerebral haemorrhage in the cerebellum. The woman died 1 day later in intensive care.

Part I Disease or condition directly leading to death	a) *Intracerebral hemorrhage in cerebellum* *due to (as consequence of):* b) *Secondary malignant neoplasm of cerebellum* *due to (as consequence of):* c) *Malignant neoplasm of breast, central portion of breast*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*hypertension, type 2 diabetes mellitus*

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Case no. 5.

A 50-year-old man was admitted to hospital with acute respiratory distress syndrome. He was diagnosed with pulmonary sarcoidosis 1 year ago. He died 1 day after admission to the ICU. He was on medication for hypertension and type 2 diabetes mellitus.

Part I Disease or condition directly leading to death	a) *Acute respiratory distress syndrome* *due to (as consequence of):* b) *Sarcoidosis of the lung*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Type 2 diabetes mellitus, Hypertension*

Case no. 6.

A 40-year-old woman has a past medical history of antiphospholipid syndrome, Hashimoto's thyroiditis and bronchial asthma over the past 10 years. She was admitted to hospital yesterday with signs of a pulmonary embolism. She died in intensive care.

Part I Disease or condition directly leading to death	a) *Pulmonary embolism* *due to (as consequence of):* b) *Antiphospholipid syndrome* *due to (as consequence of):* c) *Hashimoto's thyroiditis*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Bronchial asthma*

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Case no. 7.

A 70-year-old man was admitted to hospital with aspiration pneumonia. He died in intensive care 3 days later. The man had a history of Parkinson's disease with severe dysphagia for 10 years. The patient had a myocardial infarction 2 years ago.

Part I Disease or condition directly leading to death	a) *Aspiration pneumonia* *due to (as consequence of):* b) *Parkinson disease*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Past myocardial infarction*

Case no. 8.

A 60-year-old man presented to the emergency department with a sudden onset of severe chest pain. He had a medical history of type 2 diabetes, chronic obstructive pulmonary disease and aortic arch aneurysm diagnosed 3 years ago. He developed cardiac tamponade. He died in intensive care.

Part I Disease or condition directly leading to death	a) *Cardiac tamponade* *due to (as consequence of):* b) *Thoracic aortic aneurysm, ruptured*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Chronic obstructive pulmonary disease, Type 2 diabetes*

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Case no. 9.

A 49-year-old woman was admitted to hospital because of acute epigastric pain, right above the ribs, of several hours' duration, temperature above 38°C, chills and vomiting. Her medical history was significant for gall bladder stones (for 4 years) with several episodes of biliary colic, obesity and type 2 diabetes mellitus. The examination revealed a positive Murphy's sign, and the laboratory tests showed an elevated leukocyte count, elevated C-reactive protein, slightly elevated bilirubin, and elevated transaminase activity (AST, ALT, and alkaline phosphatase). The identified acute cholecystitis rapidly progressed to peritonitis and the patient died before surgery.

Part I Disease or condition directly leading to death	a) *Peritonitis* *due to (as consequence of):* b) *Calculus of gallbladder with acute cholecystitis*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Obesity, Type 2 diabetes*

Case no. 10.

A 30-year-old man was admitted to hospital with shortness of breath after an eight-hour flight. He was diagnosed with pulmonary embolism due to deep vein thrombosis. The deep vein thrombosis was thought to have been caused by the long journey. He was also on medication for hyperthyroidism. The man died in intensive care 1 day after admission.

Part I Disease or condition directly leading to death	a) *Pulmonary embolism* *due to (as consequence of):* b) *Deep-vein thrombosis*
Part II Other significant conditions contributing to death, but not related to the disease or condition causing it	*Hyperthyroidism*

Resources

ICD10 publications:
https://www.who.int/standards/classifications/classification-of-diseases/list-of-official-icd-10-updates

Search tool for ICD10 categories and codes: https://icd.who.int/browse10/2019/en#/

The ICD10 training by the World Health Organization: https://icd.who.int/training/icd10training/

More information about CODA-EU project: https://coda-eu.site.ined.fr