UNDERLYING CAUSE OF DEATH

1. Definition:
UNDERLYING CAUSE OF DEATH is defined by the World Health Organization (WHO) as the disease or injury that initiated the train of events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury.

2. Purpose:
The selection of a specific condition from a number of reported conditions as the underlying cause of a death facilitates categorizing deaths and enables development of statistical information on cause of death. This permits measuring the rate of death in a particular population, monitoring trends or comparing causes of death across geographic regions.

As deaths are registered, information on the causes of the death are reported by the physician certifying to the death. For most deaths, the physician reports more that one condition (i.e. disease, injury or complication) and may report a dozen or more conditions that caused or significantly contributed to the death. The fact that most deaths are attributed to multiple causes means that developing statistical information that summarizes what conditions cause death can be complex and significant patterns or trends in causes of death might be missed. To address this problem, the concept of an underlying cause of death was developed and is employed to simplify and standardize statistical tabulations on the underlying cause of death.

3. Determining the underlying cause of death:
- A death record is designed to allow the certifying physician to record multiple causes of death for a decedent and to arrange them so that the causal or etiological relationship of the medical conditions that finally lead to the death are recorded. The cause of death that initiated all other causes or conditions, as recorded by the physician, is the underlying cause of death for most deaths.
- Complex rules are followed, that can require selecting a different cause of death from the death certificate than the one inferred by the physician. Sometimes a medical term is selected that was not specifically reported by the physician. A common situation where the initiating cause as reported might not be selected would be where the initiating cause could not cause the subsequent condition. For example, if the certifier recorded that the decedent had chronic hypertension which led to lung cancer that led, in turn, to widespread metastatic cancer, the rules for underlying cause determination would not allow concluding that hypertensive disease caused lung cancer. In an example like this, the condition selected as the underlying cause would be lung cancer.
- Some medical conditions are never considered to be an underlying cause of death. Conditions such as a broken neck would not be an underlying cause. Such terms describe the nature of injury but not the cause of the injury. The reason the decedents neck came to be broken would be the underlying cause.
- Other medical terms are only selected as an underlying cause if there are no other conditions reported. Medical conditions that are classified as ill-defined conditions fall into this category. These are medical terms that do not adequately describe the true cause of death. Examples would be terms such as cardiorespiratory failure or liver failure. These terms describe the physical condition of the decedent but not what caused the condition.
- Underlying cause of death determination requires specialized training. The systematic classification of causes of death is known as nosology and a person trained in the coding

of cause of death is known as a nosologist. The complexity of cause of death coding and the determination of underlying cause of death has lead to this specialized occupation. The National Center for Health Statistics offers training in nosology and certification as a qualified nosologist.

- The determination of underlying cause of death has been greatly facilitated by the development of a software application called the Automated Classification of Medical Entities or ACME. This program was first developed by the National Center for Health Statistics in the early 1970's and is currently used as the primary means of determining underlying cause of death. The program selects the underlying cause for death using input on all the medical conditions reported for a death along with information on the reported relationship between the various conditions. The ACME program is generally able to select the underlying cause of death for a high percentage of deaths in the United States. Those that can not be classified properly by the software require review and determination by a trained nosologist.

4. Resources:

- The National Center for Health Statistics in the Centers for Disease Control and Prevention publishes and regularly updates underlying cause of death classification instructions and reference materials.

  Instruction Manual 2a: Instructions for Classifying the Underlying Cause of Death provides basic instructions.

  Instruction Manual 2c: ICD-10 ACME Decision Tables for Classifying Underlying Causes of Death contains detailed decision rules that are important to appropriate underlying cause selection.

  See: http://www.cdc.gov/nchs/about/major/dvs/im.htm

  The National Center for Health Statistics developed and maintains the ACME system software. Information on the ACME system and other cause of death related software is available from their Web site.

  See: http://www.cdc.gov/nchs/about/major/dvs/medsof.htm

5. Technical Notes:

- The coding of causes of death involves fitting the medical conditions into recognized categories. Since 1999 cause of death coding follows the International Classification of Diseases, Tenth Revision (ICD-10). Causes of death were coded using the International Classification of Diseases, Ninth Revision (ICD-9) for deaths occurring in 1979-1998. With each successive change to the cause of death classification system, changes to the rules used to determine underlying cause must also be adapted.

  Click here for more information on ICD-10 coding:

  http://www.cdc.gov/nchs/about/major/dvs/icd10des.htm

http://www.who.int/classifications/icd/en/

- There are often significant changes in the way deaths due to certain causes are classified under different International Classification of Diseases revisions. These revisions often reduce cause-of-death comparability due to changes in coding rules and disease categories, which in turn reflect differences in medical knowledge and etiology of diseases.

  For more information on this problem relative to the comparability of cause of death data between the 9th and 10th versions of the ICD see: http://www.cdc.gov/nchs/data/nvsr/nvsr49/nvsr49_02.pdf

- The history of working to develop and utilize standardized methods for determining the underlying cause of death dates back to the 1920s. Uniform rules for use in determining underlying cause first came into use internationally in 1939.

  See: http://www.who.int/classifications/icd/en/HistoryOfICD.pdf

- The accuracy of reporting medical conditions on death certificates has been the subject of concern. Some studies have established that, for important numbers of cases, the causes of death reported on death certificates do not accurately reflect the decedent's true cause of death. These discrepancies may be due to lack of training on the part of the physician, lack of ready access to the full history of a decedent when certifying to the death, difficulty in identifying the correct diagnosis or a desire to suppress the true cause of death in the interest of patient privacy. It is important to understand the reliability of these data when analyzing cause of death information. For example, the number of influenza deaths obtained from an annual NCHS death file - e.g., 1,812 in 2005 in the U.S. (ICD-10 codes J10-J11) - is considered a gross underestimate. People typically die from complications of the flu, not from the flu itself. If a person with the flu develops severe pneumonia and is taken to an ER, they are treated for the pneumonia and are usually not tested for flu. If they die, the attending or ER physician would probably not know that flu was the underlying cause (without a lab confirmation) and, therefore, would not include it on the death certificate which leads to the undercount for flu as an underlying cause. This is one of the reasons why NCHS mortality reports typically combine pneumonia with influenza. This combined number does not accurately represent the number of deaths due to the flu either (it would be an overestimate) as not all pneumonia deaths are caused by the flu. However, one favorable aspect about the combined total is that those deaths that are not complications of the flu tend to be relatively stable over time. Thus, the number of pneumonia and influenza deaths tends to fluctuate in step with the flu season. This makes the combined figure suitable for surveillance purposes - that is, a large increase in pneumonia and influenza deaths would indicate a more severe flu season.