Using ACME (Automated Classification of Medical Entry) software to monitor and improve the quality of cause of death statistics

Various methods have been used to evaluate the quality of cause of death statistics. Traditionally, necropsy findings were deemed as the gold standard to evaluate the accuracy of cause of death certification. However, because of the biased selection of necropsy cases and the decreasing necropsy rate, fewer and fewer evaluation studies have used necropsy findings as the standard. Another commonly used standard to evaluate the quality of death certification is the consensus of a panel of physicians reviewing all available information related to the deceased. Most of the studies using this method were the byproducts of large cohort studies or randomised clinical trials. These studies wanted to assure that the end point was not biased. The shortcomings of using physician review as the standard were time consuming, costly, not applicable in a large scale and routinely. As more and more disease specific registries and hospital medical records were computerised, more and more investigators began to use these datasets as the standard to evaluate the quality of death certificates. The merits of this method were time saving, less costly, applicable in large scale and routinely.

ACME (Automatic Classification of Medical Entry) is a computer software to monitor and improve the comparability of cause of death statistics across countries. It works. Then, I point out some limitations of ACME and the possibility of improvement.

What is ACME?

ACME is short for Automated Classification of Medical Entry. It is a computer software to standardise the production of mortality statistics. ACME uses a computer system to assign a single cause of death code to each death certificate. The computer program then applies each international selection rule in sequence to these codes, resulting in a code for a temporary underlying cause (TUC). This TUC code is then subjected to each international modification rule in sequence, finally yielding an assignment of a single death code. The core of ACME is the Decision Tables, which provide specific relations between one code and another to establish whether the causal sequence is acceptable, highly improbable, or acceptable as a consequence of Rule 3, or whether other modification rules are needed. ACME has been used in many countries and broad adoption could certainly improve the comparability of mortality across countries.

Example 1

1. Congestive heart failure (I509)
   - Hypertension (I10)
   - Diabetes (E149)

Example 2

1. Congestive heart failure (I509)
   - Cerebral infarction (I639), endocarditis (I38)
   - Liver cirrhosis (K746)
   - Hypertension (I10)
   II Chronic obstructive pulmonary disease (J449), Oral cancer (C069)

Example 3

1. Congestive heart failure (I509)
   - Hypertension (I10)
   - Liver cirrhosis (K746), uremia (N19), Diabetes (E149)
   - Hypertension (I10)
   II Chronic obstructive pulmonary disease (J449), Oral cancer (C069)
Limitations of ACME

Though ACME has been deemed as the de facto international standard for interpreting ICD selection rules, it is not without problems. First limitation was that there were many “MAYBE” causal relations in the decision tables, which lacked manual assignments for the UC. Examples were listed as follow:

- Is K746 (liver cirrhosis) due to A419 (sepsis)? MAYBE
- Is K746 (liver cirrhosis) due to B169 (hepatitis B)? MAYBE
- Is I698 (sequels of stroke) due to E149 (diabetes)? MAYBE
- Is J449 (chronic obstructive pulmonary disease) due to I64 (stroke)? MAYBE
- Is J189 (pneumonia) direct sequel of I509? MAYBE
- Is R54 (senility) and I509 (heart failure) combined as R34? MAYBE

If different countries had different decisions for above “MAYBE” cases, this became a major source of artifact undermining the comparability of mortality data across countries.

Another limitation, ironically this is in fact the strength of ACME, was the rigid adherence to the selection rules that resulted in the over-coding of mechanism of death (MOD). The MOD is a physiological derangement or a biochemical disturbance produced by a cause of death. Examples include various arthropathies, renal failure, cardiopulmonary failure, sepsis, and hypovolaemic shock. The cause of death, on the other hand, is a distinct entity, and is etiologically specific. Examples include cerebrovascular infarction, lung cancer, diabetes mellitus, and alcoholic liver cirrhosis. Because of their lack of aetiological specificity, MOD should not appear on death certificates. Nevertheless, because medical treatment is often aimed at modifying or ameliorating mechanisms rather than causes, thereby physicians still filled many MODs on death certificates. This poor certification behaviour was fueled by high frequency of incorrect layout of diagnoses on the death certificates. Previous studies revealed that it was very common for physicians to enter two or more diagnoses in the same line in death certificate.

Examples were:

- 1 (a) Uremia, diabetes
- 1 (a) Heart failure, liver cancer
- 1 (a) Hepatic failure, ischaemic heart disease

Another common certification error was the reverse layout of causal relations. For example, hypovolaemic shock (HS) was due to oesophageal varices bleeding (EVB) and EVB due to liver cirrhosis (LC). A correct layout should put HS in line (a), EVB in line (b), and LC in line (c), nevertheless it was not very uncommon that the certifier might put HS in line (c), EVB in line (b), and LC in line (a). Other examples were:

- 1 (a) Acute myocardial infarction
- 1 (b) Pneumonia
- 1 (c) Sepsis
- 1 (a) Stroke
- 1 (b) Urinary tract infection
- 1 (c) Sepsis

According to international selection rule 2 (for first three examples) and general principle (for last two examples), ACME would select MOD—that is, uremia, heart failure, hepatic failure, and sepsis as the UC for above examples. Most people will agree that these results were obviously not the original intents of the certifiers. MOD could not provide useful information for prevention.

Luckily many of the above mentioned problems might be solved in a Mortality Reference Group (MRG), which was set up by the World Health Organisation with the mandate to issue authoritative instructions on the interpretation of the ICD coding rules and guidelines. The NCHS have pledged themselves to implement the decision of the MRG in ACME decision tables. It is hoped that the modified Decision Tables will be more acceptable to people in most countries.

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References


Seasonality of live birth sex ratio in south western Siberia, Russia, 1959–2001

Seasonality of sex ratio of live births (SR: male births divided by total births) has been reported in Europe, North America, Brazil, and Australia. However, no uniform pattern is seen. Moreover, the magnitude of any observed seasonal variation varies from population to population with marked variation in Japan to minor variation in Germany to none in south western Finland, Scotland, Costa Rica, and Haua, Africa. The population of Novosibirsk region was 2 767 938 in 1988. Siberian climate exhibits considerable seasonal temperature changes. In Novosibirsk over the period 1951–1980, the average difference in mean monthly air temperature between January (the coldest month, −18.8°C) and July (the warmest month, 19.0°C) was 37.8°C. We tested the null hypothesis that there is no seasonal variation in SR in Siberia. Records of live singleton births were obtained from the Novosibirsk Regional Committee for Statistics. Data by month were obtained for the years 1959–2001, excluding 1961, 1962, and 1988 because of missing data. Seasonal analysis was carried out by Edwards’ method. Our analysis was quarterly because of the comparatively small number of births. Linear regression analysis was performed to test for secular trend.

A highly significant seasonal pattern was evident (χ²=14.4, p=0.001) with an amplitude of 1.2% of the observations in Germany to none in the second quarter (θ=129°) and a trough in the fourth quarter (fig 1).

Figure 1 Seasonality of sex ratio at birth in Novosibirsk region, Russia, 1959–2001. SR: male births divided by total births. Values are means and 95% confidence intervals.

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A negative annual secular trend was found for the period 1971–1980 ($r=−0.84, p=0.002$), which was replaced by the positive trend during the period 1982–1993 ($r=0.78, p=0.004$). No difference in mean SRs for the entire period was found between urban (0.513) and rural (0.513) populations.

The decrease in male births in the last quarter equates to fewer male conceptions nine months previously—that is, in the first quarter. Climatic variations in west Siberia are extreme, with heavy snowfalls in winter. Thawing of snow requires considerable energy, therefore temperatures remain low in spring, and rise sharply from the second half of April. If the observed variation in SR is indeed temperature related, then it would seem that low temperatures either reduce male conceptions or, through unknown mechanisms, reduce the survival of male conceptuses.

Industrialisation has been blamed for declining SRs in industrialised countries over the past half century. In Siberia, a different pattern is evident in that SR fell and then rose with a turning point in the early 1980s.

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