**Introduction**

Causes of Death statistics (CoD statistics) is an important tool for health policies in the context of growing interest due to aging of the population and for epidemiological research.

But there are quality problems caused by inappropriate certification at physician’s level, in terms of inaccurate and missing diagnoses. Additionally non-uniform coding of death certificates is a cause of errors [2]. Andersohn et al. analyzed mortality rates of myocardial infarction and ischaemic heart disease. They found suspect mortality rates and trends in some German regions [3].

MUSE (multicausal and unicausal selection engine) is a new software tool which supports the implementation of uniform coding practices and reduces daily workload of coding staff.

**How does MUSE work?**

MUSE is a rule-based software tool which processes death certificates in accordance with the complex guidelines of International Statistical Classification of Diseases and Related Health Problems (ICD-10) [1].

**Figure 1:** In the center is a death certificate with a chain of medical diagnoses. The originating cause of death (OC) written down by the physician is atherosclerosis (code I709).

MUSE generates two outputs: The underlying cause of death (UC) (left hand, code I639) and the multiple causes of death (MC) (right hand).

**Figure 2:** The upper part of the user interface contains the same medical diagnoses (in German) and the derived ICD-10-codes. The coding log (lower part) shows the way of automatic selection of UC. Here MUSE makes three decisions (column 2) for the selection of the UC being the main input to the CoD statistics. Temporarily and finally selected codes are in the third column. Coders see messages (column 5) explaining coding steps and the applied guidelines of ICD-10.

MUSE uses an international mortality knowledge base (“decision tables”) provided by the Iris Core Group [4]. MUSE decision logics can be modified simply by changing a configuration file.

**Improvement of quality of CoD statistics ..**

A) ...by standardization of coding practices

The most important advantage of MUSE is that coders are able to follow the complex decisions of the automatic coding system. The standardized approach is now part of daily coding work. Even less experienced coders can learn standardized coding easily.

B) ...by feedback of MUSE users

Feedback of MUSE users is used for the quality assurance of the coding system itself. A group of coding experts evaluate the feedback and submits proposals for improvement of MUSE and international decision tables.

C) ...by continuous monitoring of electronic data flow

Quality indicators Q1 and Q2 are applied for monitoring the data flow. The 2nd column of adjacent table shows the rates for “every day” certificates (N = 4155, data uploads of 20 local health authorities). Processed data also contain typing errors. After text correction Q1 increases significantly.

The indicators reflect both, the quality of medical documentation and the performance of the electronic data transfer. They are used to control the improvement of documentation and adapting the MUSE tool.

**Summary and outlook**

MUSE is a new software tool which supports the correct and complete application of ICD-10-instructions during the statistical preparation of death certificates.

The variability caused by different human coding practices can be minimized.

MUSE has been in routine use since 2012. Four German statistical offices process about 39% of all German certificates (> 800,000 per year) with MUSE. After implementation of the new German eGovernment law and a subsequent change to electronic data transfer all regional offices will use MUSE for their daily flow of death certificates.

The Iris Core Group is evaluating MUSE for their daily flow of death certificates. The Iris Institute is responsible for requirements analysis, technical design and software development of MUSE.

**Background**

MUSE is one result of a collaboration between the Federal Statistical Office and the German Institute of Medical Documentation and Information (DIMDI). The common project “Improvement in quality of CoD statistics” has been funded with support of the Federal Ministry of Health. The Federal Statistical Office has been responsible for requirements analysis, technical design and software development of MUSE.

**References**


[4] Iris Core Group and Iris Institute: https://www.dimdi.de/static/de/klass/kop/irisinst/index.htm