

Participation at the Sixth meeting of the MultiCause network

Three members of the SCOR Chair on Mortality Research took part in the Sixth Meeting of the MultiCause Network, held in Barcelona, Spain, on October 16–17, 2025. The program is available here: https://mcod.web.ined.fr/images/d/d2/Sixth_meeting_of_the_MultiCause_network.pdf

The MultiCause Network brings together international researchers dedicated to the study of all causes listed on death certificates, commonly referred to as **multiple causes of death**. As this topic represents one of the core research areas of the Chair, our participation provided a valuable opportunity to engage with experts from around the world and learn from ongoing international initiatives in multiple-cause-of-death analysis. We also presented our current research projects listed below.

Is end-of-life Morbidity Different in Deaths with Multiple versus Single Causes?

Presented by Elizaveta Ukolova

The recent rise in the reporting of multiple causes of death suggests a shift in the nature of dying, with more individuals now dying from complex pathophysiological processes. Could this be the result of increasing multimorbidity associated with the shift in mortality toward older ages? To explore the „*rise in multimorbidity – rise in multiple causes of death hypothesis*“, we combine data from the Danish National Patient Registry and the Danish Cause of Death Registry to examine differences in disease trajectories starting in 1995 for a cohort that died in 2019. We apply sequence analysis focusing on analysis of dissimilarities in disease sequences by type of pathophysiological process. The findings suggest, that end-of-life multimorbidity differs between individuals who have a contributory cause of death recorded in Part 2 of the death certificate and those who do not. A multifactor discrepancy analysis revealed that, in both younger and older cohorts, there were no significant differences in disease sequences based on whether a causal ("due to") relationship between conditions was indicated in Part 1. Non-medical factors, such as place of death and the role of death certifier, were also significant covariates of end-of-life morbidity. However, both medical and non-medical information on the death certificate account for only a small portion of the overall dissimilarity in disease sequences. In conclusion, while multiple causes of death may signal dissimilarity in end-of-life morbidity, careful attention must be paid to the specific Part of the death certificate in which these causes are recorded, as their position may carry important interpretive value.

Understanding end-of-life multimorbidity: An analysis of Multiple Causes of Death in Denmark

Presented by Cosmo Strozza

The process leading to death is complex, involving numerous health risks and diseases over a lifespan. Ultimately, death is attributed to a single underlying cause, defined as the condition that triggered the sequence of events resulting in death. While valuable for identifying key health threats, focusing solely on the underlying cause offers a limited view of the broader morbidity process. Multiple causes of death (MCoD) data, which capture all contributing conditions, provide a more complete understanding of mortality risks. In this study, we investigate the reliability of MCoD data and whether they accurately

reflect health conditions near death. Combining the Danish Population and Death registers with the Chronic Diseases register, we trace diagnoses from specific diseases, such as chronic obstructive pulmonary diseases (COPD), dementia, and diabetes, and examine (1) how often these causes are recorded among MCoD, (2) whether they appear as contributory or secondary cause, and (3) estimate multiple-decrement life tables for each subpopulation. The analysis is conducted by age, sex, and over years the registers allow. Preliminary results reveal that MCoD data cannot serve as an accurate proxy for individuals' health conditions at end of life. For individuals diagnosed with chronic conditions, reporting rates on death certificates vary significantly: dementia appears on roughly half of relevant certificates, while COPD (35%) and diabetes (14%) are reported less frequently. However, when examining specific causes associated with these chronic conditions, resulting from the life table analysis, MCoD data provide valuable insights into the chain of events leading to death, particularly for dementia (98% for mental disorders) and COPD (87% for respiratory diseases), though less effectively for diabetes. These findings suggest that while MCoD data have limitations as proxy of the health conditions near death, they remain valuable for understanding mortality pathways.

Competing Causes of Death: Quantifying the Probability of Dying from One Cause Before Another

Presented by Marie-Pier Bergeron-Boucher

Throughout life, individuals are exposed to multiple risks, where the occurrence of one can prevent the others. This is known as competing risks. In clinical settings, practitioners assess these risks to determine whether an elderly patient is more likely to die from one condition before benefiting from treatments for another. At the population level, understanding competing risks is crucial for accurately evaluating the burden of specific causes of death and designing effective public health interventions. Addressing the need for a clearer understanding of competing causes of death, this study introduces novel methods to quantifying the probability of dying from one cause before another. We conduct pairwise comparisons among the 10 leading causes of death in the U.S. and Denmark to assess the probability that one cause leads to death before another. Using outsurvival statistics, we estimate this probability under the assumption of independence between causes. This method is then compared to the cumulative incidence function, which accounts for dependence among causes. Furthermore, we evaluate both methods using two data types: deaths where diseases are listed solely as the underlying cause of death (UCD) and deaths where both causes being compared appear on the death certificate, utilizing multiple causes of death data (MCoD). Our results reveal that, when using UCD and assuming independence, there is a higher probability of dying from diseases of the circulatory system compared to other causes, highlighting their significant population burden. However, this probability decreases when accounting for dependence among causes and further decreases when analyzing MCoD data. Analysis of MCoD data highlights that individuals with neoplasms or diseases of the nervous system at the end of life are more likely to have these conditions as their underlying causes of death compared to other co-morbidities present on the death certificate.

Diversity in Causes of Death: A New Framework to Account for Multiple Causes of Death

Presented by Marie-Pier Bergeron-Boucher

In low-mortality countries, the distribution of causes of death has become increasingly diverse, carrying important public health implications. However, most studies on cause diversity focus solely

on the underlying cause of death (UCD), overlooking additional contributing causes listed on death certificates. This may lead to an underestimation of cause diversity. This paper aims to develop a comprehensive framework for analyzing cause-of-death diversity by accounting for multiple causes of death (MCoD). The proposed approach should (1) allow for comparisons over time and across countries, i.e., be age-standardized, (2) capture the two key dimensions of diversity: richness and evenness, and (3) provide diversity measures that can be decomposed. We introduce MCoD life tables to derive a range of age-standardized mortality indicators. From the deaths distribution of the MCoD life tables, we calculate the average number of causes in the life table (richness). We then suggest two approaches to estimate how common or rare each cause is, by comparing their relative abundance (evenness). The first approach assumes that all causes reported on the death certificate contribute equally to diversity. The second assumes that the UCD provides the baseline representation of cause diversity, with each contributing cause adding to this initial level. We applied this framework to data from Denmark, France, Spain, and the United States. Across all countries, we observed an increase in cause diversity over time, both in richness and evenness, and under both UCD-only and MCoD measures. Since all the indices introduced are decomposable, we were able to investigate the drivers behind the observed increase in cause diversity. The primary factor was a decline in mortality from diseases of circulatory system, which shifted mortality pressures toward other causes, many of which tend to involve a more complex array of contributing factors.