Development and application of competing risks and multi-state models in cancer epidemiology

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Competing risks and multi-state models allow us to study complex disease settings and answer composite research questions and should be used more widely in epidemiology.

In his work, Ph.D. student Nikolaos Skourlis at the Department of Medical Epidemiology and Biostatistics explored the competing risks and multi-state model areas using flexible parametric survival models. He studied several modeling aspects, such as the choice of timescale, choice of multi-state structure and sharing information across transitions by imposing restrictions in the estimation of the parameters. In addition, he aimed to help others communicate such models to a wider audience by developing an online interactive web-tool (MSMplus). Lastly, he evaluated the potential use of recurrent multi-state structures in the study of recurrent events when a terminal event is present.

What are the most important results in your thesis?

When using competing risks and multi-state models, there is a series of modeling and structural choices to be made. Choosing timescales, sharing information across transitions (in more than one aspect), minding the correspondence of each multi-state structure with a set of research questions, targeting specific measures of clinical interest, while taking into account the limitations of each structure and the nature of the data are challenging aspects to be considered. For these reasons, sensible modeling choices and sensitivity analyses are always important when applying such models.

Does your research make it easier for other researchers to present their results?

Yes, as a big portion of my research is oriented towards the evaluation and exploration of different modeling choices when applying competing

risks and multi-state models. Researchers will be able to view the process of developing and selecting appropriate multi-state structures coupled with sensible modeling choices that are either evaluated via simulation techniques or explored via sensitivity analyses. Multi-state structures can be quite complex, with a variety of derived measures that differ over time and among covariate patterns. This issue motivated me to develop MSMplus that researchers can use to present multi-state structures and estimation results with a variety of interactive graphs that enhance the understanding of the disease pathway under study.

What do you think should be done moving forward?

I think it is important for future research to focus on the simultaneous modeling of multiple timescales in a competing risk and a multi-state setting. This way, it will be possible to derive and present the estimated measures across multiple timescales, enabling a better understanding of the disease pathway. In addition, there is a rising interest in the use of multi-state models in cancer clinical trials of phase II and phase III. Therefore, interest should also be given in future research of optimal designs in clinical trials for the use of multi-state structures, securing the essential clinical trial design traits.

Last but not least, the big datasets that have become available in the last decade, especially in Sweden via data linkage from multiple registers, allow for the use of more complex, high-parametrized models that can address composite research questions and cope with data of complex nature. Joint longitudinal and survival models with one or more biomarkers/longitudinal outcomes can be fitted in the form of competing risks and multi-state structures, allowing the study of the relation between these outcomes and the multi-state process.

More information: Development and application of competing risks and multi-state models in cancer epidemiology.