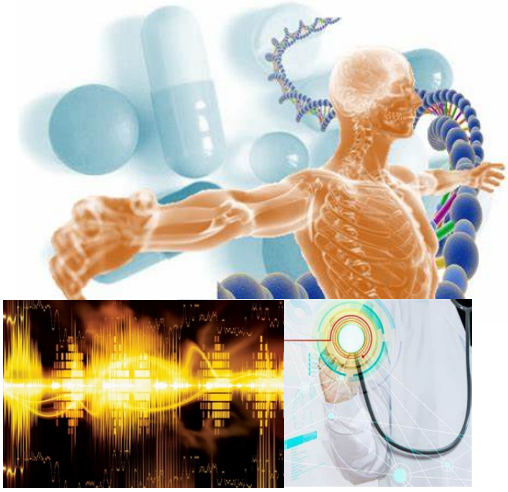
STATISTICAL SIGNIFICANCE

In cardiovascular disease field of study, recurrent events such as stroke or myocardial infarction (MI) are often encountered, leading to an increase in the risk of death. Evaluating the prognosis of patients and dynamically predicting the risk of death by taking the historical recurrent events into account is highly likely to enhance medical decisions with improved healthcare outcomes.

Tackling Dynamic Prediction of Death in Patients with Recurrent Cardiovascular Events

HISTORICAL RECURRENT EVENTS ARE ESSENTIAL

In cardiovascular disease (CVD) field of study, recurrent events (e.g., stroke, myocardial infarction) are often encountered, leading to an increase in the risk of death. Note that CVD disease severity and progression rate could change over time even for the same patient. How to take the history of CVD event occurrences into account for the mortality prediction is still understudied.



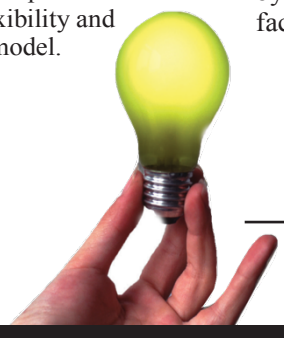
Given this fact and also due to limited prediction work under a dynamic scheme, we aim to conduct personalized prediction of survival risk, and our newly developed methods that can precisely capture the historical recurrent process with comparison to the other alternatives.

DISEASE PROGRESSION IS DYNAMIC

It is known that an inherent characteristic of many chronic diseases such as CVD is their dynamic nature. That is, disease severity and the rate of disease progression dynamically change in time even for the same patient. Establishing models of recurrent events and exploring their relationship with mortality is the first step to disentangle complicated disease mechanism. An immediate follow-up question will be how to assess the predictive accuracy of these models and identify an optimal one for clinical practice. An ideal prediction is not a one-time shot, but can be dynamically updated along with the disease progression by adapting to the most up-to-date data as well as the past history, until a terminal event (i.e., death).

STATISTICS POWERS MEDICAL DECISION MAKING

Statistics addresses decision making on therapy by aggregating patient-level data and displaying personalized risk estimates for critical events to improve medical decision making. We developed a flexible Bayesian framework that embedded the copula into joint frailty modeling of terminal and recurrent event processes. Generally speaking, a copula function is invoked to link the conditional processes of recurrent and terminal events in order to relax the assumptions of renewal process and conditional independence. Additionally, richness in terms of choices of copula functions also expand the flexibility and application of our model.



A PERSONALIZED DYNAMIC PREDICTION TOOL

Based upon most recently proposed joint modeling approaches within the Bayesian framework, we develop a dynamic prediction tool which can be applied for subject-level prediction of death with implementation in software packages. In particular, the prediction model is established by incorporating subject heterogeneity with subject-level random effects quantifying the part due to unobserved time-invarying factors and an extra copula function capturing the part caused by unmeasured time-dependent factors.