Disease trajectories following myocardial infarction: insights from process mining of 145 million hospitalisation episodes

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The number of survivors of MI has increased dramatically in recent decades, yet knowledge of post-myocardial infarction (MI) disease risk to date is limited. We investigated temporally ordered sequences of all conditions following MI in nationwide electronic health record data through the novel application of process mining. Here, we present, for the first time, the observed sequences of diseases that individuals accrue post MI.

We conducted a national retrospective cohort study of all hospitalisations (145,670,448 episodes, 34,083,204 individuals) admitted to NHS hospitals in England (1st January 2008-31st January 2017, final follow up 27th March 2017). Through process mining we identified trajectories of all major disease diagnoses following MI and compared their adjusted relative risk (RR) and all-cause mortality hazard ratios (HR) to a risk-set matched non-MI control cohort using flexible parametric survival models.

Among a total of 375,669 (1.1%) MI patients (872,450 episodes) and 1,878,345 (5.5%) matched non-MI patients (4,712,654 episodes), we identified 28,740 unique disease trajectories. The accrual of multiple circulatory diagnoses was more common amongst MI (RR 4.37, 95% CI 4.00-4.77) and conferred an increased risk of death (HR 1.32, 1.14-1.54) compared with matched controls.

Further, trajectories featuring neuro-psychiatric diagnoses (including anxiety and depression) in conjunction with circulatory disorders, were markedly more common and had increased mortality post MI (HR ranging from 1.32 to 1.74) compared with non-MI individuals.

Pathways involving both circulatory and digestive diseases appeared more frequently in the MI cohort versus matched controls (RR 4.03 [3.87-4.20] to 4.77 [4.28-5.32]). A number of trajectories including disorders of the eye/adnexa were also associated with an increased risk of death compared with matched controls (HR: 1.32, 1.11-1.57), with those eye/adnexa disorders consisting mainly of cataracts (77.6%).

This study quantifies the relative risk and mortality burden associated with disease trajectories following MI from a nationwide hospitalisation cohort for the first time. These data show the significant ongoing cardiovascular disease burden following MI, and crucially highlight the excess accrual of neuro-psychiatric diagnoses conferring increased mortality compared with non-MI individuals. These data provide a clear opportunity for early intervention targets, such as increased focus on the psychological and behavioural pathways for survivors of MI, to mitigate ongoing adverse disease trajectories, multimorbidity and premature mortality. Further understanding of the factors contributing to these trajectories is required to facilitate identification of patients in the early post-MI setting who would benefit most from closer follow-up and prompt intervention.

Trajectories: primary diseases
Trajectories: primary+secondary diseases