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Collin Melveton Stultz

Massachusetts Institute of Technology, USA

Clinically useful deep learning models for risk stratification

Cardiovascular disease and coronary heart disease (CHD) in particular remains a major cause of morbidity and mortality across the world. Over one-third of all deaths in patients over 35 can be attributed to some form of CHD and over 16 million people have CHD in the United States alone. Therefore, while tremendous progress has been made in the diagnosis and treatment of patients with CHD, significant challenges remain. Cardiovascular medicine is fortunate that insights into the appropriate care for patients with CHD are based on numerous large Randomized Controlled Clinical Trials (RCTs) over the past decades which have established contemporary treatment algorithms. Nevertheless, such insights are often not dispositive for an individual patient for several reasons. If a RCT enrolls a too heterogeneous population, it risks missing a treatment effect that is limited to a particular patient group based on comorbidities or genetic predisposition, for example. Even in a study that demonstrates the overall efficacy of a novel agent or strategy, certain signals of particular benefit (or risk) can be missed among the larger observations due to inadequate characterizations of individual characteristics. These observations demonstrate that it is not always clear how to apply the results of a given RCT to heterogeneous patient populations.Our work is guided by the hypothesis that the application of recently developed machine learning methods to large datasets, arising from observational studies, can facilitate the detection and understanding of the novel and complex interactions between patient characteristics, treatments and outcomes. In this talk I will describe a series of examples that demonstrate how complex machine learning methods can 1) improve our ability to identify high-risk patient subgroups, and, 2) discover novel treatment regimens that can reduce a patient's risk of adverse future events. More generally, I will outline a set of criteria that can be used to judge the usefulness of any machine learning model that is intended to be used by the clinical community at large.

Biography

Collin M Stultz is a principal investigator in the Research Laboratory of Electronics (RLE) at the Massachusetts Institute of Technology (MIT). He received his AB from Harvard College in 1988 and his MD from Harvard Medical School and a PhD in Biophysics from Harvard University in 1997. He is a board-certified internist and cardiologist. An alumnus of the Harvard-MIT program in Health Sciences and Technology (HST), Professor Stultz is on the faculty of both HST and MIT's Department of Electrical Engineering and Computer Science. He is a member of the American Society for Biochemistry and Molecular Biology and the Federation of American Societies for Experimental Biology. Among his honors are being a recipient of the Burroughs Wellcome Fund Career Award in Biomedical Sciences and the James Tolbert Shipley Prize.

cmstultz@mit.edu

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