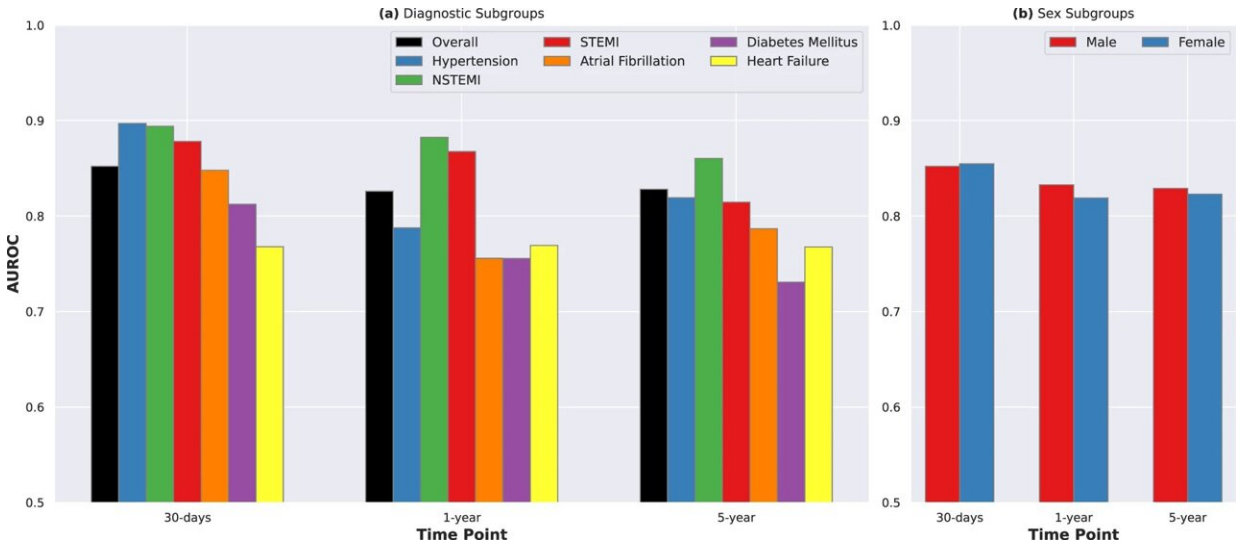
Machine learning programs predict risk of death based on results from routine hospital tests

March 21 2023, by Gillian Rutherford



Model performances in diagnostic and sex-based subpopulations. **a** Performance of DL: ECG traces, Age, Sex models in different primary diagnosis subgroups. The models performed better in patients with STEMI and NSTEMI (AUROC of 0.867 and 0.882 for 1-year mortality, respectively) than in the overall cohort. The performance of the model in the other subgroups (heart failure, diabetes and atrial fibrillation) was lower than in the overall holdout cohort. **b** The prognostic models performed slightly better in men than in women. AUROC Area under the receiver operating characteristic curve, DL deep learning, ECG electrocardiogram, NSTEMI non-ST elevation myocardial infarction, STEMI ST elevation myocardial infarction.

If you've ever been admitted to hospital or visited an emergency department, you've likely had an electrocardiogram, or ECG, a standard test involving tiny electrodes taped to your chest that checks your heart's rhythm and electrical activity.

Hospital ECGs are usually read by a doctor or nurse at your bedside, but now researchers are using artificial intelligence to glean even more information from those results to improve your care and the health-care system all at once.

In recently published findings, the research team built and trained machine learning programs based on 1.6 million ECGs done on 244,077 patients in northern Alberta between 2007 and 2020.

The algorithm predicted the risk of death from that point for each patient from all causes within one month, one year and five years with an 85 percent accuracy rate, sorting patients into five categories from lowest to highest risk. The predictions were even more accurate when demographic information (age and sex) and six standard laboratory blood test results were included.

The study is a proof-of-concept for using routinely collected data to improve individual care and allow the health-care system to "learn" as it goes, according to principal investigator Padma Kaul, professor of medicine and co-director of the Canadian VIGOUR Centre.

"We wanted to know whether we could use new methods like artificial intelligence and machine learning to analyze the data and identify patients who are at higher risk for mortality," Kaul explains. "These findings illustrate how machine learning models can be employed to convert data collected routinely in clinical practice to knowledge that can be used to augment decision-making at the point of care as part of a learning health-care system."

A clinician will order an electrocardiogram if you have high blood pressure or symptoms of heart disease, such as chest pain, shortness of breath or an irregular heartbeat. The first phase of the study examined ECG results in all patients, but Kaul and her team hope to refine these models for particular subgroups of patients. They also plan to focus the predictions beyond all-cause mortality to look specifically at heart-related causes of death.

"There is a big push to see how we can use AI to improve the delivery of health care," says Kaul. The advantage of using high-powered computing is that, unlike humans, it can see the patterns in a multitude of data points at once, she says. "We want to take data generated by the health-care system, convert it into knowledge and feed it back into the system so that we can improve care and outcomes. That's the definition of a learning health-care system."

The study is published in the journal *npj Digital Medicine*.

More information: Weijie Sun et al, Towards artificial intelligence-based learning health system for population-level mortality prediction using electrocardiograms, *npj Digital Medicine* (2023). DOI: 10.1038/s41746-023-00765-3

Provided by University of Alberta