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New AI-powered computer model predicts disease progression during aging

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Using artificial intelligence, a team of University at Buffalo researchers has developed a novel system that models the progression of chronic diseases as patients age.

Published in October in the *Journal of Pharmacokinetics and Pharmacodynamics*, the model assesses metabolic and cardiovascular biomarkers—measurable biological processes such as cholesterol levels, body mass index, glucose and blood pressure—to calculate health status and disease risks across a patient's lifespan.

The findings are critical due to the increased risk of developing metabolic and cardiovascular diseases with aging, a process that has adverse effects on cellular, psychological and behavioral processes.

"There is an unmet need for scalable approaches that can provide guidance for pharmaceutical care across the lifespan in the presence of aging and chronic co-morbidities," says lead author Murali Ramanathan, Ph.D., professor of pharmaceutical sciences in the UB School of Pharmacy and Pharmaceutical Sciences. "This knowledge gap may be potentially bridged by innovative disease progression modeling."

The model could facilitate the assessment of long-term chronic drug therapies, and help clinicians monitor treatment responses for conditions such as diabetes, high cholesterol and high blood pressure, which become more frequent with age, says Ramanathan.

Additional investigators include first author and UB School of Pharmacy and Pharmaceutical Sciences alumnus Mason McComb, Ph.D.; Rachael Hageman Blair, Ph.D., associate professor of biostatistics in the UB School of Public Health and Health Professions; and Martin Lysy, Ph.D., associate professor of statistics and actuarial science at the University of Waterloo.

The research examined data from three case studies within the third National Health and Nutrition Examination Survey (NHANES) that assessed the metabolic and cardiovascular biomarkers of nearly 40,000 people in the United States.

Biomarkers, which also include measurements such as temperature, body weight and height, are used to diagnose, treat and monitor overall health and numerous diseases.

The researchers examined seven metabolic biomarkers: Body mass index, waist-to-hip ratio, total cholesterol, high-density lipoprotein cholesterol, triglycerides, glucose and glycohemoglobin. The cardiovascular biomarkers examined include systolic and diastolic blood pressure, pulse rate and homocysteine.

By analyzing changes in metabolic and cardiovascular biomarkers, the model "learns" how aging affects these measurements. With machine learning, the system uses a memory of previous biomarker levels to predict future measurements, which ultimately reveal how metabolic and cardiovascular diseases progress over time.

More information: Mason McComb et al, Machine learning-guided, big data-enabled, biomarker-based systems pharmacology: modeling the stochasticity of natural history and disease progression, *Journal of Pharmacokinetics and Pharmacodynamics* (2021). DOI: 10.1007/s10928-021-09786-5

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