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ANNOUNCEMENT

**Artificial Intelligence Reveals the Invisible Multi-Organ Damage Caused
by Hypertension for the First Time – Aristotle University Makes a Key
Contribution**

Thessaloniki, 13 July 2026

An international collaboration led by the University of Oxford, with the participation of Aristotle University, is ushering in a new era of personalized hypertension management.

A new international scientific study is set to fundamentally transform the way hypertension is understood and evaluated. Researchers from Aristotle University of Thessaloniki, the University of Oxford, Khalifa University, and twelve additional leading universities and research institutions have developed a pioneering Artificial Intelligence (AI) framework capable of identifying, quantifying, and mapping the overall multi-organ damage caused by hypertension. This breakthrough opens new avenues for Precision Medicine and the personalized prevention of cardiovascular disease.

The study was published in *Circulation*, the flagship scientific journal of the American Heart Association in the field of cardiovascular medicine.

A New Artificial Intelligence Model for Hypertension

At the core of the study is the development of a novel computational framework based on advanced Contrastive Machine Learning techniques. The researchers analyzed **566** multimodal biomedical markers from more than **27,000** participants in the UK Biobank, leveraging data from cardiac and brain magnetic resonance imaging (MRI), vascular ultrasound examinations, electrocardiograms, blood tests, body composition measurements, respiratory function tests, and other clinical information. The team subsequently validated the model successfully in an independent cohort of

more than **5,500** participants from the U.S.-based ARIC study, confirming both the reliability and generalizability of the findings.

From Blood Pressure Measurement to Mapping Organ Damage

The study's most significant innovation lies in shifting hypertension assessment from the simple measurement of blood pressure to the evaluation of the disease's actual biological impact on the human body. The new system calculates a comprehensive multi-organ damage index, HyperScore, which captures each patient's overall burden of organ injury. At the same time, it introduces the concept of HyperTrajectories—six distinct hypertension progression pathways—demonstrating that the disease does not evolve in the same way across individuals. Instead, the framework identifies different phenotypes characterized by predominant effects on the heart, brain, blood vessels, kidneys, or metabolism, creating the foundation for more targeted and personalized therapeutic interventions.

Aristotle University Contribution to the International Research Effort

Aristotle University participated through the **Signal Processing & Biomedical Technology Unit (SPBTU)** of the **Telecommunications Laboratory**, School of Electrical and Computer Engineering. Professor **Leontios Hadjileontiadis**, Director of the SPBTU, contributed to the study representing both Aristotle University and the **Healthcare Engineering Innovation Group (HEIG)** at **Khalifa University**, highlighting the international reach of Greek scientific research.

The SPBTU ranks among Greece's most active research groups in Biomedical Engineering and AI for Healthcare. Drawing on extensive expertise in biomedical signal and image processing, digital biomarker development, trustworthy AI, medical imaging, and decentralized clinical studies, the team coordinates and participates in major Horizon Europe and Horizon 2020 projects, including AI-PROGNOSIS, iPROLEPSIS, MOSAIC, MULTIPULM, HosmartAI, and PROTEIN, actively contributing to the development of the next generation of digital health technologies.

International Collaboration Among Leading Universities

This international collaboration brought together scientists from the University of Oxford, Khalifa University, Aristotle University, McGill University, King's College London, the London School of Hygiene & Tropical Medicine, St George's, University of London, the University of Bristol, Brighton and Sussex Medical School, the University of Brighton, the University of Sussex, the University of Cape Town, and the South African Medical Research Council. By combining expertise in Biomedical Engineering, Cardiology, Medical Imaging, Epidemiology, and Artificial Intelligence, the consortium demonstrated the power of interdisciplinary collaboration in addressing complex healthcare challenges.

Hypertension as the "Silent Killer"

Hypertension has long been recognized as the "silent killer." Although it is the most important modifiable risk factor for cardiovascular disease and is responsible for millions of deaths worldwide each year, its true impact on the human body develops silently. Long before the first symptoms appear, hypertension gradually damages the heart, brain, kidneys, blood vessels, and other vital organs, while these changes often remain undetected until serious complications arise.

Artificial Intelligence Reveals the "Invisible" Pathways of Hypertension

Professor **Leontios Hadjileontiadis** stated: "This study reflects the transition of Artificial Intelligence from simply analyzing data to generating new biomedical knowledge. Hypertension is not a single disease that progresses uniformly; instead, it follows different trajectories from one individual to another, affecting different organs and biological systems. By leveraging advanced AI algorithms, we were able to uncover these previously invisible disease progression pathways, creating the conditions for earlier diagnosis, improved prognosis, and truly personalized treatment. Our team's participation in this international collaboration confirms that the research carried out at Aristotle University actively contributes to shaping global advances in Biomedical Engineering, Precision Medicine, and trustworthy Artificial Intelligence."

School of Electrical and Computer Engineering at the Forefront of International Research

Professor **Pantelis Micropoulos**, Chair of the School of Electrical and Computer Engineering at Aristotle University, stated: "Through the active participation of the Signal Processing & Biomedical Technology Unit of our Telecommunications Laboratory, under the direction of Professor Leontios Hadjileontiadis, in a high-level international collaboration led by the University of Oxford, our School has demonstrated its capacity to produce cutting-edge research with substantial scientific and societal impact. This collaboration resulted in a publication in *Circulation*, one of the world's leading journals in cardiovascular medicine, pioneering the strategic use of Artificial Intelligence in the service of healthcare. International engagement, interdisciplinary collaboration, and the development of technologies that benefit society are among the strategic priorities of our School. I warmly congratulate Professor Leontios Hadjileontiadis and all members of the research team on this remarkable achievement. This distinction strengthens the international presence and reputation of both our School of Electrical and Computer Engineering and Aristotle University."

The study is available as **Open Access** at:

<https://www.ahajournals.org/doi/full/10.1161/CIRCULATIONAHA.125.077394>

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