

NEW AI-AUGMENTED TEST REFINES KIDNEY STONE ANALYSIS



In a world of ever-faster technical change, Mayo Clinic Laboratories is uniquely positioned to innovate. Collaboration with clinicians pinpoints unmet patient needs and facilitates the development of diagnostic testing that provides answers.

Kidney stones are one of the most common and reported health concerns around the world. In the United States, one out of 10 people will develop a kidney stone during their lifetime. As incidences of these small but painful urinary tract deposits continue to increase, so do Mayo Clinic's research and technology efforts to provide accurate, cost-effective, and rapid kidney stone analysis.

Since March 2019, [Paul Jannetto, Ph.D.](#), director of the Metals Laboratory at Mayo Clinic, along with his colleagues across the enterprise and his laboratory staff, have developed, validated, and implemented an artificial intelligence (AI)-augmented test with algorithms designed to interpret the kidney stone FTIR spectra. To successfully treat and prevent kidney stones, lab technologists have adopted Fourier transform infrared spectroscopy (FTIR), a manual method used to discover what the stones are made of. With more than 90,000 kidney stones analyzed each year at Mayo Clinic, this new AI-assisted test has streamlined lab processes and improved patient care.

"This project has been in the works for more than four years. The original concept came from Patrick Day, one of our development techs whose vision incorporated the use of AI to interpret and determine the constituents of kidney stones," says Dr. Jannetto. "We typically follow an extremely manual and laborious process where we must first clean and dry the stones, crush them, perform FTIR analysis, then interpret the spectra. The constituents are then reported out on a percentage basis and manually entered into our laboratory information system (LIS)."

Why kidney stones analysis matters to patients?

Kidney stones are complex in nature and caused by genetic, dietary, and lifestyle factors. If left untreated, these hard deposits made of minerals and salts can lead to severe pain, urinary tract infections, and loss of kidney function. After a patient passes a stone or has undergone surgery for its removal, accurate analysis is the most crucial laboratory diagnostic procedure needed for them to receive proper treatment and prevent recurrence, which sits currently at a rate of 50%. Given the irretrievable nature of kidney stones, technologists have just one opportunity to obtain a perfect compositional analysis from urine and stone constituents. With this new AI-augmented analysis, more accurate results can help clinicians determine what treatment strategies are appropriate for a patient based on the type of kidney stone they have.

Trusting the process

The new AI-assisted test — the first of its kind in Clinical Pathology at Mayo Clinic — went live in April 2023. However, its journey did not come without challenges, successes, and stretches of extensive research. In July 2022, Dr. Jannetto and team published a [12-month prospective study](#) to prove its efficacy in improving operational workflow and the accuracy of results.

“We went through multiple iterations of the test to enhance the AI model and algorithms. For 12 months, we also ran the test behind the scenes as a quality assurance vehicle, where the AI program reviewed kidney stone results that we released manually,” says Dr. Jannetto. “During that time, we identified a revision rate of kidney stone reports about eight times higher than without, it because the AI caught typographical errors on reports which had to be revised. In the end, it showed us that the AI could prevent more errors than our two-human review process.”

A team effort

In four years, Dr. Jannetto and his team created something transformative, but they didn't do it on their own. From the start in 2019, the Digital Innovation Lab team at Mayo Clinic's Florida campus, led by Rickey Carter, Ph.D., helped develop the algorithms. Additionally, the Department of Laboratory Medicine and Pathology, Information Technology, Regulatory Affairs, Computational Pathology, and Artificial Intelligence teams combined their expertise from across the organization to make this groundbreaking discovery possible.

“ONE GREAT THING ABOUT THIS PROJECT IS HOW IT HIGHLIGHTS THE STRENGTH OF BEING AND WORKING FOR A PLACE LIKE MAYO CLINIC,” SAYS DR. JANNETTO.

“There are so many people and teams to thank. I can't stress enough how grateful we all are for Patrick Day and his idea to start this project. Also, we wouldn't be successful without Dr. Ricky Carter and his team's support of the project. In addition, Denise Rokke, a quality specialist within the Metals Laboratory, helped immensely to review hundreds of spectra and AI-quality reports to get this project off the ground.”

The future of AI-generated kidney stone analysis

With AI top of mind for improvements in health care research, Dr. Jannetto is confident that the new algorithms and test developed for kidney stones will also be applied to other laboratory tests and spectra generated within the Department of Laboratory Medicine and Pathology.

“Artificial intelligence will definitely have a huge impact on the clinical and anatomical sides of laboratory medicine,” says Dr. Jannetto. “There are so many applications, and we're just scratching the surface now. We already see AI being used in cardiology to interpret EKGs and in radiology to interpret imaging. We're going to see a huge influence and impact on laboratory medicine as it can help improve our diagnostic capabilities and quality.”