

New method aims to optimize HIV treatments, improve quality of life

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In the quest to overcome quality-of-life altering side effects linked to combination antiretroviral therapy (cART) in people with HIV, a team of Johns Hopkins researchers has developed a new way to optimize HIV

treatments that balances suppression of the virus with a strategy to reduce side effects, ultimately improving the quality of life for individuals undergoing treatment.

The Hopkins team, led by Yanxun Xu, associate professor in the Whiting School of Engineering's Department of Applied Mathematics and Statistics, and postdoctoral fellow Wei Jin, used a two-step approach to personalizing optimal cART regimens to reduce a patient's chances of comorbidities such as depression, [chronic kidney disease](#), and cardiovascular issues. The team's [results](#) are published in the *Annals of Applied Statistics*.

"Personalizing cART treatment for people with HIV has the potential to yield more effective health outcomes, enhancing overall well-being and quality of life. For example, individuals grappling with depression could experience a remarkable 22% improvement in their depression scores by adhering to the medication recommendations derived from our model, surpassing the benefits of their initially assigned medications," said Xu.

Xu's team faced an enormous challenge: evaluating the vast number of potential drug combinations to find the best one for each patient.

They proposed a two-phase strategy that uses patient information to personalize plans. First, they employed a Bayesian statistical method called a multivariate Gaussian process (MGP) to understand changes in patients' health over time. They then integrated the MGP into an offline reinforcement learning framework to figure out the best sequence of treatments (cART regimens) based on what they've learned about how patients' health evolved.

The researchers then tested their method using a large HIV database called the Women's Interagency HIV Study (WIHS). When their approach was used to select treatment plans for a group of 29 people

with HIV experiencing serious depression, it resulted in a 22% improvement in their depression scores.

Fourteen out of these 29 people didn't experience any signs of depression in the two years that followed, Xu said. The team suggests that their new method shows great promise for improving the well-being of people with HIV.

Jin highlights the study's broader implications, noting that the shortage of HIV care providers poses a significant challenge, particularly with approximately 1 million people living with HIV in the U.S. and nearly 40,000 new diagnoses annually. Primary care clinicians, often responsible for over half of HIV care, may lack updated knowledge of HIV prevention, screening, and diagnosis.

"The proposed method acts as a valuable resource, supporting physicians in their treatment decisions and potentially enhancing therapy management for better patient outcomes," Jin said.

The researchers plan to develop a user-friendly online software that recommends optimal cART assignments to physicians using this method.

"We believe that this software has the potential to play an important role in revolutionizing the clinical management of HIV. Unlike conventional HIV treatment guidelines focused solely on viral suppression, our approach considers potential comorbidities arising from both HIV disease and its medications, aiming to minimize additional health challenges for individuals with HIV," said Xu.

More information: Wei Jin et al, A Bayesian decision framework for optimizing sequential combination antiretroviral therapy in people with HIV, *The Annals of Applied Statistics* (2023). [DOI: 10.1214/23-AOAS1750](https://doi.org/10.1214/23-AOAS1750)

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