Maths shows that treating AIDS and hepatitis C simultaneously is more effective

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A Spanish researcher has collaborated on a mathematical analysis, recently published in the journal *Science Translational Medicine*, which concludes that joint therapy to counter HIV in patients who also have hepatitis C increases the chance of success in the fight against both infections. Between eight and nine million people worldwide simultaneously suffer from AIDS and hepatitis C.

Maths is becoming increasingly used in hospitals. Now, a study published in the journal *Science Translational Medicine* states that simultaneous infection from HIV and hepatitis C (HCV) must be detected at an early stage and treated as soon as possible with [antiviral drugs](#) in order to reduce hepatic damage.

"Therefore, once the first week of treatment against HIV has been completed, in which HCV spreads, the immune system reacts against the hepatic disease and has a beneficial effect on both infections," Mario Castro, professor at the Comillas Pontifical University ICAI-ICADE and one of authors of the research together with scientists from the United States and Europe, explains to SINC.

Hepatitis C is a disease that is rarely discussed in the media, "in part because it's not fatal in the short term; although it normally turns into cirrhosis of the liver, which can lead to the need for a transplant or death," declares Castro. "The problem becomes more serious when this infection occurs together with another one."

The expert stresses that we currently know very little about the effect of antiviral drugs when the patient is suffering from both infections. Despite this, estimates suggest that there are between eight and nine million people worldwide who find themselves in this situation (around 50,000 in Spain)..

Castro indicates that [mathematical analysis](link) can help in these cases. "Statistical causality analysis techniques based on the data reveal the hypothesis that treatment against HIV exacerbates the spread of the hepatitis C virus and causes immediate hepatic damage in [patients](link)," he adds.

Two types of statistical analysis were carried out on the patients' data. Firstly, an attempt was made to work out whether or not HIV treatment has any influence on HCV and hepatic damage. Through the use of a technique that is also used in economic analysis, the basic idea consists in determining if a temporal series 'precedes' another. That is, if HIV leads to the appearance of HCV.

However, in the long term, the stimulation caused by the treatment of HIV reduces the infectious load of both viruses. "In reality, it is the immune system that combats hepatitis," he explains.

"Indeed, for the majority (14 out of 16 of the patients), the test allows for the conclusion that the HCV viral charge is affected by HIV, and not the contrary," states Castro.

The second step involved using a model based on differential equations. By means of parameters adjusted to fit this model, it has been concluded that there is a significant Spearman correlation (that measures if when one function increases another significantly increases or decreases) between treatment and the evolution of the hepatitis C virus.

Mathematical models for countering diseases

Doctors and biologists already know the benefits of maths and information technology, which has led theories to change, particularly in the last ten years.

Castro highlights that hospitals must be multidisciplinary and include mathematicians and statisticians amongst their staff "because there is information that is not being taken advantage of and that doctors don't have time to look into".

"Bioinformatics", he indicates, "is a new branch of study that uses all the power of computer resources and applies it to biology and biomathematics, which some give the more generic name 'systems biology', attempting to look at each problem using calculus or computing in order to reach quantitative results."

The Spaniard, from the ICAI Higher Technical School of Engineering, is a member of a European scientific network that organises exchanges at institutions in other countries and has spent one month per year, for the last five, at the Los Alamos National Laboratory, a centre of reference for mathematical models in patients with AIDS.

The prognosis worsens with age

A recent study, made public last week during the Sixth Conference of the AIDS Study Group (GeSIDA), reveals that those infected with both HIV and hepatitis C and diagnosed when older than 50 have a risk of death that is between twice to nine times higher than those only infected with HIV and younger than 50.

The study was undertaken on a sample of more than 10,000 patients

treated in hospitals in Catalonia and the Balearic Islands. Specifically, the risk of death in patients over 50 years old who are infected with both HIV and HCV was found to be twice as great as in patients over 50 years old and with just HIV and patients diagnosed with both HIV and HCV before reaching 50 years of age, and nine times greater than those patients under 50 years old and only infected with HIV.

More information: Sherman, K. E., Guedj, J., Shata, M. T., Blackard, J. T., Rouster, S. D., Castro, M., ... & Perelson, A. S. (2014). Modulation of HCV replication after combination antiretroviral therapy in HCV/HIV co-infected patients. *Science translational medicine*, 6(246), 246ra98-246ra98.

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