

FEATURE

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Analytical Chemistry in the Fight for Life

According to a survey released on 26/01/2021 by Johns Hopkins University, the new coronavirus has already infected more than 100 million people and killed 2 million around the world. In Brazil, there have been almost 8 million confirmed cases of COVID-19 and more than 200,000 deaths from the disease. The United Nations (UN) has declared that the current pandemic is humanity's greatest challenge since World War II.

Faced with this situation, short-, medium-, and long-term actions, such as understanding how the virus causing COVID-19 acts in the human body, developing inputs for diagnostic tests, researching new uses of established drugs, using technology to produce and repair mechanical ventilation equipment, and producing 70% alcohol on a large scale for distribution in public health units, are being developed by chemistry professionals in association with specialists in other scientific areas to confront the coronavirus pandemic throughout Brazil.

An example of these actions is the test for COVID-19 that employs artificial intelligence algorithms and generates results in just 20 minutes, which was developed by a group of pharmaceutical, biological, medical and computer scientists from the University of Campinas (Unicamp), University of São Paulo (USP), São Paulo state regional hospitals, together with professionals from institutions in the State of Amazonas, Brazil.

This test developed by Brazilian scientists for COVID-19, and coordinated by Prof. Dr. Rodrigo Ramos Catharino, coordinator of the Innovare Biomarkers Laboratory at the Faculty of Medical Sciences at Unicamp, uses artificial intelligence algorithms to analyze data obtained by high-resolution mass spectrometry using blood plasma samples and metabolomics concepts to identify a characteristic pattern of molecules in patients with the disease. According to the article published in the scientific journal *Analytical Chemistry* [1], in addition to replacing the reagents with artificial intelligence algorithms, this test is able to predict which infected people will be at higher risk of suffering complications due to infection by the SARS-CoV-2 virus.

"The software captures the signals measured on the mass spectrometer and learns which molecules in the body are responsible for the positive and negative diagnosis. In addition, it also learns which molecules are responsible for severe and mild cases of infection with SARS-CoV-2. This test is an important tool for the medical team to make decisions for the treatment because it makes a very accurate screening of those who need more care and hospitalization. In this way, the test helps to save lives at the front lines of the fight against COVID-19," said the research coordinator, Dr. Catharino.

"Initially, the project had the participation of 728 patients, of which 369 were diagnosed with COVID-19 clinically and by RT-PCR. Samples from uninfected individuals were used for comparison, as a kind of control group. In the case of some infected patients who developed complications and needed to be hospitalized, a second blood sample was collected. In general, among patients with confirmed COVID-19, there were individuals with mild and severe symptoms," explained one of the research coordinators, the PhD student Jeany Delafiori.

The use of the machine learning technique to search for markers capable of assisting in the diagnosis is very important because this technique is capable of accumulating knowledge and improving its performance as more samples are analyzed. "If today this test has a 90% accuracy rate, it is likely that this rate will increase even more when we reach thousands of patients analyzed," says Prof. Dr. Anderson Rocha of the Institute of Computing at Unicamp. In addition to COVID-19, other diseases may be diagnosed by the platform through databases on other diseases.



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Other advantages of this test are the speed of diagnosis, practicality of use, and low price in relation to the COVID-19 tests that are currently available on the market. This new test provides a COVID-19 diagnosis in about 20 minutes, while other tests can take days. In addition, the cost of the RT-PCR test in Brazil is between R\$ 80 and R\$ 100, while the cost of the test developed by Brazilian scientists should be R\$ 40.

This diagnostic method seeks to minimize one of the greatest difficulties in halting the progress of the new coronavirus pandemic in Brazil, which is the low testing done on the population. The joint effort of universities aims to provide testing, case locations, and tracking of the spread of the virus at low cost and high speed. “As it is about developing a new diagnostic concept, we need financial support for the implementation of this test. Cooperation agreements can be established through the Innovation Agency Inova Unicamp,” said Dr. Catharino.

The test has not yet been approved by the National Health Surveillance Agency (Anvisa); however, the expectation is to submit for approval as soon as possible.

Another important example of action in Brazil to face the COVID-19 pandemic came from Fleury Group, a private diagnostic center, which also developed a new test for the diagnosis of COVID-19. The project led by the biochemists Dr. Valdemir Melechco Carvalho and Dr. Karina Helena Morais Cardozo resulted in a pioneer proteomics assay. The test is based on the analysis of specific peptides from the new coronavirus proteins directly from respiratory tract clinical samples. This method is considered as reliable as the gold standard RT-PCR test, which detects the RNA of the virus.



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Scientific Advisor to Fleury Group



Dr. Karina Helena Morais Cardozo
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The Fleury test was initially developed with micro chromatography and high-resolution mass spectrometry and subsequently implemented in multidimensional turbulent flow chromatography coupled to tandem mass spectrometry, which enables robustness and speed for routine work. It is fully automated, which reduces the analysis time and risks in handling the samples. With the potential to analyze more than 1,500 samples per day, this new test is a high-throughput targeted proteomics assay that generates results in up to 2 days. According to the Fleury Group, the new test may be an alternative in case of a shortage of consumables for the RT-PCR test. Also, it provides a testing option for the most remote areas of Brazil since the proteins are more stable than RNA simplifying the logistics for specimen transportation.

This proteomics test is recommended for use in the first three to seven days of COVID-19 symptoms and is performed directly from nasopharyngeal and oropharyngeal swabs, similar to RT-PCR. It was validated in a study with more than 1000 samples previously analyzed by RT-PCR, and it was able to detect more than 83% of positive cases [2]. This proteomics test is currently available for hospitals, laboratories, and clinics in regions far from major centers in Brazil.

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