

Light-based device uses a few drops of saliva to effectively test Covid-19 patients

A team of researchers from ICFO and IrsiCaixa report on the development of a low-cost, portable, non-invasive device that uses light and saliva to test Covid-19 patients in less than 30 min. The results have shown that the device can detect very low concentrations of SARS-CoV-2 with a sensitivity of 91.2% and a specificity of 90%, similar to that of PCR but as fast as an antigen test.

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The breakout of Covid-19 became a game changer in the medical field in 2020. Studies bloomed and steered into full motion to try and find solutions via different paths; on one hand, vaccinations to control the spread of the disease, and on the other hand, seeking for testing techniques that could be available and accessible to everyone around the globe. At the beginning, PCRs were one of the few available techniques capable of providing accurate

results, but this technique was expensive and it required specialized personnel and equipment to carry them out. Due to the increasing demand of tests, antigen testing then became an alternative that was much faster and cheaper, but less reliable since it was less sensitive than the former.

In a recent study published in Biomedical Optical Express, ICFO researchers **Rubaiya Hussain, Alfredo E. Ongaro, Ewelina Wajs**, led by ICREA Prof. **Valerio Pruneri**, in collaboration with researchers **Maria L. Rodriguez De La Concepcion, Eva Riveira-Munoz, Ester Ballana, Julia Blanco, Ruth Toledo, Anna Chamorro, Marta Massanella, Lourdes Mateu, Eulalia Grau, Bonaventura Clotet, led by Jorge Carrillo** from IrsiCaixa AIDS Research Institute, have demonstrated and developed a novel technology capable of providing fast and reliable detection of SARS-CoV-2 in saliva samples for COVID-19 testing. The team achieved a detection limit much lower than the antigen tests and when carried out a blind test on more than 50 patients, they obtained results with a sensitivity of 91.2% and a specificity of 90%. ?

The need

Working daily with COVID-19 patients, **Marisa Rodriguez and Jorge Carrillo, researchers at IrsiCaixa**, remember that i¿½at the beginning of the pandemic we knew it was real y important to detect all those infected individuals in order to control the virus spread. That s why IrsiCaixa researchers, with Bonaventura Clotet at the helm of the initiative, got togeth r and saw the need to find an alternative to PCR and antigen tests that would combine t e advantages of each of them, and that would also detect SARS-CoV-2 infection from sali a samples as it is much simpler and less invasive to obtain for most patients.i¿½. With this dea in mind, they contacted ICFO seeking for the technology for light-based imaging and diagnosis devices, developed by Valerio Pruneri's te**Alfredo Ongaro, ICFO researcher**, recalls vividly that i¿½researchers from IrsiCaixa contacted us to see if we could come p with a solution to the problem of testing and provide a new device that could dete t SARS-COV-2 from saliva, avoiding painful nasal swab sampling, and achieve accurate resul s in short time scales, possibly as fast as an antigen testi

A flow virometer

The team developed a flow virometer, a device that uses light to detect the concentration of the virus in a liquid that flows through a very small tube called a microfluidic channel. As **Rubaiya Hussain, ICFO researcher**, explains i¿½the device uses a couple of drops of sali a and fluorescent light markers. When saliva is collected from the saliva of a patient's mout , we introduce it in a solution that contains fluorescent antibodies. If the saliva contains a

y presence of viral particles, the fluorescent antibodies will attach to the virusi¿½. Then, i?½the reader collects the sample and sends it into a microfluidic channel that will pass thrugh a laser illumination detection set-up. The laser illuminates the sample and if there is prsence of viral particles, they will emit a unique enhancement of the fluorescence signal. In les than 1 minute, the reading translates into peaks in our graph and alerts the system that the ample is a positi

i¿½. The team at ICFO carried out a blind test with 54 samples provided by IrsiCaixa and w re able to identify **31 cases out of 34 positives** with only 3 false negatives. In addition, they measured **3834 viral copies per milliliter**, which is at least three orders of magnitude lower than that of commercially available rapid antigen tests, meaning that the device is capable of detecting the presence of virus at very **low concentration** levels.

A device used anywhere, by anyone

Finally, **Ewelina Wajs, ICFO researcher**, points out that i¿½Our device is very versatile. y selecting proper antibodies, this technology could also be adapted for the detection of other viruses, such as seasonal coronavirus or influenza virus, or even microorganisms in water, such as Legionella and E-coli, with a very fast response time, with respect to gold standars relying on culture.i

½ The researchers remark that a **single device** could carry out up to **2000 tests per day**. The components that make up the device are **low-cost, commercially available** off-the-shelf, which allows their **large-scale fabrication**. In addition, this technique also implies reducing the need of plastic packaging due to massive testing in one device, which favors green environment policies.

Finally, due to its low cost and simple operational design, it could be an excellent solution for diagnosis and spread control in low-income countries where there is limited access to healthcare and vaccines for all the population. The fact that it does not have to be operated by specialized staff or be in a specialized lab could translate in being used for mass screening of the population in crowded places such as restaurants, schools, offices, theatres, and cinemas.

REFERENCE: A small form factor flow virometer for SARS-CoV-2**,** Rubaiya Hussain, Alfredo E. Ongaro, Maria L. Rodriguez De La Concepcion, Ewelina Wajs, Eva Riveira-Munoz, Ester Ballana, Julia Blanco, Ruth Toledo, Anna Chamorro, Marta Massanella, Lourdes Mateu, Eulalia

Grau, Bonaventura Clotet, Jorge Carrillo, & Valerio Pruneri, Biomedical Optical Express, 2022, https://doi.org/10.1364/BOE.450212



Rubaiya Hussain carrying out the testing of a saliva sample with the device in the Biology lab at ICFO. ©ICFO



Alfredo Ongaro preparing the device in the Optoelectronics lab to then take it to the Biology lab at ICFO for the testing of the saliva samples. ©ICFO



Jorge Carrillo (left) and Marisa Rodriguez from the Immunology Group at IrsiCaixa



Video abstract