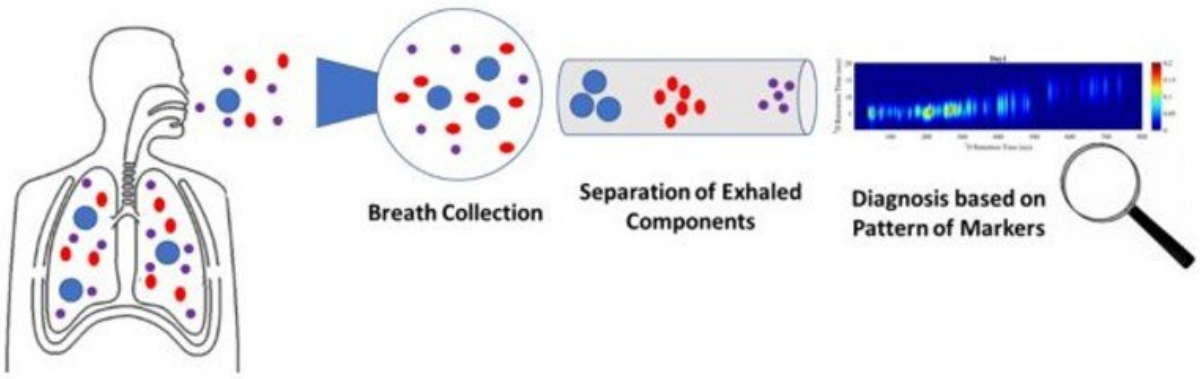
Scientists develop means for detecting early stages of lung problems caused by COVID-19

June 1 2020



This schematic illustration shows how a disease is identified by the pattern of compounds detected in exhaled breath. Gas chromatography is an analytical technique that separates the chemical constituents of an air sample into components, with the retention time (the amount of time it takes for a given compound to pass through the chromatography column) being an identifying characteristic of each compound. Credit: Air Force Office of Scientific Research

Air Force Research Laboratory scientists are working with University of Michigan and Intelligence Advanced Research Projects Activity (IARPA) researchers to build and test a revolutionary chemical sensing device that can detect acute respiratory disease syndrome (ARDS) associated with COVID-19 deaths.

Under IARPA's molecular analyzer for efficient gas-phase low-power interrogation (MAEGLIN) program, AFRL Materials and Manufacturing Directorate and 711th Human Performance Wing researchers, along with University of Michigan scientists, are making modifications to an existing gas analysis system based on a small gas chromatograph (micro-GC) from MAEGLIN.

The MAEGLIN program is developing an ultra-low power chemical analysis system for remote site detection and identification of explosives, chemical weapons, industrial toxins and pollutants, narcotics, and nuclear materials in the presence of significant background and interferents by analyzing air samples. This portable system is sufficiently compact to enable several practical applications, both military and civilian. For example, it can continuously and remotely monitor areas prone to industrial pollution or can be carried by warfighters in the field to avoid unseen explosives.

Now it has one more use: sampling air exhaled by patients stricken with COVID-19.

The team quickly realized that the MAEGLIN program's gas sensor, which was originally developed for environmental monitoring, could be modified for medical use. To that end, AFRL decided to have the program contract modified.

"The goal of the MAEGLIN program was not to develop a medical device, but a means for autonomous environmental gas monitoring," said AFRL research team member Dr. Robert Bedford. "However, the technology showed promise for medical applications, and we saw an opportunity to use it for urgent needs during the global pandemic."

Used somewhat like a breathalyzer, the system, which is designed to identify trace amounts of gas, can detect the chemical signature of

ARDS in its earliest stages through non-invasive use. This allows overwhelmed medical staff to quickly and easily identify at-risk patients 24 hours earlier than by using any other diagnostic techniques available today. Such early detection can help determine which patients will likely need ventilators, saving lives by intervening before the coronavirus can seriously damage the patient's lungs.

Previous, preliminary testing of a similar device was funded by the National Institutes of Health and involved 20 non-COVID ARDS patients. The NIH device was a small, suitcase-sized gas chromatograph. The MAEGLIN device also uses gas chromatography, but it is much smaller and more efficient. It is also expected to be more accurate, since it uses machine learning algorithms developed under the MAEGLIN effort.

Although not part of the NIH testing on non-COVID ARDS patients, AFRL is currently involved in testing as a result of the modified contract. Modifications to the MAEGLIN contract took less than a week and the effort built four prototype units. After approving the Institutional Review Board Protocols, the University of Michigan began trials in non-military ICUs with COVID-19 ARDS patients, as well as with healthy adults as a control group.

When asked about successes to date, Bedford admits it is too early to tell. "This is a trial, after all. However, in breath analysis experiments, gas chromatography is often used to verify other systems. Therefore, the micro-GC system with its powerful signal analysis techniques combine to make a very promising approach."

For now, the benefits of this device and approaches for its use will be monitored on an ongoing basis.

Provided by Air Force Office of Scientific Research