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Air sampling surveillance could give early warning of Covid-19 infection risks in hospitals, nursing homes: Researchers

Dr Irvan Luhung, a senior research fellow holding the air sample collector. PHOTO: SCELSE

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SINGAPORE - Air sampling to provide early warning of Covid-19 infection risks could provide a boost for hospitals and nursing homes to protect both vulnerable groups and healthcare staff.

Researchers from the Singapore Centre for Environmental Life Sciences Engineering (SCELSE) at Nanyang Technological University and NUS Yong Loo Lin School of Medicine have developed a surveillance system to sniff out the presence of airborne Sars-CoV-2 RNA - the genetic sequence for the virus that causes Covid-19.

The extracted RNA is tested using a real-time quantitative reverse transcription polymerase chain (RT-qPCR) technique - used commonly in swab tests - to detect the virus.

The surveillance system was trialled in three hospital wards for Covid-19 patients from February to May last year. It was found that there was a higher detection rate of the Sars-CoV-2 virus compared to surface swab samples collected in the same area.

The findings were published in scientific journal Indoor Air on Sept 14.

Professor Stephan Schuster, deputy centre director at SCELSE, told reporters on Friday (Oct 8) that it has previously been "deemed impossible" to detect the virus in well-ventilated rooms with very high air exchange rates.

This refers to the number of times the air in a room is replaced by outdoor air.

In a hospital ward, the air change rate can be up to 14 times per hour, whereas a plane has about 20 air changes an hour, noted Prof Schuster, who co-led the study.

Dr Irvan Luhung, a senior research fellow from SCELSE , said the air surveillance technique could go a long way in keeping healthcare workers safe.

"In hospitals with a high daily number of Covid-19 patients, employing a routine air surveillance programme with high sensitivity could be beneficial in detecting the virus early and help to keep frontline medical staff safe," said Dr Luhung.

The team is collaborating with the National Environment Agency for more widespread surveillance in outbreak settings, he added.

Associate Professor David Allen from the NUS Medicine's Infectious Diseases Translational Research Programme, who also co-led the study, said the air surveillance technique could be an additional tool for mass screening, in addition to wastewater

sampling, for example.

Wastewater testing, which indicates the presence of the virus in sewage discharge, has been deployed at a number of Housing Board blocks and dormitories to detect ongoing Covid-19 transmission.

However, this method is retrospective in nature which means that pre-emptive action is often not possible.

The team will be looking to expand the study to see if the results remain consistent with the Delta variant at play.

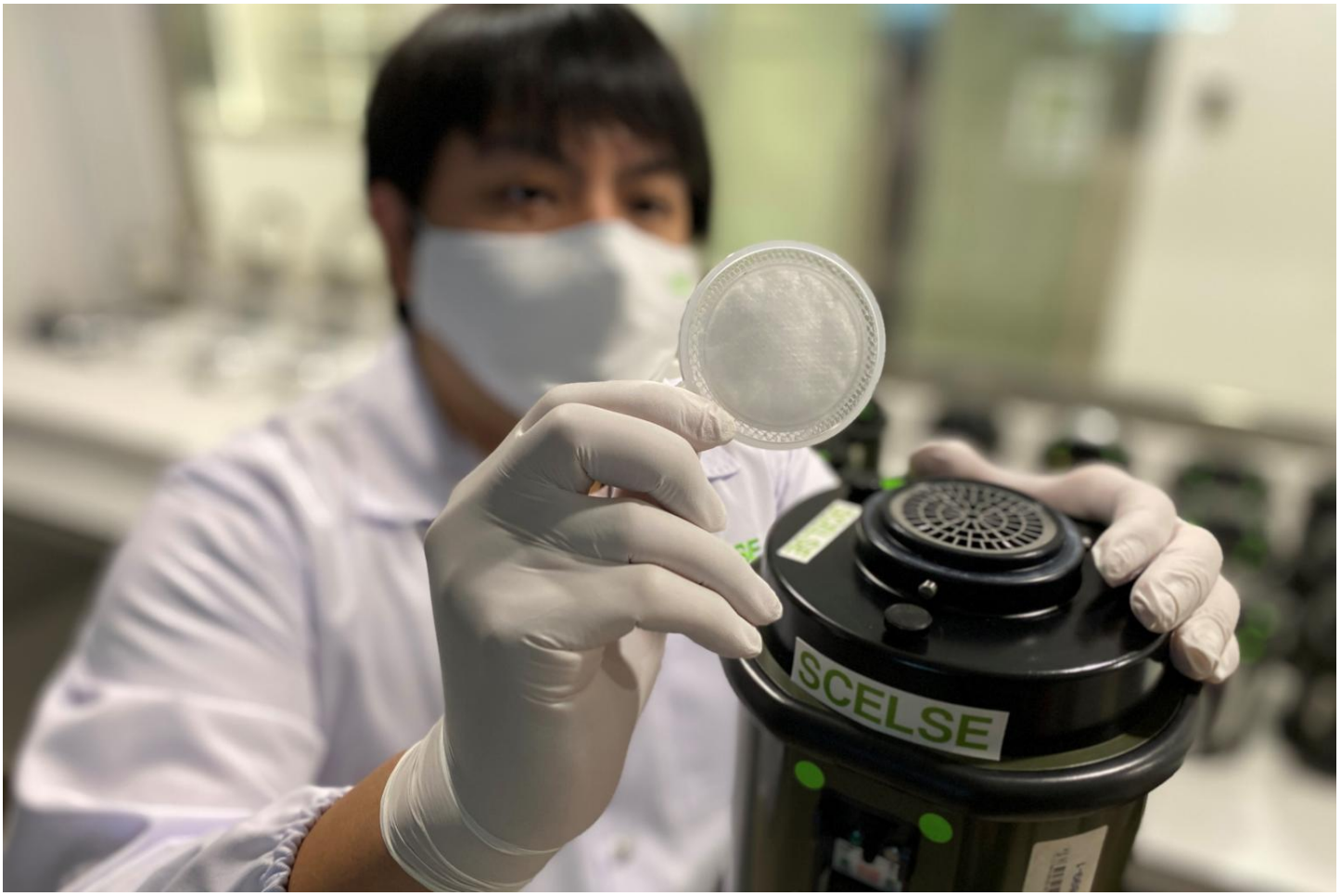

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PHOTO: SCELSE

As that variant is associated with higher viral loads in patients, Prof Allen expects that more virus will be detected in the samples both in the air and in the environment.

He added that the National Centre for Infectious Diseases is currently using the technique to conduct spot checks and iron out some issues with patient flow.

Professor Paul Tambyah, deputy director of the NUS Medicine's Infectious Diseases Translational Research Programme, said the surveillance system could also be used in settings, such as concerts or airplanes where many people are present for at least three

hours or more.

"My dream was to put one of these devices on a plane, turn it on and take off, and then when you arrive, do a PCR test so you could tell if any of the passengers were infected by the time they clear Customs," he added.

This could revive air travel and do away with quarantine, he noted.

Given the situation with the Delta variant and with the number of infected people having increased, this surveillance method could also inform researchers if the risk of infection in a particular setting is too high, said Prof Schuster.

They can then improve the ventilation and air flow to reduce this risk, he added.

How the study was conducted

Two types of hospital wards were tested from February to May last year: two naturally ventilated, open wards and a mechanically ventilated isolation ward.

Air sample collectors with varying flow rates were deployed for eight-hour periods in different areas in the ward, such as the personal protective equipment (PPE) donning area in the open-cohort ward, the windowsill in the isolation ward, and the toilets of both wards.

A total of 27 air samples were collected.

Seventy-three surface swab samples from the patient care, staff and toilet areas of the two ward types were also collected and analysed for comparison. The chosen swab sites were not cleaned for at least eight hours prior to swabbing.

The scientists found that their devices operating at the higher air sampling flow rate of 150L/min (compared to 50L/min) improved the chances of successfully detecting the airborne Sars-CoV-2 virus.

For the samples collected by the high flow rate sample collectors, 13 out of 18 were found to contain the Sars-CoV-2 virus. The remaining nine air samples from the devices operating at a lower flow rate did not detect any traces of viral RNA.

This is in comparison to the surface swab samples, which showed a positive detection rate of 9.6 per cent.

These results highlight the potential of air sampling as a tool to detect the presence of Sars-CoV -2 in the environment, said the scientists.

Future air surveillance studies will need to be conducted in locations outside of hospital environments where mass gatherings occur.