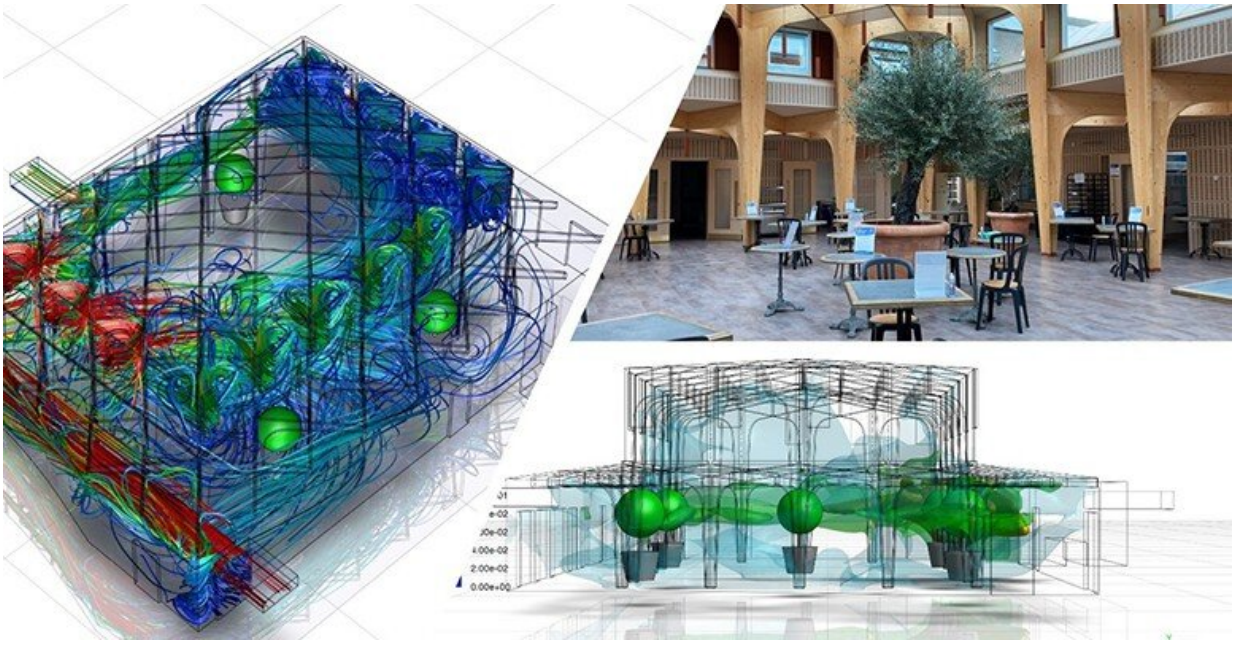
Simulation-design tools map a ventilation system to reduce COVID-19 infection risks

April 6 2022



Credit: University of Manchester

Advanced computing expertise is being used to help ensure that hospice patients are better protected from COVID-19 following a pioneering study led by The University of Manchester.

Computer modeling and simulation technologies have been applied in a hospice—where some of society's most vulnerable patients are cared for—to study airflow dynamics in order to identify the 'safest' parts of a

communal area for patients to use.

The Manchester findings informed care managers at the hospice and enabled them to find ways of mitigating any risks and to create an even safer environment for patients, staff and visitors. The pioneering work has also provided a new metric to inform architects when they look to design similar care facilities in the future.

The work was led by Dr. Amir Keshmiri, Reader in Computational Fluid Dynamics (CFD) at The University of Manchester, and his team who used advanced simulation-design tools to map a ventilation system in the newly constructed, award-winning and large community space known as "The Green," within St Richard's Hospice, which is based in Worcestershire.

This work was conducted in partnership with Ansys and in collaboration with Associated Architects and specialist construction consultants CPW.

"Assessing the risks of infection in a large and modern building for patients with terminal illness who may not be protected by the same level of antibodies as the rest of the population is extremely complex in nature," said Dr. Keshmiri.

He added: "Even as we all begin to learn to live with COVID-19 it should be remembered it is still extremely high risk for patients in a hospice to catch the virus. So, identifying all the risky areas with a high level of accuracy without any field data—as the space we studied was brand new—is the basis of the pioneering science behind this study.

"Our work has developed a numerical framework and a new metric to assess the level of risk with a high level of confidence, which can be used in all future ventilation designs for all similar large buildings.

"This fascinating project was a great example of where advanced computational models can make a real impact in the fight against COVID-19 and any other future viral infections for some of the most vulnerable people in our society."

The St Richard's Hospice cares for people with a serious progressive illness who have complex needs that cannot be met by other care services. In line with modern engineering priorities the building was designed to include the latest thinking in energy reduction technologies, such as natural ventilation.

Following their investigation Manchester researchers were able to pinpoint potential viral 'hotspots' to avoid, as well as identifying areas where there was also the least chance of infection in "The Green," the internal courtyard that provides space for patients, staff and visitors at the heart of the hospice.

The researchers found that, as expected, some architectural features like pillars or columns, as well as the arrangement of internal furniture, provided some disruption to the airflow at heights of 1-1.5m above the floor. This type of disruption can potentially influence virus transmission indoors.

Professor Richard Lewis, a consultant physician and the vice-chairman of St Richard's Hospice, was the medical lead on this study. He said: "We have been extremely grateful to Dr. Keshmiri and his team for their enthusiasm, skills and dedication.

"When it came to wanting to answer the question whether it was safe for our vulnerable patients to meet in the new communal space, the CPD team at Manchester was the obvious group to ask.

"In particular we were aware, because this is an area where both staff,

patients and their families eat and drink—and therefore remove their masks to do so—that it was important to be able to study the dynamics of airflow in order to identify the 'safest' area for our patients, and find ways of mitigating any risks.

"As a result of the studies at Manchester we felt able to open the space to our extremely vulnerable patients. This is one step nearer to 'normality' for folk who have been effectively locked down for the past two years, and a step which we now make with confidence."

A current Ph.D. project based at the University will carry on to develop a series of new metrics that link clinical data of virus transmission by COVID-19 patients, to better assess infection risks. This will provide a probability of infection map throughout the building's whole flow domain.

"Furthermore, by quantifying viral loads in the air, sensors will also be used to mitigate infection risk through controlling the required openings of the supply [ventilation] grilles to do so," added Dr. Keshmiri.

Provided by University of Manchester