New app calculates coronavirus infection risk in rooms

12 April 2021

Teaching under coronavirus conditions: the distance between students minimizes the risk of infection by droplets with a diameter of more than 50 micrometres. The HEADS App developed by the Max Planck team in Göttingen makes it possible to estimate the risk of infection by aerosol particles with less than 50 micrometres. Credit: Friso Gentsch

The risk of being infected with the coronavirus indoors can now be determined more reliably than before using a web app. A team from the Max Planck Institute for Dynamics and Self-Organization in Göttingen and the University Medical Center Göttingen uses a refined statistical method in the web app called Human Emission of Aerosol and Droplet Statistics, or HEADS, to calculate the risk of infection via aerosols. The researchers include in their analysis the size distribution of infectious aerosols and the rate at which they settle in a room. As a result, HEADS now gives a realistic risk of infection from aerosols in enclosed spaces that are not too large. The app does not make any statement about the risk of becoming infected by droplets larger than 50 micrometers in diameter when in contact with a virus carrier at a short distance.

A new, tighter lockdown may soon be another attempt to reduce the number of COVID 19 cases. However, ways must be found to return to a reasonably normal life even with the SARS-CoV-2 coronavirus. Therefore, especially in light of new mutations, it is important to know what the risk of infection is in different situations and how it can be minimized. To better assess the risk of infection indoors, the Max Planck Institute for Dynamics and Self-Organization and the Institute of Hospital Hygiene and Infectiology (IK&I) at the University Medical Center Göttingen (UMG) have released the free web app HEADS (Human Emission of Aerosol and Droplet Statistics). It can be used to calculate the risk of infection for a certain number of people in indoor spaces that can be as large as 100 square meters, twice the size of a classroom. All users have to enter into the app are a few parameters, such as the size of the room, the number of people present, and whether these people are just breathing, talking loudly, or perhaps singing.

The main factor in the spread of SARS-CoV-2 and other pathogens are droplets that virus carriers release with the air they exhale. Droplets typically vary in size from about 100 nanometers—about the diameter of a single virus—to about one millimeter. Droplets larger than about 50 micrometers fall quickly to the ground, so the risk of infection from them can be minimized by keeping people at least 1.5 meters apart. Droplets smaller than 50 micrometers in diameter—equivalent to the radius of a fine woman's hair—dry quickly, become lighter particles, and as such remain airborne longer. The Göttingen team now asked themselves how high the risk of infection from these aerosols is in a closed, well-mixed environment, and developed the HEADS app based on their own research results and findings from other groups. The model behind it is now up-to-date with the latest scientific findings and in particular takes into account the size distribution of the aerosols released with the air we breathe. As the researchers measured on more

than 130 test subjects, there are many small aerosols and only a few large ones.

The larger the aerosol droplets, the more dangerous they can be

Even for aerosol droplets with a diameter of less than 50 micrometers, the larger they are when released, the more harmful they can be. This is because they can contain several viruses, which increases the risk of infection when inhaled. Using a statistical method that takes this fact into account, the HEADS app now enables a particularly reliable estimate of virus exposure in enclosed spaces. "With our holographic and particle tracking measurements, we now know the large aerosols very well," says Mohsen Bagheri, head of a research group at the Max Planck Institute for Dynamics and Self-Organization. "This allows us to determine the viral load in an indoor environment very well." Compared to many similar apps that exist around the world, the HEADS app therefore determines a higher risk of infection.

"We are confident that with the new theory and the new data, our app represents the risk of infection in closed, well-mixed rooms very well," says Eberhard Bodenschatz, director at the Max Planck Institute in Göttingen. "The bad news is that there is a greatly increased risk of infection." Mohsen Bagheri adds, "The good news, however, is that FFP2 masks and medical mouth-nose protection greatly mitigate the risk, especially when they fit tightly to the face."

The new app is currently available in German and English, but is expected to be released in other languages as well.

More information: Freja Nordsiek et al. Risk assessment for airborne disease transmission by poly-pathogen aerosols, *PLOS ONE* (2021). DOI: 10.1371/journal.pone.0248004