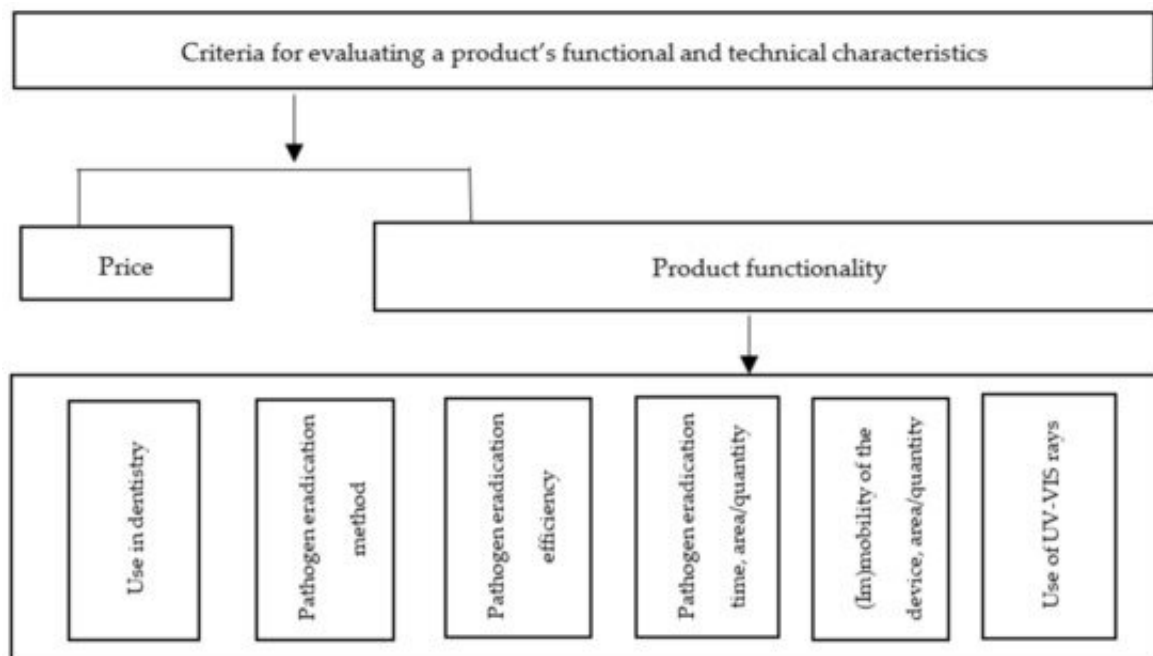


Scientists create dental equipment that destroys viruses

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Criteria for evaluating a product's functional and technical characteristics.
Credit: *Sustainability* (2023). DOI: 10.3390/su15032664

Three years of the COVID-19 pandemic particularly affected the daily life of health care professionals, who consulted patients remotely due to being more likely to get infected, and some of them, like dentists, were even prohibited from working. A new invention by Lithuanian scientists can allow for providing health care services and ensure the safety of specialists during the outbreaks of various diseases.

An innovation that focuses on the needs of dentists is the result of the collaboration of scientists from Kaunas University of Technology (KTU), Lithuanian University of Health Sciences (LSMU), and Dental Clinic Senamiesčio Stomatologijos Klinika.

Project manager, KTU School of Economics and Business (SEB) professor Vaidas Gaidelys says that the novelty was created after considering the challenges that health care professionals face. In particular, [dental patients](#) cannot wear masks during treatment, and the possibility of contracting the virus for dentists is particularly high due to the constant contact with the patients' fluids.

"During the pandemic, patients suffering from toothaches or facing more serious health problems could not get proper help, so we developed equipment that will increase the accessibility of health care services. The developed solution is intended specifically to ensure the safety of providing health care services to persons who cannot wear physical shields," says Prof Gaidelys.

HINS rays that kill viruses

Although the use of ultraviolet rays for disinfection and protection against viruses is not a new concept in the scientific community, most products on the market use different wavelengths of UV-C radiation sources, which have certain requirements for their [effective use](#) that disrupt the health care process.

"For example, the quartz lamps that are still used for indoor disinfection complicate the specialist's work, because during disinfection people have to leave the area. Also, the effectiveness of these lamps in destroying virus cells declines in the wider operating range—there should be a small distance between the germicidal lamp and the area to be disinfected, and the greater the distance, the longer the surface should be irradiated," says

Gaidelys.

The innovation, created by Lithuanian researchers, can be used during the provision of health care services and forms several protective barriers that ensure the safety of the health care professional. According to conducted market research published in *Sustainability*, the equipment that utilizes short-wave High-Intensity Narrow-Spectrum (HINS) ultraviolet rays to destroy the viability of various viruses is the first of its kind on the market.

"HINS rays have a high degree of efficiency in destroying SARS-CoV-2 virus cells, but it can also be used to protect against various forms of influenza or other viral cells," says KTU SEB professor.

In order to meet the needs of various health care specialists, three pieces of equipment were created to facilitate the work of not only dentists, but also oral hygienists, endodontists, periodontists, and other specialists.

"From a small idea, when we hoped to destroy virus cells in the patient's mouth, this project has developed into three actual innovations," says Gaidelys.

Air purifier

A special air purifier SSK SDE-1, created by a team of researchers from the School of Economics and Business (SEB) and Faculty of Mathematics and Natural Sciences (FMNS), can disinfect the air exhaled by a patient. The aerosol disinfection module is placed to not interfere with the health care professional's work, and the air suction pipe is directed at the patient—at a 20-centimeter distance from the person's face.

"The air then travels through the primary filter to the closed container

inside the air purifier, where the virus cells attach it selves to the secondary filter. For a certain time, this filter is illuminated with HINS rays, which destroy the virus cells, thus the virus does not spread," says Gaidelys.

The invention, which utilizes ultraviolet waves, releases already clean, disinfected air into the environment, thus reducing the possibility of infection for the persons in the room. The scientist explains that for the efficient use of the equipment it is important to change the filters in the device regularly, but the primary—no more than once a month, and the secondary no more than once every six months.

Transparent protective shield

In addition to this invention, the team of scientists developed the SSK SDE-2 barrier module, which separates the patient from the specialist. The frame-like transparent barrier limits the visibility only slightly, allowing the specialist successfully provide [health care services](#) to the patient while stopping the airborne diseases.

"This protective barrier makes it possible to provide, for example, dental hygiene services, plaque, and tartar are cleaned from the surface of the teeth, without fear that the health care specialist will be infected with a virus that the patient may be carrying. After the cleaned particles settle on the barrier separating the patient and the dentist, the barrier is disinfected thanks to the lamps emitting UV radiation integrated into the frame," explains the KTU researcher.

Glass, which is resistant to the destructive effects of UV waves, but allows the destruction of virus cells that come in contact with it, was chosen for the production of the device.

Disinfecting dental water

The third invention of Lithuanian scientists is the SSK SDE-3 dental water disinfection module. During the normal provision of dental services, saliva, and other liquids, collected using a saliva ejector, drain into the general sewage system, from which they enter the environment. This invention will disinfect such liquids and ensure that the virus cells no longer spread.

"The created module can be integrated into existing dental systems in order to disinfect liquids before they enter the common sewage system: HINS light sources are inserted into the container, where the collected liquids are stored, and disinfects them within the appropriate time frame," says Gaidelys.

The strength of the UV rays used in the developed dental equipment is not suitable for disinfecting [human skin](#), as their concentration can cause skin damage, thus the technology has been adapted for use in a closed container—inside an [air purifier](#), transparent barrier, or a container that stores liquids.

"The widely known PCR molecular method was implemented to determine the effectiveness of the innovation. It was also used during the pandemic to determine whether a person has an infection caused by COVID-19. Also, the products were tested by dentists of various specialties, whose comments and advice were considered when improving this innovation, that the equipment would not overcomplicate the experience of the patient receiving the services or the work of the health care specialist," says KTU SEB professor.

Patent pending

According to Gaidelys, the team of eleven scientists managed to create the innovation in less than a year: "Indeed, there were many challenges and particularly intensive work hours, which resulted in achieving the set goal and perhaps even exceeding expectations."

Currently, the created innovation is in the commercialization stage—a patent is pending, which would allow the product to be introduced to the market. The scientist claims that dental equipment will be accessible to many businesses: the price of the products will be competitive.

"This product is aimed at global market, as all the world faced the challenges posed by the pandemic," says Gaidelys.

Although the team of scientists has already presented the equipment to companies in the United States (US), they do not rule out the possibility of seeing the innovations they have developed in Lithuanian dentists' offices.

"Mass production requires a production base and experience in adopting innovations, so we chose the US market as they are very interested in innovations and are ready to invest in them. However, we are also interested in distributing the product in the European Union," says KTU SEB professor.

More information: Yu-Xia Tu et al, Changes in the Competitive Environment and Their Evaluation in the Context of COVID-19: A Case Study, *Sustainability* (2023). [DOI: 10.3390/su15032664](https://doi.org/10.3390/su15032664)

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