Toxin testing reaches new levels

MALDA measures hazardous aerosols to help those exposed to them.

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ENVISION A VACUUM PUMP taken to toxin-spewing industrial sites to measure airborne contaminants and how deeply they can enter workers' airways. Such information would be invaluable to pulmonologists—and save lives.

Enter MALDA, or Mobile Aerosol Lung Deposition Apparatus.

Created by a UTHealth Houston School of Public Health researcher and not yet on the market, the tool's main features are a human airway replica and an aerosol measurement system. With them, MALDA can measure hazardous aerosols in the air of a community or workplace and estimate how many are inhaled—and how deeply. That data is relevant to health risks of people who are exposed to them.

"If a patient tells us they were exposed to asbestos, we have no tools to know how much of that asbestos may have reached the part of the lungs that's more sensitive to it," says George L. Delclos, M.D., M.P.H., Ph.D., an environmental pulmonologist and professor at UTHealth Houston School of Public Health.

That's because today's common workplace or ambient aerosol assessing approaches are unable to determine how many health-harming pollutants remain in the airways after being inhaled, says Wei-Chung Su, Ph.D., MALDA's creator and an assistant professor of environmental and occupational health sciences at UTHealth Houston School of Public Health.

A person's airways are much like an inverted tree. The trachea is the trunk, from which increasingly tinier branches descend. MALDA explores more deeply into those tiny branches.

Precisely where pollutants are deposited is important, since not all parts of the lungs are equally sensitive to toxins, Su says. Generally, the smaller the particles, the farther they can travel in airways. The lower respiratory tract is where much of the harm from e-cigarettes, car exhaust, welding fumes and wildfire occurs.

MALDA's pinpointing which areas of the lungs are most vulnerable could lead to more precise, targeted treatments.

"MALDA measures all the way to those tiniest and most vulnerable airways," Delclos says. "Although it's mainly a research tool, perhaps one day it will be

able to give pulmonologists and epidemiologists a much better idea of how much tobacco smoke and other pollutants and aerosols in the workplace are able to reach the parts of the lung, including the alveoli, or tiny air sacs, where they could cause the most damage."

Such knowledge could help identify who is at greatest risk of lung cancer, emphysema, cardiovascular disease, lung scarring (fibrosis) and chronic obstructive pulmonary disease (COPD), he says. "By better identifying who's at greatest risk of a disease from aerosol toxins, we can get closer to identifying accurately who benefits most from screenings," Delclos says. "That is MALDA's main potential application."

How it works

MALDA includes a complete set of human airway replicas spanning from the nasal airway and lung tree to the alveolar region of small air sacs. It also has a battery-powered air pump to inhale aerosols and a pair of particle sizers to measure them.

From blueprint to reality took two years, but the challenge gestated for decades in the mind of Su, its developer.

"In the past we could only conduct measurements in a laboratory," Su says. "My goal has been to overcome those limitations. MALDA can obtain on-site aerosol deposit data so we can study health risks caused by real-life exposure. For instance, we can put MALDA in the workplace, on the street or in homes to assess potential cancer risks caused by breathing vapors from combustion, e-cigarettes and wood burning."

Besides helping to identify who's most at risk and could benefit most from screenings, MALDA's pinpointing which areas of the lungs are most vulnerable could lead to more precise, targeted treatments, Delclos says.

Treatments can be improved

"Chemotherapy can do a lot of good, but when it's given by vein or by mouth, it goes all over the body," Delclos says. "It may treat a tumor, but there can be lots of side effects, including injuring the liver or kidneys. So there's a growing interest in targeted cancer treatments that aim for the tumor, but without spreading to the rest of the body, thus cutting chances of side effects."

He says MALDA could be helpful for developing such treatments.

"In addition, more and more we're using medications that are inhaled, delivering medication by nebulizers," Delclos says. "MALDA may help make these drugs more targeted, effective and less toxic while also guiding the development of newer drugs."

MALDA already is of interest to researchers and respiratory toxicologists, Su says. "So far, the information is useful for scientists to estimate inhalation doses and understand linked health risks caused by aerosol exposure." •

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