Improving indoor air quality to increase health and well-being

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Credit: Penn State

From homes, schools and offices to hospitals, sporting venues and buildings of worship, nearly 90 percent of the average American's time is spent indoors. Because a person is indoors for a signification portion of time each day, most of the air he or she inhales, including toxic particles, comes from within buildings.

Known as indoor air quality (IAQ), the air quality within buildings directly impacts the health and comfort of a structure's occupants. The importance of understanding how to better control IAQ and the pollutants associated with it continues to increase as health issues related to poor air quality continue to rise.

Dongyun Rim, assistant professor of architectural engineering, focuses his research on understanding the sources, distribution and transportation of critical air pollutants in indoor environments. He examines pollutant dynamics around humans, nanoparticle generations from consumer products, low-cost indoor air quality sensing and smart ventilation strategies that specifically focus on the interactions between building systems and occupant activities. Rim's research helps engineers, architects and building scientists achieve healthy building design and operation.

"These days, we put significant efforts in to build airtight buildings for improving energy-efficiency. Such airtight buildings, however, lead to accumulation of chemicals and synthetic products inside buildings, which in turn can cause indoor air quality problems that are detrimental for human health and well-being," Rim said. "My study results reveal pollutant dynamics in buildings and how to control hazardous air contaminants generated indoors or entered from [the] outdoors in energy efficient manners."

Through his IAQ research, Rim provides information on to how to reduce human exposure to indoor pollutants in critical facilities such as nursery schools, as well as effective ways of improving human health and productivity in residences and commercial buildings.

Due to the complex nature of buildings and human behavior, Rim often collaborates with colleagues in fields such as chemistry, electrical engineering and medicine to produce meaningful research results aimed at improving health and well-being of building occupants. Currently, he is involved with a two-year research project funded by the Alfred P. Sloan Foundation in which he collaborates with a molecular physicist and chemists to develop comprehensive, integrated physical-chemical models. These models include a realistic representation of indoor chemical processes under influences of occupants, indoor activities and building conditions.

Next, Rim hopes to conduct experiments at the MorningStar Solar Home, a 100-percent renewable energy-powered home located on Penn State's University Park campus, to measure airborne nanoparticles associated with consumer products

and human activities. Using these measurements, Rim hopes to develop a computer model for predicting physical, chemical and transport characteristics of nanoparticles discharged from home appliances, personal care products, and cleaning agents under varied building conditions including cooling, heating and mechanical fan operation.

"We tend to focus on monthly building energy bills, but unfortunately we don't get monthly health bills associated with poor indoor air quality," he said. "Indeed, we know very little information about how building conditions and human activities affect our exposure to outdoor-generated and indoor-generated contaminants in buildings."

Provided by Pennsylvania State University