Air Pollution’s Systemic Effects

Breathing fine particles suspended in the air is harmful for everyone—and can kill those with cardiovascular or respiratory vulnerabilities, a fact known since the 1990s. Now a study of 95 million Medicare hospitalization claims from 2000 to 2012 links as many as 12 additional diseases, including kidney failure, urinary tract and blood infections, and fluid and electrolyte disorders, to such fine-particle air pollution for the first time. The research demonstrates that even small, short-term increases in exposure can be harmful to health, and quantifies the economic impact of the resulting hospitalizations and lives lost.

Fine particles (known as PM2.5 because they are smaller than 2.5 microns in diameter) can slip past the human respiratory system’s copious mucosal defenses in the nose and upper airways. These tiny byproducts of combustion, principally of fossil fuels such as coal and oil, land in the thin-membraned alveolar sacs deep in the lungs where oxygen exchange occurs. From there, they can pass into the blood. But the full extent of the systemic harm they cause is not well understood, explains principal investigator Francesca Dominici, Gamble professor of biostatistics, population, and data science and co-director of Harvard’s Data Science Initiative. Joel Schwartz, professor of environmental epidemiology and senior author of the BMJ (formerly the British Medical Journal) paper elaborates: “We wanted to shed further light on the risks of exposure to short-term air pollution by searching for links between such pollution and all diseases that are plausible causes of hospitalizations.”

To do so, the researchers used a “big-data” approach, aligning Medicare-patient hospital admissions by time and geography with known levels of PM2.5 pollution on the previous day. That information was modeled using satellite and temperature data, and verified with actual measurements from thousands of ground-based monitoring stations. The approach sounds simple, but Dominici explains otherwise: she built the data platform on which the study relies “one year at a time” during the past 20 years of...
Each increase of one microgram...was associated with an annual increase of 634 deaths, 5,692 hospitalizations, and 32,314 patient-days in hospital.