

Two silent epidemics: air pollution and climate change. “Slow and sustainable medicine” as part of the solution

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Human health is one of the earliest biosensors of climate change, which increases the frequency and severity of many diseases, as reported by Bellone.¹ In Europe, air pollution is becoming a severe health problem that needs to be addressed by physicians of all specialties as well as governments and the general public.

Unfortunately, it is acknowledged that the Po Valley in Italy is among the most polluted areas in Europe. As physicians practicing in this area, we feel we must remind our colleagues of the increasing impact of the environment on the health of ourselves and our patients. Along with having a substantial negative influence on

both human and environmental health, air pollution also has a financial cost since it raises medical expenses and reduces productivity due to missed workdays. We can define this situation as a silent epidemic that affects all people, regardless of age.

Air pollution in the Po Valley

The Po Valley has been identified by the European Environment Agency (EEA) as the most polluted region in Western Europe, facing the persistent environmental challenge of air pollution. The recently published air quality data indicates that the situation in the Po Valley is so dramatic that air pollutant levels pose a risk to human health, including the development of cardiovascular and respiratory diseases and reduced life expectancy, causing more than 1,200 premature deaths among under-18s every year in Europe.²

Despite continuous general improvements in air quality, air pollution is still a major health problem for Europeans, especially in Northern Italy, with levels of pollutants exceeding EU criteria and concentrations considerably above the most recent WHO recommendations.³

The Po Valley is a heavily industrialized and densely populated area, that releases large quantities of pollutants into the atmosphere. Its geography and characteristic weather patterns exacerbate the problem: the Po Valley is effectively “boxed in” between the Alps and the Apennines, creating a basin that traps air pollutants and causes some of the highest concentrations of particulate matter and toxic gas in Europe. In addition, the stagnant air and the lack of ventilation exacerbate the concentration and make the solution to the problem difficult. Air pollution in the Po Valley exhibits distinct seasonal patterns. During the winter months, fine particulate matter concentrations tend to spike. In contrast, during the summer ozone levels are more elevated, stemming from increased solar radiation and the presence of precursors (nitrogen oxides and volatile organic compounds) emitted from various sources. These fluctuations in air pollution levels have significant repercussions for human health^{4,5} and the environment.

Air pollution, climate change and health

The Po Valley exceeds the European guideline limits for ozone, nitrogen dioxide, and fine particulate matter (PM_{2.5}).⁶ Ozone is one of the most dangerous substances for asthma sufferers, while nitrogen dioxide is produced mainly by road vehicles and is carcinogenic. Fine particulate matter (PM_{2.5} and PM₁₀) is one of the pollutants that has the greatest negative effects on human health. It is mostly composed of airborne solid and liquid particles, up to half a millimeter in diameter, that come mainly from industry, fossil fuels used for road transport, and the burning of wood and coal. PM₁₀ is inhalable and can have an impact on respiratory health; PM_{2.5} poses health risks by entering the blood-

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stream through the lungs, causing cardiovascular diseases, respiratory diseases, and allergies. According to EU directives and legal standards, concentrations of PM10 exceeding 50 µg/m³ are deemed dangerous, and this threshold should not be surpassed for any location for a specified number of days annually, typically set at 35 days. Recent observations indicate that in January 2024, there have been multiple instances where this critical threshold was exceeded.⁷ An article titled “Impossible to live like this: Italy’s Po Valley blighted by air pollution among the worst in Europe” appeared in *The Guardian* in September 2023. The article highlighted the dire circumstances in Crotta d’Adda (Cremona, Lombardy) due to pollution from vehicles, industry, and farm animal waste, which created an unbearable and potentially noxious stench that caused headaches, dizziness, vomiting, and swollen eyes.⁸ During the COVID-19 pandemic, the relationships between air pollution and health became more and more significant, showing once again the importance of actions aimed at improving the quality of air.^{9,10}

Infants and children are particularly sensitive to pollution and climate change and bear its consequences for a longer time^{11,12} through multiple pathways.¹³ Exposure to heat waves during fetal development is associated with increased risks of preterm birth and low birth weight, as well as infant death and hyperthermia, heat stress, and kidney diseases in children. Climate change has also a negative impact on children’s and teenagers’ mental health, increasing mental health-related emergency department visits.^{14,15} Major floods and hurricanes have caused drowning, physical injury, and traumatic stress in children.¹⁶ Exposure to wildfire smoke is associated with asthma flare-ups, wheezing, pneumonia, and bronchitis in childhood.¹⁷

Air pollution is a well-known trigger of asthma attacks in children with the disease and is now understood to be a cause of asthma,¹⁸ but it is also a risk factor for respiratory infections, bronchitis, and impaired lung growth and function.¹⁹ The “Air pollution and child health: prescribing clean air” report,²⁰ written by WHO for the first Global conference about air pollutants and health (November 2018), clearly underlines how the pediatric population is at specific risk: 93% of children under the age of 15 are exposed to particulate levels that are higher than those recommended by guidelines about air quality. In the United States, children have had more allergies and asthma attacks requiring emergency department access due to the increased levels of airborne pollen as a result of higher temperatures and rising levels of carbon dioxide, which have resulted in longer growing seasons and increased pollen production.²¹ The WHO estimated that venoms in the air caused 600,000 deaths in children in 2016. Italy distinguished itself negatively, with 98% of the children exposed to too high levels of particulates. These are astounding numbers, and something must change.

According to a recent 9-year observational study conducted by the Pediatric Emergency Unit of IRCCS Azienda Ospedaliero-Universitaria of Bologna (Italy), children with bronchiolitis may be more likely to require hospitalization if they are exposed to outdoor air pollutants, especially high concentrations of PM_{2.5}, C₆H₆, NO₂, and PM₁₀. Based on these results, the authors strongly recommend avoiding open-air exposure of infants during rush hours and in the most polluted areas.²²

Collaborations between governments, industries, and local communities are essential to solving the problem. The main components of this process are financial incentives, education, and community involvement, but we all need to contribute to the transformation.

Imaging as a cause of climate change

As doctors, we are fearful of climate change and air pollution, but we are part of the problem since healthcare contributes significantly to this dramatic scenario. We must reflect on the evidence that medical imaging contributes significantly to the CO₂ emissions, that are the most important cause of global warming. In 2023, the amount of CO₂ production in the world (fossil origin) was the largest.²³ Among the common cardiac imaging techniques, CO₂ emissions are lowest for transthoracic echocardiography (0.5–2 kg per exam), increase 10-fold for cardiac computed tomography angiography, and 100-fold for cardiac magnetic resonance. A conservative estimate of 10 billion medical examinations per year worldwide implies that medical imaging accounts for approximately 1% of the overall carbon footprint. In 2016, CO₂ emissions from magnetic resonance imaging and computed tomography, calculated in 120 countries, accounted for 0.77% of global emissions. A significant portion of global greenhouse gas emissions is attributed to health care, which ranges from 4% in the United Kingdom to 10% in the United States.²⁴ The Choosing Wisely campaign celebrated its 10th birthday in 2022. This initiative has taught patients and doctors that overuse is an equity issue, and that avoiding overuse can protect patient safety.²⁵

Promoting appropriateness in imaging, including the economic and radiological cost and the carbon cost of medical imaging in decision-making, could avoid medical imaging overuse and can also protect planet safety. To treat and cure every patient without endangering the environment or the health of the world, we must examine what we have done and work toward a “slow and sustainable medicine” — the so-called “one health” approach.

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