ACS CHEMICAL HEALTH & SAFETY

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Editorial

The Chemical Exposure Multiverse: Navigating Chemical Hazards through Multidisciplinary Insight

Published as part of ACS Chemical Health & Safety special issue "The Chemical Exposure Multiverse".

Cite This: *ACS Chem. Health Saf.* 2025, 32, 530−531

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At a time when synthetic chemicals permeate nearly every facet of modern life, from industrial manufacturing to household products, the need for accurate, context-sensitive data on chemical exposures has never been more urgent. This Special Issue of *ACS Chemical Health and Safety* brings together a diverse array of contributions from around the world that illuminate the multifaceted nature of chemical exposure across occupational, environmental, and public domains.

The articles featured in this issue span a wide spectrum of disciplines and settings, reflecting the editorial vision to foster multidisciplinary dialogue and actionable insights. From the quantitative analysis of aldehydes in archival dust[1] to Houlroyd et al. insights drawn from decades of expertise as industrial hygienist,[2] each contribution underscores the complexity of chemical exposures and the importance of tailored risk-management strategies.

Several studies have focused on occupational exposure and monitoring. For example, Xu et al.'s reports an extensive assessment of metalworking fluid aerosols in automotive manufacturing and their resulting health impact on exposed workers.[3] A review of benzene exposure across 22 countries by Muto et al. highlights the effectiveness of Vapor Recovery Systems (VRS) in reducing airborne benzene concentrations at gas stations, further advocation for concrete steps toward establishing globally harmonized exposure limits to protect workers.[4] Zakir, Feinberg and coauthors' implementation of a risk-based safety framework at Argonne National Laboratory stands out as a widely applicable success story for sciences-informed and collaborative reform of risk management systems.[5] Together, these contributions highlight the value of statistical analyses, stakeholder engagement, as well as data-driven and adaptive safety systems in productively mitigating workplace hazards.

Given the rising incidence of silicosis among workers in the countertop fabrication industry worldwide, the study by Nabiwa et al. on respirable dust concentrations in copper mines provides timely insights for real-time exposure monitoring.[6] Their findings highlight significant risks of silicosis from respirable crystalline silica, especially in the mining high-dust areas.

Radiation exposure, often overlooked in chemical safety discussions, is addressed in two compelling studies. Hossain et al. examine ionizing radiation exposure in cardiology practices in Bangladesh, while Aliyu et al. evaluate effective occupational dose levels in Saudi Arabia's oil and gas sectors.[7,8] Both studies emphasize the importance of technology-driven continuous monitoring and analyses to guide protective measures and maintain workers' exposures within the established safe limits.

The issue also explores chemical exposure in public and domestic environments, with Mata-Segreda and Prado-Elizondo's investigations into the evaporation kinetics of industrial and household liquids or gels.[9,10] The authors report both practical and analytical methods to reliably and cost-effectively assess volatility of materials. In addition, Ghosh et al. present a predictive framework for assessing inhalation hazards (blood/air partition coefficients, K_{ba}) of paint thinner ingredients, also offering a cost-effective alternative to current methods.[11] The study provides data on 78 organic compounds to support prioritizing thinner products with lower blood/air partition coefficients (K_{ba}). Lastly, Harada et al. developed deep learning models capable of predicting chemical hazards directly from molecular structures.[12] With remarkably encouraging predictive accuracies from 70 to 89%, this approach can be a time, cost-competitive and ethical alternative to identifying chemical hazards. Together, these studies help address the risks posed by new substances, chemicals lacking toxicological data or currently unregulated ingredients.

Also in the realm of toxicology with biochemical lenses, two companion studies using *Drosophila melanogaster* models by Ghanty, Ganguly's team demonstrate the dual nature and concentration dependent effects of compounds like naringenin and rutin.[13,14] These findings underscore the importance of dose standardization and the potential of dietary interventions in mitigating chemical-induced adverse effects.

Finally, Ghach et al.'s cross-sectional study on Multiple Chemical Sensitivity (MCS) in Lebanon provides critical epidemiological data post Beirut Port Blast (2020).[15] The study reveals a high prevalence of MCS symptoms in the general population, especially female over 50 years old, and is

Received: August 20, 2025
Published: September 22, 2025

calling for greater public health awareness and policy intervention.

Collectively, these contributions reflect the editorial support of the United Nations Sustainable Development Goals,[16] particularly those related to health, safety, and responsible chemical management. By showcasing research that is both scientifically rigorous and contextually grounded, this Special Issue aims to empower decision-makers, educators, and practitioners with the tools and knowledge needed to navigate the chemical exposure multiverse. The contributions herein offer not only data but also direction toward safer workplaces, informed public health strategies, and actionable regulatory frameworks.

To conclude, I will be remiss not to mention that during the development of our Special Issue, nonacademic contributors found it particularly difficult to share their reality, experience and challenges, despite their relevance. The barriers were numerous: lack of institutional support, low recognition or incentive to publish leading to lower priority, leadership approval challenges. Finally, while academics are accustomed to the peer review process that often involves critical feedback and multiple rounds of revisions, seeing it through a nonacademic's eyes highlighted once again how challenging the process can be for an outsider.[17] In this context, I am thankful to everyone who contributed to *The Chemical Exposure Multiverse*, especially those who dedicated extra time to overcome those barriers. Our shared goal is to value within one issue all perspectives from original research to studies or commentaries on effective practices aimed at protecting individuals from hazardous chemicals. I invite readers to explore these contributions and consider how their insights might inform their own practices and policies, leading to the responsible handling of hazardous substances.

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https://pubs.acs.org/10.1021/acs.chas.5c00152

Notes

Views expressed in this editorial are those of the author and not necessarily the views of the ACS.

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