‘Omics’ and Adverse Outcome Pathways: tools for risk assessment of nanomaterials

Sabina Halappanavar, PhD
Environmental Health Science and Research Bureau, Health Canada, Ottawa, Canada

The feverish pace of nanotechnology growth, and the sheer number of nanomaterials synthesised and used have outpaced our ability to assess their safety using the traditional animal-reliant test methods. This has resulted in emergence of novel toxicity testing strategies involving *in vitro* and *in silico* models as alternatives to animal testing. However, unless based on the mechanistic knowledge, the alternative testing strategies offer little to alleviate the burden placed on toxicologists to complete the human health risk assessment of nanomaterials in a timely and effective manner. ‘omics’ tools are enabling comprehensive profiling of biomolecules and interactions within the cell following exposure to substances. This data is then used to understand the perturbed biology, define the underlying mechanisms of toxicity and identify markers of exposure and effects. However, the key is to accurately differentiate the essential molecules and interactions from the non-essential ones. Adverse Outcome Pathways (AOPs) is a framework that enables structured and simple representation of causally linked biological events at various levels of biological organisation. AOPs trace the journey of an adverse outcome or a disease from the time it is initiated following exposure to a substance to the time a disease is clinically manifested. This presentation will provide examples that demonstrate how ‘omics’ and AOPs can advance safety assessment of nanomaterials, summarise various AOPs that are currently addressing nanomaterial-induced adverse outcomes, role of ‘omics’ in the development of AOPs and finally, present a case study that is currently investigating their utility in risk assessment or risk categorisation of nanomaterials.