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Nanotechnology: Scope and safety challenges

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Nanotechnology promises to revolutionize a wide variety of industries and provide innovative ways to improve human and environmental well-being, including diagnosis and treatment of diseases, whether cardiovascular, neurodegenerative (ND), or oncological conditions, as well as mitigate ecological impact of human activity. However, what is often ignored is the flip-side of this nano-revolution, the safety profile of many engineered nanomaterials(NM), including those with potential for therapeutic use. The Janus nature of nanotechnology and scope of its impact need to be addressed in order to provide a sound basis for use and avoid potential toxicity. The issues to be addressed in this context include occupational exposure, the environmental kinetics and dynamics, NM behavior during the intended use of products that incorporate NM and the handling of these products at the end of their projected life-span. To date, little or no consensus has been given to the evaluation of NM and the cross-talk that needs to take place between stakeholders, including those in the field of nanomedicine and where many applications are potentially forthcoming. Toxicologically, NM have redefined many cornerstone principles of the field, where it is no longer simply dose, but the physico-chemical properties (shape, charge, agglomeration), inclusive of size, that may define the toxicity level. This is relevant when we consider that lethality no longer defines toxicity, but rather the adverse effect occurring at the genomic, genetic, biochemical, physiological or morphological level that may lead to acute or chronic impairment of function. In that context, NM have been demonstrated to precipitate oxidative stress, immune activation, autoimmune responses (AI), act as haptens, accumulate in the nervous system, and induce cardiovascular lesions. Interestingly, some of these same activities make them desirable therapeutically for targeted drug delivery in cancer and ND. By way of demonstration, this lecture draws on our own interests in ND and AI and our experiences in therapeutics, where NM formulations may improve efficacy and reduce toxicity, and in the environmental toxicology where NM may precipitate toxicities not previously described with bulk materials. This talk highlights the scope of safety challenges associated with NM, the promising advances in the use of NM in improving the treatment of diverse diseases, and calls for an implementation science approach for ensuring safety of NM. It is intended for both those conversant with bionanotechnology and those new to the field.

Biography:

Hassan A. N. El-Fawal is Professor of Neuroscience, Toxicology and Pharmacology and Dean of the School of Sciences and Engineering at the American University in Cairo (AUC). Prior to joining AUC in 2016, he was Professor of Pharmaceutical Sciences and Dean of the School of Health Sciences at Albany College of Pharmacy and Health Sciences in New York. He was previously Assistant Chair and Chair of Natural Sciences and Professor of Health Sciences at Mercy College from 1997 to 2009. The focus of his research is diagnostic and prognostic neuro immune biomarkers for neuro degeneration, neurotoxicity and the evaluation of therapeutics, as well as cardiopulmonary disease. He earned a B. Sc. from Alexandria University, Egypt in 1979, and M.Sc. from the University of Guelph in Canada. His Ph.D. in Biomedical and Environmental Sciences, was earned at Virginia Tech in 1989. From 1989 to 1997 he worked as Research Assistant Professor at NYU School of Medicine's Institute of Environmental Medicine.