Nanotechnology, Occupational Health and Safety Concerns

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Nanotechnology is the manipulation of matter on a near-atomic scale to produce new structures, materials and devices. Nanoparticles (NPs), the building blocks of nanotechnology, are the objects with at least one dimension smaller than 100 nanometer [1,2]. NPs find numerous applications in many fields, starting with electronics, throughout medicine, cosmetology, and ending with automotive and construction industries [3]. Nanotechnology, nanomedicine and nanotoxicology are complementary disciplines aimed at the improvement of human life. Nanomedicine will develop applications for novel and superior diagnostic, therapeutic and preventive measures. Nanotoxicity provides for the necessary safety assessment of nano-enabled products [4,5]. Exciting achievements based on nanotechnology and nanomedicine await us in the future; yet there are many challenges to get it right and recognize and avoid potential risks associated with these new developments where nanotoxicology will have a crucial role [6].

Concerns have been expressed about risks posed by engineered nanomaterials (ENMs), their potential to cause undesirable effects, contaminate the environment and adversely affect susceptible parts of the population [7,8]. Toxicity of NPs depends on many factors, for example: size, shape, chemical composition, solubility, surface area and surface charge. Risk assessment related to human health, should be integrated at all stages of the life cycle of the nanotechnology, starting at the point of conception and including research and development, manufacturing, distribution, use and disposal or recycling [3].Fundamentally, risk assessment involves an estimation of the potential for exposure and characterization of hazard. Potential routes of NPs exposure include inhalation, dermal, oral, and in the case of biomedical applications, parenteral. Toxicity resulting from NPs exposure could occur at the various portals of entry, such as the lungs and skin, or at distant sites. Exposure to nanomaterials could occur during their development, manufacture, use, or following disposal [9].

NPs translocation and uptake by the body occurs after inhalation exposure (neuronal uptake, translocation across lung epithelium, and ingestion), oral exposure (ingestion), and dermal exposure. Risk assessment related to human health, should be integrated at all stages of the life cycle of the nanotechnology, starting at the point of conception and including research and development, manufacturing, distribution, use and disposal or recycling [3].NPs exposure includes inhalation, dermal, oral, and in the case of biomedical applications, parenteral. Toxicity resulting from NPs exposure could occur at the various portals of entry, such as the lungs and skin, or at distant sites. Exposure to nanomaterials could occur during their development, manufacture, use, or following disposal [9].

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In conclusion, the current knowledge of OSH in nanotechnology includes the following: (i) NPs can be measured using standard measurement methods (respirable mass or number concentration), (ii) workplace exposures to NPs can be reduced using engineering controls and personal protective equipment, and (iii) current toxicity testing and risk assessment methods are applicable to NPs. Yet, to ensure protection of workers’ health, research is still needed to develop (i) sensitive and quantitative measures of workers’ exposure to NPs, (ii) validation methods for exposure controls, and (iii) standardized criteria to categorize hazard data, including better prediction of chronic effects [2].

References


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