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Nanoparticles in humans: Experiments, methods and strategies

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The nanotechnology industry is rapidly growing with promises of substantial benefits that will have significant global economic and scientific impacts applicable to a whole host of areas from engineering and electronics to environmental remediation and medical healthcare. However, at present there is growing concern over the safety of nanomaterials with respect to occupational, consumer and environmental exposures and associated health effect. Particularly, information on nanomaterial exposure, dosimetry, risk assessment and health effect is negligible. According to Kulinowski, et al. "there's a lot more data now than there was back in the early days. Unfortunately, however, "it becomes equally difficult to say that all these data are conclusive". A recent analysis found that much of the "nanotoxicology" research is done *in vitro*, focusing on acute toxicity and mortality induced by native nanoparticles, with limited relevance to human health. Up to present time, available quantitative data related to dosimetry of nanomaterials, and particularly aerosoloized nanoparticles are very difficult to find. As it discussed in [Geraci, 2009, NIOSH] in terms of nanoparticles we still don't know: nature and extent of hazard; nature and extent of exposure; nature and extent of risk; what measure to use; limitation of controls; limitations of protection; there are no specific exposure limits; According to [Friend of the Earth Nanotechnology, 2009] there is "no consistent nomenclature, terminology and measurement standards to characterize and describe nanoparticles and exposure. Inadequate understanding of nanotoxicity, in particular to determine whether acceptable exposure limits exist. No effective methods to measure and assess workplace exposure to nanoparticles; Despite the hundreds of products containing nanomaterials that of scientific literature demonstrating the serious risk associated with nanotoxicity, there are still no laws to manage workplace exposure and to ensure workers' safety. This suggested that governments have learnt little from their experiences with asbestos". From our point of view one of the more important reasons for such situation is the lack of instruments, methods and even workable ideas for measuring parameters of nanoparticles. Moreover, there is also lack of the strategy, lack of the general approach in the assessing the health effect associated with nanomaterials, and particularly the dose as a cause of the effect from nanoparticles. According to EPA USA, "In epidemiological studies", an index of exposure from personal or stationary monitors of selected pollutants is analyzed for associations with health outcomes, such as morbidity or mortality. However, it is a basic tenet of toxicology that the dose delivered to the target site, not the external exposure, is the proximal cause of a response. Therefore, there is increased emphasis on understanding the exposure-dose-response relationship.

Exposure is what gets measured in the typical study and what gets regulated; dose is the causative factor.

1. Radon and its progeny as a radiolabel present very attracting opportunity for several reasons:
2. Radon and its progeny belong to the natural background of radioactivity to which the general population is exposed during their lifetime. Therefore, it is easy to assess the additional risks due to its use by the methods proposed.
3. Marker is negligible relative to subjects' background exposures, it may be assumed that the increased risk in using of radioactive label is negligible relative to the background exposures of subjects.
4. Radon decay products are easy to generate.
5. Radon decay products are short-lived nuclei. Human studies of exposure to radon progeny can be used as an assessment of the safety in measurement of deposition and dosimetry of nanoparticles. If radiation exposure to a radioactive marker is negligible relative to subjects' background exposures, it may be assumed that the increased risk in using of radioactive label is negligible relative to the background exposures of subjects.

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