Nanosafety

Looking at the toxicology of nanomaterials

Nanomaterials are small particles that can be found everywhere, including in the air we breathe. Nanosafety is an emerging area of research dealing with the effect of nanomaterials on health and environment. Dr Ernesto Alfaro-Moreno of the International Iberian Nanotechnology Laboratory in Braga, Portugal, has been involved in continued research on the toxicology of nanomaterials. For his latest study, he has collaborated with fellow researchers to incorporate machine learning strategies to predict the potential risks of several nanomaterials with promising application in our daily life. Their findings indicate that computational tools could be the future of faster toxicology assessment.

Nanomaterials can be found anywhere, from cosmetics to paints and coatings, textiles to food and drugs, and several other applications and objects that we use every day. Since the introduction of the concept of nanomaterials in the late 20th century and the blooming of nanotechnology and its applications from that point on, one way or another, we are all inevitably exposed to nanomaterials. This exposure could be either through active choices, such as use of cosmetics or household commodities, or passively, through paint layers or car protective coatings. As with many technological advancements, the big question arises: how can nanomaterials affect our health and the environment?

The Nanosafety Group of International Iberian Nanotechnology Laboratory (INL) in Braga, Portugal, evaluates nanomaterials and their potential adverse effects. The group is led by Dr Ernesto Alfaro-Moreno, in collaboration with fellow researchers, and their latest study centres around the toxicological effect nanomaterials and nanoparticles can have on human lungs and other biological targets.

NANOSAFETY – A NEW CONCEPT TO ASSESS NANOMATERIALS

Labels, such as ‘Not suitable for children under 3 years’, which warn against small particles in items that we use every day are a fairly common occurrence. Even for adults, this warning is implicit. But what happens when the object in question is invisible to the naked eye? What precautions do we take then, and how do we comprehend the effect of something we cannot see?

Instructions to wash the hands before making contact with the eyes, nose, or mouth have been ingrained in us while growing up and were further emphasised during the recent COVID-19 pandemic. These practices help prevent cross-contamination in case we carry bacteria or other toxic substances on our hands. But what happens if the toxic substance, or the toxic effect of a substance, is not necessarily as well mapped out for its effect on health as small parts or common viruses? An emerging area of research called ‘nanosafety’ deals with the toxicology of nanomaterials and their impact on human health and the environment.

ASSESSING NANOMATERIAL TOXICOLOGY THROUGH MODELS

There are three main ways to assess the potential effects of nanomaterials on health. These effects can be evaluated by using in vivo, in vitro, or in silico methods. The difference between the three methods is quite substantial in terms of importance to life and resources required. During in vivo studies, the effect of the nanomaterial under examination is assessed using living organisms (eg, animal testing, or trial phases during drug development). In vitro studies involve assessing the effect practically, but outside living organisms, under laboratory conditions mimicking the conditions of a living organism as closely as possible. In silico studies use computational modelling and theoretical approaches, without employing any sort of live or laboratory-based samples.

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The researchers have developed a machine learning model to predict the potential human lung nano-cytotoxicity induced by engineered nanomaterials (metal oxide nanoparticles).

**Bio**
Dr Ernesto Alfaro-Moreno has dedicated his efforts to evaluating the potential adverse effects of inhaled particulate matter and nanomaterials since the 1990s. He has worked for the National Cancer Institute of Mexico, the Lung Toxicology Unit of the KU Leuven in Belgium, and SWETOX at Karolinska Institute in Sweden. Alfaro-Moreno currently leads the Nanosafety group at the International Iberian Nanotechnology Laboratory in Braga, Portugal.

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**Collaborators**
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**References**

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**Personal Response**
Is it possible to adapt this model for assessment of nanomaterial toxicity to distinct parts of the body? In order to adapt the model, we need to analyse data regarding the behaviour of cells from other tissues first. The specialisation of each organ is related to the metabolic activity of each cell type, and also to the probability of materials reaching other organs, which may not be the first target of different materials. That is why is a focus on developing specific models for specific targets.