Session 8A: Nanomaterial epidemiology & biomonitoring

Thursday 1 June, 10:30 - 12:00
Location: Room 3
Session chairs: Enrico Bergamaschi & Anne T Saber

Health surveillance and epidemiology in nanomaterial workers worldwide - where are we today?

Michael Riediker[1,2,3]
[1]IOM Singapore, Singapore; [2]Nanyang Technological University, Singapore; [3]Institut de Santé au Travail, University of Lausanne, Switzerland; michael.riediker@iom-world.sg

Epidemiological studies and health surveillance are essential to understand the risk to workers exposed to potentially harmful substances, and to evaluate the effectiveness of "safe exposure levels" that were derived from animal and cell experiment data. Globally, a few epidemiological studies already started to assess the health of workers potentially exposed to manufactured nanomaterials. However, as anticipated in early discussions, most companies have still relatively small numbers of workers. To allow pooling international cohorts, five years ago, several leading groups defined together a road map for a globally harmonized framework for exposure characterization, identification of study populations, definition of health endpoints, evaluation of appropriateness of study designs, data collection and analysis, and interpretation of the results. These studies have progressed but it is not clear how strongly funding limitations impacted their ability for a coordinated approach. This presentation will review studies ongoing to data and compare the progress made to the initial roadmap.

Epidemiological surveillance of nanotechnology workers: Past and new challenges based on the French example

Irina Guseva Canu
Institut universitaire romand de santé ou travail (IST), France; irina.guseva-canu@chuv.ch

France was a pioneer country developing the first registry of engineered nanomaterials (ENM) in Europe and launching a program of prospective epidemiological surveillance of nanotechnology workers focused on potential long-term health effects of ENM. While the former was ordered by the French Ministry of Ecology, the latter was a joint demand of the Ministries of Health and of Labor. A challenge was both, political and scientific: the definition of ENM was imprecise and ENM physicochemical properties influencing their exposure potential, biological and clinical effects following the exposure, and related risks were unknown.

In 2012, the French Institute for Public Health Surveillance proposed a step-by-step project where the first step was to identify companies dealing with ENM, and to register potentially exposed workers. An exploratory study showed that the ENM-producing companies are more willing to cooperate as compared to ENM-using companies. A strong involvement of the ministries was required to establish collaboration with them; however, it also appeared challenging. Moreover, lacking standardized methodology of ENM exposure assessment made challenging identification of eligible workers even in collaborating companies.

Thanks to the "Quintet ExpoNano" partnership, involving national experts in ENM metrology, occupational hygiene and epidemiology, and collaboration with the Occupational Health Inspectorate, academic researchers, and the national registry "R-nano", the program has been moved forward, and a general protocol with standardized methodological tools and questionnaires for workers' exposure and health assessment, and two communication strategies to recruit companies into the program and to motivate eligible workers to participate and to retain their participation constant over time were developed. Implementation of this program resulted in recruitment of about 25 companies and of more than 150 workers between January 2014 and June 2016. However the program was deemed inefficient. The recruitment of companies remained the biggest challenge given the lack of interest to cooperate among large industrial companies.

In a situation of financial crisis, political and economic reforms, the program could be discontinued, that is politically challenging, or substantially modified by simplifying its protocol, the procedure of exposure assessment and the content of questionnaires. If the second option is proceeded, it would bring a challenge to solve essentially a non-scientific problem by scientific means.

Occupational exposure and health effects of multi-walled carbon nanotubes

Liliya Fatkhutdinova[1], Timur Khaliullin[2], Elena Kisin[2], Anna Shvedova[2]
[1]Kazan State Medical University, Russian Federation; [2]National Institute for Occupational Safety and Health, WV 26505, Morgantown, USA; liliya.fatkhutdinova@gmail.com

Studying the behavior of nanoparticles (NPs) in living systems and safety aspects of new nanomaterials is one of the strategic objectives of nanotechnology network development. The urgency of the problem is due to lack of sufficient information regarding behavior of engineered nanoparticles in humans. The carbonaceous NPs occupy a leading position on the market of nanomaterials. The number of enterprises, which are produced or used carbon nanotubes (CNT) and other types of carbonaceous nanomaterials, is growing from year to year. Investigation of the cell and molecular mechanisms of biological and toxic effects in interaction with the human body is necessary for risk assessment and control. In 2009-2015, in the frame of the joint Russian-American CNT-ERA project (Carbon NanoTubes Exposure and Risk Assessment), exposure and human health risks associated with industrial exposure to inhaled MWCNTs had been investigated. The study included a hygienic, toxicological and epidemiological stages. Respirable fraction concentration of aerosol in the employee's breathing zone, averaged over the 8-hour period, were in the range of 0.54 to 6.11 mg / m3 (calculated as elemental carbon). Our data suggest that exposure to MWCNTs at the workplace could change the content of some markers of fibrosis in serum and induced sputum samples. In particular, the KL-6 levels in induced sputum were significantly related to exposure to MWCNTs. Moreover, we could detect exposure-related increase in serum TGF-β1, but only for young workers. Osteopontin in this study did not show itself as informative human biomarker, but it is still recommended to be included in the battery tests for future research. The significant changes in several miRNAs and mRNAs expression as well as their regulatory networks identified in this study revealed important insights into the molecular details of MWCNT-induced toxicity and pathogenesis in humans.