

NanoImpactNet: The European Network on the Health and Environmental Impact of Nanomaterials

Extended Summary:

Recent technological advances allow the targeted production of human engineered objects and materials in the nanoscale (between one and 100 nm), in at least one dimension. Nanomaterials can have chemical, physical and bioactive characteristics, which are different from those of larger entities of the same materials. Parameters that can influence this are:

- size and thus surface area
- surface composition, shape and structure
- solubility
- charge
- aggregation state
- shape and structure

It is often these differences that give ideas for developing new and exciting applications, but they raise public concerns about nanomaterials. Their as yet unknown health and environmental impact mean that the effectiveness of current health and safety measures is disputed. The pace of nanomaterial development has proved too fast for new legislation to be written specifically for it. There are also enormous knowledge gaps, especially in nanomaterial toxicological and ecotoxicological potential. Nomenclature, classification, description, definition, characterisation, reference materials are missing and thus thresholds limits have not been set.

Industry arguments tend towards the idea that there is no nano regulation problem, rather there are different chemical, pharmaceutical, consumer products or food safety problems. However, current environmental and health regulations may not be adequate to prevent the dispersion of nanomaterials into the environment or to protect human health. Several national and European programs and projects investigating such risks are already running, about to start or under preparation. However, up to now there has been insufficient communication between these initiatives, and this created difficulties for some European researchers and stakeholders.

NanoImpactNet¹ is a growing, multidisciplinary network of scientists and stakeholders from over 20 European countries. These include :

- academic and public laboratory researchers;
- representatives of multinational companies and small and medium-sized enterprises, whether they are hygienists or regulatory officers;
- civil society and NGO officers involved in worker, animal and consumer rights, or the environment;
- and policy making represented by national and European Commission civil servants from all types of ministries and directorate generals, including health, environment, enterprise, research, etc..

Launched in April 2008, NanoImpactNet is part of the European Commission's commitment to define a robust European strategy on nanotechnology, which intrinsically includes the important issues of health, safety and environment.

NanoImpactNet's objective is to create a scientific basis to ensure the safe and responsible development of engineered nanoparticles and nanotechnology-based materials and products. It will thus support the definition of regulatory measures and implementation of legislation in the European Union. It includes a strong two-way communication to ensure efficient dissemination of information to stakeholders and the European Commission, while at the same time obtaining input from the stakeholders about their needs and concerns.

By coordinating research between European scientists from over 30 countries, NanoImpactNet will help to harmonise methodologies and communicate results, initially across Europe, but now also worldwide, thereby boosting international cooperation. Numerous NanoImpactNet workshops, training schools and conferences provide opportunities to share and discuss state-of-the-art knowledge on nano-impact research. They help identify knowledge gaps, define strategies to address these gaps and train research staff and students.

Discussions within NanoImpactNet focus on potential human hazards and means of exposure to nanomaterials, such as at work, via products containing nanoparticles or having a nano-effect, and via nanomaterial release into the air. They also look at the fate of nanomaterials in the environment and the potential hazards to nature, such as in soil or aquatic systems. Impact assessment, risk communication and management, and integration and nomenclature. Discussions about strategies and methodologies are initiated through well-prepared workshops covering these topics. All researchers and stakeholders are encouraged to participate. The same researchers also collaborate to produce thorough reports and sets of guidelines reflecting the consensus reached during the workshops.

NanoImpactNet's six workpackages are:

WP1 – Human hazards and exposure

WP2 – Hazards and fate of nanomaterials in the environment

WP3 – Impact assessment (risk and life cycle analysis)

WP4 – Communication

WP5 – Integration, nomenclature and Environmental, Legal and Social Issues

WP6 – Coordination and management

These workpackages ensure that all of the leading European research groups with activities in nanosafety, nanorisk assessment, and nanotoxicology are represented. The Work Packages can work closely together, but there are great opportunities for cross-talk. All exposure routes, major disease classes and impact assessment approaches are represented within the network. NanoImpactNet will coordinate such activities within Europe, but will seek input and views from outside the continent also. In addition to the events which it organises, NanoImpactNet communicates regularly to an ever growing network via its Internet site, its electronic newsletter (over 350 recipients), and the promotion of the project in symposia and meetings by its members across Europe and beyond. NanoImpactNet's expanding coverage and its continual growth will help in the implementation of the EU Action Plan for Nanotechnology and support a future with responsible, sustainable and safe development of nanotechnologies in Europe.

¹ *NanoImpactNet is a Coordination Action under the European Commission's 7th Framework Programme. The 24 institutes organising the NanoImpactNet activities are leading European research groups from 11 countries and active in the fields of nanosafety, nanorisk assessment and nanotoxicology. More information at www.nanoimpactnet.eu.*



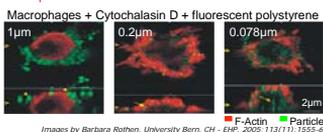
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Why study the impact?

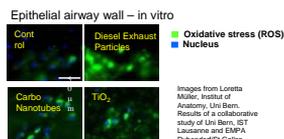
The potential risks of nanomaterials for health and the environment must be assessed to allow for a sustainable development of the nanotechnology enabled industries and markets. Despite recent advances in medical and toxicological research, it is still unclear exactly how nanomaterials interact with biological targets and which parameters of the nanomaterials drive these responses.

Nanoparticles can enter cells even when transport mechanisms are blocked



Solid nano-particles (nano-particulate material confined in three dimensions at the nanoscale) and nano-rods (confined in two dimensions) in particular raise potential safety, health and environmental concerns. There is evidence that some of these materials pass through tissue barriers (including the blood-brain barrier) and cell membranes [4], and there have been reports of lipid oxidation, granulomatous tissue formation and other adverse responses to interaction with nanoparticles [5].

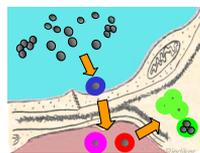
Some nanoparticles can cause oxidative stress in cell culture systems similar to the stress caused by diesel exhaust particles



Little is known about the exposure of workers and consumers to nanomaterials, and the effectiveness of existing health and safety measures for industrial processes and consumer products is disputed [3]. This is a challenge for impact assessment studies. Even less is known about the environmental fate and impact of nanomaterials. Thus, there are clear knowledge-gaps that need to be addressed as a European priority. Importantly, current environmental and health regulations may not be adequate to prevent the safe environmental dispersion of nanomaterials or to protect human health.



There are big knowledge gaps related to exposure of humans and the release of nanomaterials into the environment



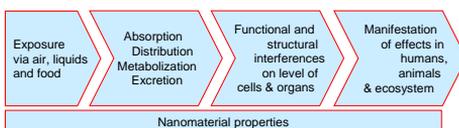
Why the need for coordination?

The main impediments that hamper progress in the area of nanorisk assessment:

- Little awareness, communication and cross-talk
- Emphasis on toxicity as opposed to safety
- Lack of agreed standards, metrics and protocols
- Lack of comparable cell lines, testing organisms and media, handling protocols and experimental protocols
- Lack of agreed exposure determination guidelines and standards
- Absence of information about behaviour of nanomaterials in environmental compartments and systems
- Uncertainty of existing risk- and life-cycle methods
- Large amount of data not published and not available

Several national and European programs and projects investigate already the risks of nanomaterials. However, many of these programs run in isolation, and experiences and findings are not effectively shared with the research community. It is difficult for researchers and stakeholders (industries, public interest groups, and policy makers) to access the knowledge created by these projects. A unified platform where all of this information is collected, compiled and prepared for the direct use by all interested groups is required.

Coordination is needed throughout the chain of effects and when the knowledge gained is put into perspective in risk and life cycle assessment studies



Standards are needed for experimental and measurement work to allow comparison of results obtained by different groups.

Parameters that may influence the impact of nanomaterials:

- ✓ Size
- ✓ Composition
- ✓ Solubility
- ✓ Aggregation state
- ✓ Shape and structure
- ✓ Surface: composition, charge and catalysts
- ✓ Specific bio-reactivity

= substance properties + nano-properties

NanoImpactNet - to promote European coordination

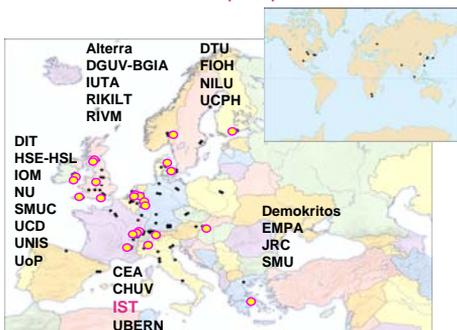
The objective of the NanoImpactNet co-ordination action is to create a widely supported scientific basis to ensure the safe and responsible development of engineered nanoparticles and nanotechnology-based materials and products, and to support the definition of regulatory measures and implementation of legislation in Europe.

NanoImpactNet is the largest European grouping of scientists and researchers in the arena of nanosafety, nanorisk assessment and nanotoxicology. All of the exposure routes (oral, dermal, inhalation etc.), all of the major disease classes (cardiovascular, neurodegenerative, etc.) and all of the diverse approaches (ecotoxicology, classical toxicology, exposure assessment, health effects, risk and life cycle assessment, communication, ethics etc.) are represented within the network.

NanoImpactNet is committed to openness and all researchers and stakeholders are invited to participate.

NanoImpactNet will ...

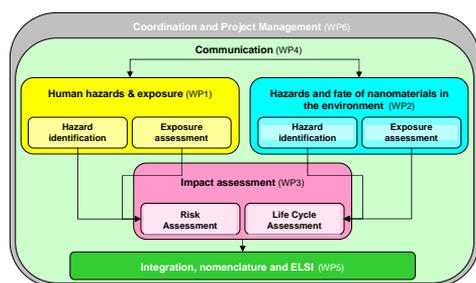
- Bring together researchers to...
- Share and discuss existing knowledge
- Identify knowledge gaps
- Define strategies to address these gaps
- Train their staff and students and to...
- Facilitate collaboration between projects
- Communicate results to stakeholders and their needs back to researchers
- Implement the EU's Action Plan



NanoImpactNet is an FP7-proposal put forward by the management committee of the already existing NanoHealthNet. It will be implemented over four years.

Interaction and communication between the six work packages (WPs) WPs will be a primary goal of the program, to ensure that the consensus of one WP reflects the views, findings and best-practices of the other WPs. Where possible, workshops will be held jointly between WPs to ensure this cross-talk.

- WP 1: Human hazards and exposures
- WP 2: Hazards and fate of nanomaterials in the environment
- WP 3: Impact assessment (Risk and Life Cycle Analysis)
- WP 4: Two-way Communication (Input to researchers, output to stakeholders)
- WP 5: Integration, nomenclature and ELSI
- WP 6: Coordination and Management Cycle Analysis)



Coordinator NanoImpactNet:

Dr Michael Riediker
Institute for Work and Health
Bugnon 21, 1005 Lausanne
Switzerland

Additional information:

info@nanoimpactnet.eu
www.nanoimpactnet.eu

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