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Recent Government Briefs

- (US EPA) On October 18, US EPA formally announced its plans to develop a Stewardship Program for nanoscale materials to complement its new and existing chemicals programs under the Toxic Substances Control Act (TSCA). In development of the Stewardship Program, US EPA intends to provide a number of future opportunities for public participation, including scientific peer consultations to discuss risk management practices, preparation of a concept paper describing EPA's approach to the Stewardship Program as well as Information Collection Requests to gather data, and public meetings to discuss various documents and program elements. This announcement followed the recent release of a Discussion Paper summarizing a proposed approach to risk management practices (RMP) under US EPA's voluntary nanotechnology program. The paper was written in preparation for public meetings held in Washington, D.C. on October 19 and 20 on risk management practices for a Stewardship Program. Reflecting input from the National Pollution Prevention and Toxics Advisory Committee (NPPTAC) on the intended outcomes of the voluntary program, this paper outlines a RMP approach for a Basic Program with five topics areas/groupings: (1) Personal protective equipment (PPE), (2) Engineering controls, (3) Waste and release management (including spills), (4) Worker training/work practices, and (5) Hazard communication/product labeling/customer training. Under each topic area/grouping, the paper provides a set of discussion questions to be considered, and also outlines considerations for an In-Depth program. For more information, visit: <http://www.epa.gov/oppt/nano/>

- (DEFRA) The UK Department for Environment, Food and Rural Affairs announced in September the commencement of a Voluntary Reporting Scheme for industry and research organizations to provide the Government with information relevant to understanding potential risks posed by engineered nanoscale materials. In order to assist with the development of appropriate controls, DEFRA states that they are interested in receiving data from any company or organization involved in manufacturing, using, importing, researching, or managing wastes consisting of engineered nanoscale materials. The scheme, which is voluntary does not replace existing legislation and is scheduled to run from September 2006 until September 2008. For more information, including operation details on the scheme and a Data Reporting Form (Annex A), see: <http://www.defra.gov.uk/environment/nanotech/policy/index.htm>

Reports, Reviews, White Papers, and Books

Societal Implications of Nanoscience and Nanotechnology in Developing Countries

Birgit R. Bürgi and T. Pradeep , 2006. Current Science. 90:645-658.
<http://www.ias.ac.in/currsci/mar102006/645.pdf>

This comprehensive paper on the societal implications of nanotechnology – from the perspective of the developing world – provides both historical context and recommendations for decision-making and development in the expansive field of nanotech. The authors first discuss how scientific and technological innovations affect society in general, and then they turn their focus toward potential societal changes from nanotech and nanomaterials. For example, the authors contend that scientific education, training, and research opportunities in developing countries are not only absolutely necessary to avoid a “nano divide,” but are also wholly possible given existing partnerships. Issues related to military applications of nanotech, risk assessment and management needs, and the role of the public are briefly reviewed. Finally, topics on sustainable development of nanomaterials specifically relevant to developing countries (e.g., antimalarial therapeutics) are presented, including numerous applications still in the early research stage. Due to the great potential for economic and public health benefits from nanotechnologies in the developing world, the authors call for “joint and concerted efforts by all concerned” in order to “rule out future factions and new divides.”

A Matter of Size: Triennial Review of the National Nanotechnology Initiative

Committee to Review the National Nanotechnology Initiative,
National Research Council

<http://www.nap.edu/catalog/11752.html>

This report, requested by Congress, evaluates the National Nanotechnology Initiative (NNI), as well as the economic impact of nanotech and US nanoscale R&D as it stands today. The NNI was created in 2000 to “focus and coordinate” nano R&D activities funded by multiple federal agencies, and reviews of the NNI’s progress will be conducted every three years. This report is the first review of the NNI and key points include a recommendation of continued support for the initiative, a call for an independent advisory panel with expertise in nanotech, and the identification of inconsistent reporting and tracking of federal funds for nano R&D as a concern. The report can be pre-ordered from the link provided, though all chapters can be “skimmed” online for free.

Upcoming Meetings and Conferences

International Conference on Nanotechnology Occupational and Environmental Health and Safety: Research to Practice

Cincinnati, OH, Dec. 3-8, 2006

<http://www.uc.edu/noehs/>

NIOSH, the University of Cincinnati, US EPA, and others are the co-sponsors of this conference, considered one of the pre-eminent EH&S nano meetings. The meeting will address the future of nanotechnology from two distinct perspectives of health and safety: the promotion and protection of worker safety throughout the life cycle of nano products, and the use of nanotech to prevent, detect, and treat occupational and environmental diseases.

Strategic Communication and Applied Ethics in Nanobiotechnology

Oxford, England, UK, March 11-16, 2006

http://nanobio-raise.org/Members/Daan/news_item.2006-06-28.7426659990

Researchers in academia, industry, and government are invited to attend this six day course on public communication of nanotechnology. The goals of the course are to equip attendees with “knowledge of the relevant ethical, legal, and social aspects of nanobiotechnology; skills to communicate effectively with the media and the public; and understanding of issues involved in the public acceptance of nanobiotechnology.” The course format includes lectures, case studies, group exercises, discussions, and debates.

Hot-off-the-Presses Peer-Reviewed Research Articles of Note

Inoue *et al.*, 2006. “Effects of Airway Exposure to Nanoparticles on Lung Inflammation Induced by Bacterial Endotoxin in Mice.” *Environmental Health Perspectives*. 114(9): 1325-1330.

Abstract: <http://www.ehponline.org/members/2006/8903/8903.html>

Synopsis:

- Although nanoparticles have been suggested to induce adverse cardiopulmonary effects, including lung inflammation, there remains little experimental evidence on their mechanism of facilitating such effects *in vivo*. Based on research that has shown a lung inflammation effect of diesel exhaust particles related to bacterial endotoxin, this study investigated whether nanoparticles might also have an aggravating effect on lung inflammation related to bacterial endotoxin in mice.
- This study was designed to observe the effects of two sizes (14 nm or 56 nm) of carbon black nanoparticles on lung inflammation induced by intratracheal administration of bacterial endotoxin. Mice were divided into six experimental groups: the vehicle group received phosphate buffered saline, each nanoparticle group received 4 mg/kg of either 14 nm or 56 nm nanoparticles in saline, the bacterial endotoxin group received 2.5 mg/kg lipopolysaccharide (LPS) in saline, and each bacterial endotoxin plus nanoparticle group received either 4 mg/kg 14 nm or 56 nm particles combined with 2.5 mg/kg LPS in saline. Biochemical endpoints included cell and neutrophil counts in bronchoalveolar lavage, lung water content, histologic evaluation, cytokines (IL-1 β and TNF- α) and chemokines (MIP-1 α , MIP-2, MCP-2, and KC) in lung tissue supernatants, 8-OHdG immunohistochemistry, and coagulation analysis (prothrombin time, activated partial thromboplastin time, fibrinogen, activated protein, and activity for von Willebrand factor).
- Combined challenge with bacterial endotoxin and 14 nm nanoparticles was found to have the greatest response in all of the tests, demonstrating that carbon black nanoparticles instilled intratracheally markedly enhance neutrophilic lung inflammation with pulmonary edema related to bacterial endotoxin. This was accompanied by increased local expression of proinflammatory cytokines (IL-1 β but not TNF- α) and chemokines.
- Bacterial endotoxin and 14 nm nanoparticle treatment significantly increased circulatory fibrinogen levels compared with bacterial endotoxin alone, implying that nanoparticles can facilitate coagulatory disturbance as well.

Implications:

- These experiments provide evidence that nanoparticles can exacerbate lung inflammation related to bacterial endotoxin, with greater effects for 14-nm than 56-nm particles. Since experiments were for a constant particle weight (4 mg/kg) but greater surface area for the smaller-sized 14-nm particles, these results are consistent with prior studies that have reported a correlation between nanoparticle surface area and lung inflammation. The authors caution, however, that further studies with uniform surface area and particle numbers are required to better elucidate this relationship.
- Enhanced formation of 8-OHdG, a measure of oxidative damage to DNA, was seen in the nanoparticle, bacterial endotoxin, and bacterial endotoxin plus nanoparticle groups. The most intense response compared to the controls was found in the nanoparticle only groups, confirming results from prior studies indicating that nanoparticles may cause oxidative stress in the lung independent of bacterial endotoxin.
- These findings suggest that smaller nanoparticles can facilitate coagulatory disturbance accompanied by lung inflammation in the presence of bacterial endotoxin. The mechanisms for this are unknown, but the authors propose three possible hypotheses: 1) Damage induced by bacterial endotoxin and subsequent infiltration by effector leukocytes may allow large amounts of smaller nanoparticles to pass into circulation resulting in coagulatory disturbance, 2) Exposure to nanoparticles generates oxidative stress which may in turn induce inflammation and blood coagulation, and 3) Nanoparticles enter the circulation system by themselves and contribute to a high susceptibility to LPS induced inflammation and coagulatory disturbance.
- Consistent with real-world conditions, this study employed scenarios of simultaneous exposure to endotoxins and particulate matter. However the relationship of the dose employed to human dose is unknown. For further extrapolation to humans, the authors suggest that it would be interesting to know whether nanoparticles can exacerbate pre-existing inflammation.

Schulte and Salamanca-Buentello, 2006.
“Ethical and scientific issues of nanotechnology in the workplace.” *Environmental Health Perspectives*. EHP-in press.

Abstract: <http://www.ehponline.org/docs/2006/9456/abstract.html>

Synopsis:

- Claiming that no ethics research to date has focused on nanotechnology and the workplace, this article identifies ethical issues posed by nanotechnology in the workplace and presents a framework for consideration of ethical and scientific issues affecting decision-making about hazards, risks, and controls. The authors emphasize that ethical and social reflection should occur in parallel with any newly developed science rather than as a second step so that potential impacts can be more accurately anticipated and options for decision-makers can be developed.
- To lay the groundwork for their reflections on ethical issues posed by nanotechnology in the workplace, this article begins with a review of the state of the knowledge on hazards and risks associated with nanotechnology in the workplace. The authors conclude that although findings to date fail to provide scientific clarity on the potential health effects of occupational exposure to nanoparticles, such findings may be sufficient to support precautionary action.
- To prevent any concealment of hazards to workers, the study authors emphasize that the ultimate ethical requirement is to accurately portray the state of the knowledge about hazard or risk, without overstating or understating the level of understanding. One solution offered by the authors to better do this involves making pronouncements on the potential health concerns of nanoparticles independent from references to the promises and commercial benefits of nanotechnology.
- The authors identify as a critical ethical question what constitutes a necessary and adequate level of control to prevent injury and illness. The authors acknowledge the difficulty in addressing this question given that the risk posed by nanoparticles remains uncertain, but they conclude that we should draw upon our experience in controlling exposures to incidental ultrafine particles and gases — and that employers should be moved to use more rather than fewer control measures.
- The authors conclude that employers can conform to ethical principles to the extent that they (1) accurately portray hazards and risks, (2) are precautionary in their approach to hazards, (3) engage in communication and dialogue with workers, and (4) take the necessary steps to control risks so that they appear reasonable and acceptable to workers.

Implications:

- The authors conclude that due to the diverse mix of particles and processes associated with nanotechnology, hazards and risks may be more accurately assessed on a case-by-case basis, with consideration of such factors as the type of production methods and whether or not particles are embedded in a matrix or are unbound.
- The authors indicate that efforts should be dedicated towards developing a clear and coherent approach for defining the ethical obligations of scientists involved in nanotechnology research. They suggest that such an approach should involve not only requiring scientists to use appropriate qualifiers in their published papers and exercise caution in generalizing their results, but also to not shrink from the potential implications of their work even in the absence of scientific clarity.
- Because it is not possible to accurately address ethical issues without sufficient knowledge of the hazards involved, the authors conclude that ethical obligations necessitate continued investment in toxicological and control research. The authors recommend that special emphasis be placed on the development of occupational safety and health guidance information for small businesses given their importance in nanotechnology development.

- The authors highlight the importance of a risk-based approach for identifying an appropriate level of protection, and raise the need for nanoparticle-specific risk assessments. As discussed by the authors, there is a need for a range of particle-specific risk assessments that reflect the diverse particle characteristics (size, composition, surface characteristics, shape) of specific nanoparticle applications.

Coming Next Month

- Brief review of the CTFA nanotechnology White Paper
- Research on approaches to quantifying lung inflammatory response to nanoparticle exposure



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