Considerations in the Application of Nanoinformatics to Occupational Safety and Health

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The findings and conclusions in this report are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health.
Growth of Nanotechnology

- Effective growth of nanotechnology
  - Depends on society’s perception of the safety of nanomaterials
  - Will be delayed if perceptions of hazard and risk are not addressed

- Workers are the first in society
  - To have exposure to nanomaterials
    - Often at levels higher than consumers
  - Are likely to be the first people to show health effects
Occupational Safety and Health (OSH) is an Applied Field

- The focus is to protect working people from hazards at work
  - By conducting research
  - By developing guidance
- Data, information, and knowledge—generated for specific purposes
  - Hazard identification
  - Exposure assessment
  - Risk characterization
  - Risk management
OSH Information Has a Variety of Users

**Employers:** Responsible for safe and healthy workplaces

**Workers:** Self-protection

**General public:** Public awareness
OSH Information Has a Variety of Users (Cont’d)

Government Agencies: Provide guidance and regulation

Trade Association/Unions: Support employees and workers
The Question

What role can nanoinformatics play in OSH?
Informatics Helps the Progression Toward Preventive Action

- Knowledge (information and judgment)
- Information (data in context)
- Data (unstructured facts)

Translation

Action
Research and Guidance

Research

- Identify Information Gaps
- Conduct Research
- Disseminate Research
- Translate Research

From information to guidance

- Search for Information
- Establish Evidence Base
- Develop Knowledge
- Develop and Issue Guidance
- Implement Guidance
# Examples of OSH Information Relevant in Protecting Workers from Nanomaterial Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Exposure</th>
<th>Risk</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toxicity data</td>
<td>Exposure data</td>
<td>Quantitative risk assessments</td>
<td>Hazard banding</td>
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<tr>
<td>Party characteristics</td>
<td>• by job/task</td>
<td>Qualitative risk assessments</td>
<td>Control banding</td>
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<td>• by sector</td>
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<td>• by particle type</td>
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<td>• by metrics</td>
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<td>• by equipment characteristics</td>
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<tr>
<td>Hazard surveillance data</td>
<td>Job/exposure matrices</td>
<td>Epidemiologic research data</td>
<td>Medical surveillance guidance</td>
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<tr>
<td></td>
<td>• Explosivity</td>
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<td>Medical surveillance data</td>
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<td></td>
<td>• Flammability</td>
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<tr>
<td>Safety research matrices</td>
<td>Exposure registry data</td>
<td>Uncertainty data</td>
<td>Control research data</td>
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<td>Compliance research information</td>
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</table>

*OEL (Occupational Exposure Limit)
### From Information to Guidance

<table>
<thead>
<tr>
<th>Step</th>
<th>Hazard identification</th>
<th>Exposure assessment</th>
<th>Risk characterization</th>
<th>Risk management</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Search for Information</td>
<td>Establish Evidence Basis</td>
<td>Develop Knowledge</td>
<td>Develop and Issue Guidance</td>
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</table>
Nanomaterial Workplaces

- Research Laboratories
  - Academic
  - Commercial
    - Warehousing/Maintenance
    - Waste Handling
  - Transport
  - Start Up/Scale Up Operations
    - Transport
    - Warehousing/Maintenance
  - Manufacturing/Production
    - Warehousing/Maintenance
    - Transport
    - Waste Handling
  - Incorporation in Products
    - Maintenance of Products
    - Manipulation of Products
    - Application of Products - Medical Delivery
  - Disposal / End of Life
  - Recycling
- Warehousing/Maintenance
- Transport
<table>
<thead>
<tr>
<th>Sector: <strong>Materials</strong></th>
<th>Nanomaterial Type</th>
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</thead>
<tbody>
<tr>
<td><strong>Workplaces</strong></td>
<td>Carbon Nanotubes</td>
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<tr>
<td>Laboratory Research</td>
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<tr>
<td>Start up/Pilot</td>
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<tr>
<td>Manufacturing</td>
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<td>Production</td>
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<td>Disposal</td>
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Utility of Nanoinformatics in OSH

- Predict hazards and risks of nanomaterials for specific nanomaterials or categories of nanomaterials
  - Prioritize toxicologic research
  - Develop occupational exposure limits (OELs) for categories of nanomaterials
- Be able to characterize a range of reported exposures, controls, or risk management efforts
  - New high power search engines
  - New databases
- Assist in design of safer nanomaterials
Concerns about nanoinformatics

- Informatics is a broad term
- Lack of specific objectives can lead to ineffective use of resources
- Costly to maintain
- Occupational safety and health needs are specific and applied
- Opportunity costs of building information structures versus generating new information
- Need to distinguish between data, information and knowledge, and resources needed to develop each
Conclusions

- Scarce resources for OSH should be invested primarily in activities that address targeted outcomes

- Nanoinformatics may be a basis for:
  - Predicting the hazards of new nanomaterials and appropriate controls
  - Characterizing the range of hazards, exposures, risks, and guidance
  - Designing safer nanomaterials