WHO Guidelines on MNMs

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WHO guideline process

• Evidence-based to increase transparency
• Started with key questions; NOT handbook
• Answers based on systematic reviews of the scientific literature
• Recommendations based on evidence, values, feasibility
Guiding principles

• Precautionary approach

• Hierarchy of controls
Best practices

• Educate and train workers
• Involve workers in risk assessment and control
• Group MNMs into:
  • MNMs with specific toxicity
  • MNMs that are fibres
  • MNMs that are granular biopersistent particles
Recommendations

- Strong: everybody should do this
- Conditional: will probably be adapted according to local context
Recommendations

1. Assess health hazards of MNMs
2. Assess exposure to MNMs
3. Control exposure to MNMs
4. Health surveillance should be in place
5. Training and involvement of workers is needed
1. Assess health hazards

1. Assign hazard classes to all MNMs according to the *Globally Harmonized System* of Classification and Labelling of Chemicals for use in safety data sheets. For a limited number of MNMs this information is made available in these guidelines.

2. Update *safety data sheets with MNM-specific hazard information* or indicate which toxicological end-points did not have adequate testing available.

3. For the respirable fibres and granular biopersistent particles’ groups, use the available classification of MNMs for *provisional classification of nanomaterials of the same group*. 
### Assess Health Hazards: Table 2

<table>
<thead>
<tr>
<th>MNM</th>
<th>Acute toxicity</th>
<th>Skin corrosion / irritation</th>
<th>Serious eye damage / eye irritation</th>
<th>Respiratory or skin sensitization</th>
<th>Germ cell mutagenicity</th>
<th>Carcinogenicity</th>
<th>Reproductive toxicity</th>
<th>Specific target organ toxicity (single exposure)</th>
<th>Specific target organ toxicity (repeated exposure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fullerene (C&lt;sub&gt;60&lt;/sub&gt;)</td>
<td>No&lt;sup&gt;a&lt;/sup&gt;</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No data&lt;sup&gt;b&lt;/sup&gt;</td>
<td>No data</td>
<td>No</td>
<td>No</td>
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<tr>
<td>SWCNT</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Cat 2B&lt;sup&gt;c&lt;/sup&gt; (L)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>No data</td>
<td>IARC 3 (M)&lt;sup&gt;f&lt;/sup&gt;</td>
<td>No data</td>
<td>No data</td>
<td>Cat 1 (L)</td>
</tr>
<tr>
<td>MWCNT</td>
<td>No</td>
<td>No</td>
<td>Cat 2A&lt;sup&gt;(H)&lt;sup&gt;g&lt;/sup&gt;</td>
<td>Cat 2 (H)</td>
<td>MWCNT–7: Cat 2 (M), IARC 2B Other MWCNTs: IARC 3 (M)</td>
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<td>No data</td>
<td>No data</td>
<td>Cat 1 (M)</td>
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<td>No</td>
<td>Cat 1B (H)</td>
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<td>No data</td>
<td>Cat 1 inhalation (M) Cat 2 oral (M)</td>
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<td>AuNP</td>
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<td>No data</td>
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<td>No data</td>
<td>No data</td>
<td>No data</td>
<td>Cat 1 inhalation (H)</td>
<td></td>
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<tr>
<td>SiO&lt;sub&gt;2&lt;/sub&gt;</td>
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<td>No</td>
<td>No</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
<td>Cat 2 inhalation (H)</td>
<td></td>
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<tr>
<td>TiO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No data; IARC 2B</td>
<td>No data</td>
<td>No data</td>
<td>Cat 1 inhalation (H)</td>
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<tr>
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<td>No data</td>
<td>Cat 1 inhalation (H)</td>
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<td>Dendrimer</td>
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<tr>
<td>Nanoclay</td>
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<tr>
<td>ZnO</td>
<td>No</td>
<td>No</td>
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<td>No data</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
<td>Cat 1 inhalation (M)</td>
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</table>
2. Assess exposure

1. Assess workers’ exposure in workplaces with methods similar to those used for the proposed specific occupational exposure limit (OEL) value of the MNM.

2. Assess whether workplace exposure exceeds a proposed OEL value for the MNM. A list of proposed OEL values is provided in Annex 1 of these guidelines.

3. If specific OELs for MNMs are not available in workplaces, use a stepwise approach for inhalation exposure. For dermal exposure assessment, there was insufficient evidence to recommend one method of dermal exposure assessment over another.
### OELs

<table>
<thead>
<tr>
<th>Category</th>
<th>Study reference</th>
<th>MNM and specs</th>
<th>OEL name</th>
<th>Mass concentr. µg/m³</th>
<th>Particle concentr. (particle/ml, fibres/cm³)</th>
<th>Surface concentr. (nm²/cm³)</th>
<th>Derivation approach</th>
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</thead>
<tbody>
<tr>
<td><strong>Inhalation exposure: general MNM approach</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>MNM</td>
<td>Guidotti 2010</td>
<td>Particles ≤ 2500 nm</td>
<td>BOEL</td>
<td>30</td>
<td>ND</td>
<td>ND</td>
<td>Environmental</td>
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<tr>
<td>MNM</td>
<td>McGarry 2013</td>
<td>Airborne particles from NT processes</td>
<td>PCVs</td>
<td>ND</td>
<td>3 times LBPC for more than 30 minutes</td>
<td>ND</td>
<td>Environmental</td>
</tr>
<tr>
<td><strong>Inhalation exposure: categorical MNM approach</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>CMAR</td>
<td>BSI 2007</td>
<td>CMAR nanomateri als, NM</td>
<td>BEL</td>
<td>0.1 × bulk WEL</td>
<td>ND</td>
<td>ND</td>
<td>Bridging</td>
</tr>
<tr>
<td>Fibres</td>
<td>AGS 2013</td>
<td>Non-entangled fibrous NM</td>
<td>Acceptance level, respirable fraction</td>
<td>ND</td>
<td>0.01</td>
<td>ND</td>
<td>Bridging/grouping</td>
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<tr>
<td>Fibres</td>
<td>BSI 2007</td>
<td>Fibrous NM</td>
<td>BEL</td>
<td>ND</td>
<td>0.01</td>
<td>ND</td>
<td>Bridging/grouping</td>
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<tr>
<td>Fibres</td>
<td>Stockmann-Juvala 2014</td>
<td>Carbon nanofibres</td>
<td>OEL</td>
<td>ND</td>
<td>0.01</td>
<td>ND</td>
<td>Bridging/grouping</td>
</tr>
</tbody>
</table>
3. Control exposure

1. Focus control of exposure on preventing inhalation exposure with the aim of reducing it as much as possible
   • especially during cleaning and maintenance, collecting material from reaction vessels and feeding MNMs into the production process.
   • In the absence of toxicological information, implement the highest level of controls to prevent workers from any exposure. When more information is available, take a more tailored approach.

2. Use the principle of hierarchy of controls
3. Control exposure

1. Prevent *dermal exposure* by occupational hygiene measures such as surface cleaning and the use of appropriate gloves.

2. When assessment and measurement by a workplace safety expert is not available, *use control banding* for nanomaterials to select exposure control measures in the workplace.
4. Other recommendations

1. Health surveillance: no nano-specific recommendations

2. Worker training and involvement: no nano-specific recommendations. Good training materials available for MNMs. (e.g. Kulinowski NIHS US 2011)
Questions for breakouts

1 How could these guidelines be utilized in your organization?

2 Which recommendations do you consider most important to be implemented?

3 What is needed most for implementation? (e.g. information, expert training, financial support, local OEL)

4 Is the current occupational health infrastructure sufficient to deal with MNM problems?

5 Should there be additional regulation?
Thank you!

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