FAIRification of genotoxicity data to improve their reusability: from Nanomaterials to Micro- and Nanoplastics

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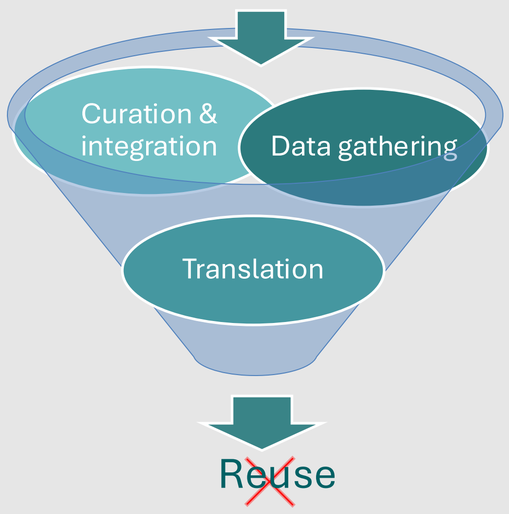
Background

A great amount of data on the genotoxicity of nanomaterials have been produced over the last decades. Although nanosafety data in general, and genotoxicity data in particular are essential to support risk assessment, for the development of predictive models and for advancing knowledge on mode and mechanisms of action, their effective reuse is hampered by several obstacles (Jeliazkova *et al*. 2021).



A huge stimulus for improving the management of scientific data comes from the **FAIR principles** (Wilkinson *et al*. 2016), which summarize the key characteristics that data and metadata must have to optimize reusability.

FAIR principles

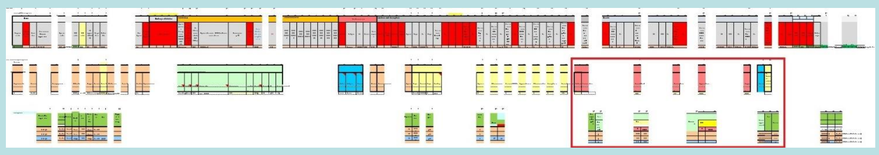
Findable
Accessible
Interoperable
Reusable

FAIR related issues in reusing NMs data

- ✓ Difficulty in finding data and associated metadata
- ✓ Poorly described (meta)data
- ✓ Access to (unpublished) data from international initiatives
- ✓ Non-standard and not harmonized terminology
- ✓ Lack of harmonized reporting formats and criteria

Issues in reusing *in vitro* comet data

- ✓ Lack of an OECD TG → high variability in the test protocols
- ✓ Different templates for data reporting



Comparison of templates for data reporting adopted in EU projects (results section highlighted in red)

1. NANoREG,
2. NanoReg2
3. NanoGenoTox

- ✓ Different criteria for the interpretation/translation of the results (Bossa *et al*. 2021)

	Criteria for assign a genotoxic effect (overall = positive)
OECD TG 489 *in vivo* **Comet assay** all criteria to be met	i) At least one of the test doses exhibits a statistically significant increase compared with the concurrent negative control;
	ii) the increase is dose-related when evaluated with an appropriate trend test;
	iii) considerations on distribution of historical negative controls.
NanoGenoTox, ***in vitro*** **Comet assay** one of the criteria to be met	i) A statistically significant increase with ≥ 2 doses;
	ii) a statistically significant increase at high dose and a dose-dependent increase.
NANoREG ***in vitro*** **Comet assay** both criteria to be met	i) A concentration-related induced DNA damage or at least genotoxic response in one concentration with cell viability more than 60% compared to control;
	ii) reproducible response
NanoReg2, ***in vitro*** **Comet assay** one of the criteria to be met (an intermediate category for equivocal results available)	i) Dose response observed and statistically significant increase at 1 dose (cytotoxicity ≤ 20%);
	ii) statistically significant increase with ≥2 doses (cytotoxicity ≤ 20%).

Nanosafety Data Interface (NDI)

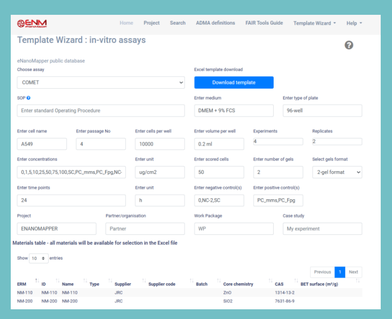
- ✓ Different international projects and initiatives addressed the challenge of advancing nanosafety data FAIRness, and contributed to the creation of the NDI
- ✓ NDI is a FAIR-compliant repository with projects-specific databases, storing data on characterization and effects of NMs

https://search.data.enanomapper.net/

Templates Wizard

- ✓ Web form, where the user can enter metadata of the experiment and download a template
- ✓ Available for physchem, ecotox, *in-vitro* assays and exposure and release experiments
- ✓ Designed to facilitate the capture of experimental data, aligning to community standards, supporting data harmonization and interoperability (Jeliazkova *et al*. 2024)

Template Wizard will be applied to create new templates, suitable for MNPs data generated in the PNC BioPlast4safe project



Template Wizard for Comet assay

From Nanomaterials to Micro- and Nanoplastics (MNPs)

- ✓ Standardization in the field of MNPs is particularly challenging, because it is a relatively young research area
- ✓ Previous experience with nanosafety data may inform data management needs of MNPs
- ✓ Genetaring MNPs data following the FAIR principles is crucial and urgent to maximize their availability, understanding, exchange and reuse

Suggested references
Bossa *et al*. 2021 Computational Toxicology https://doi.org/10.1016/j.comtox.2021.100190
Jeliazkova *et al*. 2021 Nature Nanotechnology https://doi.org/10.1038/s41565-021-00911-6
Jeliazkova *et al*. 2024 Nature Nanotechnology https://doi.org/10.1038/s41596-024-00993-1
Wilkinson *et al*. 2016 Scientific Data https://doi.org/10.1038/sdata

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