NanoBio4Can: FAIR Data Principles and Data Management Plan for Fellows and Supervisors

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Abstract

This guideline equips NanoBio4Can MSCA Cofund postdoctoral fellows and their supervisors with a clear, step-by-step framework for applying FAIR (Findable, Accessible, Interoperable, Reusable) data principles and fulfilling the requirements of Horizon Europe's Data Management Plan (DMP). It begins with a concise policy background and detailed explanations of each FAIR dimension, then walks users through drafting and updating their DMP (including the mid-term D1.3 at M24 and final D1.4 at M60 deliverables), selecting trusted repositories and metadata standards, and avoiding common pitfalls. A hands-on Zenodo upload tutorial (account setup, metadata entry, licensing, embargoes, and versioning) ensures datasets are properly archived, citable, and discoverable. The included compliance checklist and glossary of key terms make this document a practical, living resource for transparent, reproducible, and long-term preservation of NanoBio4Can research outputs

Keywords: FAIR Data Principles, Data Management Plan; Zenodo; NanoBio4Can MSCA Cofund; Horizon Europe

1 Introduction

This document supports NanoBio4Can MSCA Cofund postdoctoral fellows and their mentors in understanding and fulfilling their responsibilities regarding FAIR (Findable, Accessible, Interoperable, and Reusable) data principles and Data Management Plan (DMP) under the Horizon Europe framework. It aims to make the concepts and requirements accessible and practical for researchers in the NanoBio4Can MSCA Cofund Postdoctoral Training Network.

The FAIR data principles—**Findable, Accessible, Interoperable, and Reusable**—are central to ensuring transparency, reproducibility, and long-term value of publicly funded research. These guidelines are specifically designed for postdoctoral fellows in the NanoBio4Can MSCA Cofund programme to help them understand and fulfil their data responsibilities under the Horizon Europe framework.

This guideline also describes Horizon Europe's **Data Management Plan (DMP)** requirements in a clear, action-oriented handbook for NanoBio4Can fellows and supervisors. It guides you through crafting your DMP, provides practical checklists and a tutorial for Zenodo uploads, and defines key terms in a handy glossary.

2 What Is FAIR Data?

FAIR data is not necessarily open (as open as possible, as closed as necessary), but it must be discoverable, accessible, interoperable, and reusable by others under clearly defined conditions. The key is good data stewardship: organizing, documenting, and managing data so that it can be easily located, interpreted, and reused (where appropriate) by other researchers or systems.

The concept applies equally to quantitative and qualitative data, as well as to software, workflows, and physical research outputs. **FAIRness** is about maximizing transparency and research impact.

3 Why FAIR Data Matters in Horizon Europe

As a Horizon Europe researcher, you are expected to manage and share your research results in ways that maximize their value. The FAIR principles are embedded in the programme's core objectives:

- Promoting open science and responsible research
- Supporting reproducibility and data-driven innovation
- Strengthening cross-border, interdisciplinary collaboration
- Enhancing the visibility and credibility of EU-funded research

In legal terms, Article 17-18 (Communication, Dissemination and Visibility) and the "Open Science and Research Data Management" policy of the Horizon Europe Model Grant Agreement require you to apply FAIR principles to all research outputs, regardless of whether the data is shared publicly. **Non-compliance can lead to audit findings, budget corrections, or rejection of deliverables.**

FAIR data also benefits you directly by:

- Making your research more citable and discoverable
- Supporting your career development through best practices
- Facilitating collaborations and new funding opportunities

If you plan to publish in Open Research Europe (ORE), you will be required to provide open data links or justifications for restricted datasets as part of the submission process. ORE and other open-access routes are explained in the Publication Guidelines of the NanoBio4Can project and are available online on the project website under the Toolkit tab.

4 FAIR Data Principles in Detail

This section explains each of the four FAIR principles in more depth to support both implementation and project monitoring:

4.1 Findable

Data must be assigned a persistent identifier (such as a DOI) and described with rich metadata that meets community standards. These metadata records should be registered in searchable repositories to ensure others can locate them easily. Project officers will verify whether datasets are findable through OpenAIRE or similar indexing services.

4.2 Accessible

The data should be retrievable through standard open protocols (e.g., HTTPS or OAI-PMH), and the access conditions must be clearly explained. If data cannot be openly shared, a justification must be provided, and metadata must still be openly available.

4.3 Interoperable

Your data should use machine-readable, community-accepted formats and vocabularies (e.g., CSV, JSON, ontologies). Interoperability ensures that data can be integrated into other systems, reused across disciplines, and preserved long-term.

4.4 Reusable

Data must be clearly licensed (e.g., CC BY or CC0), accompanied by information about its origin, processing, and usage limitations. Reusability is closely tied to ethical integrity and methodological transparency.

If your project generates physical samples or non-digital assets, describe them in your DMP and include information on how they will be documented, stored, or made available for reuse where applicable.

5 Key Requirements under Horizon Europe MSCA Cofund

As a participant in the MSCA Cofund program, you are required to manage your research data in accordance with Horizon Europe's Open Science and FAIR policies.

These requirements apply to all research output, regardless of whether they are shared publicly, and must be clearly addressed in the consolidated **Data Management Plan** (DMP) and project deliverables.

5.1 Data Management Plan (DMP)

The NanoBio4Can project must submit consolidated DMP files as Deliverables at D1.3 at M24 and D1.4 at M60. The DMP must be updated:

- During mid-term reporting
- After major changes to data collection, formats, or sharing plans
- Before the final report submission

A shortened and simplified DMP template will be shared with the MSCA Cofund Fellows and Supervisors prior to the deliverable deadlines. A final, consolidated DMP will be shared with the EU office and TUBITAK for audit purposes.

5.2 Open Access to Research Data

- Data underlying peer-reviewed publications must be deposited in a trusted FAIR-compliant repository, for example, **Zenodo**.
- Metadata describing your dataset must be **openly accessible**, even if the data itself is under embargo or restricted. Metadata answers the "who, what, when, where, why, and how of your data". It is required even if your actual data cannot be openly shared (e.g., due to confidentiality or IP).

5.3 Justification for Non-Disclosure

- If you cannot share certain datasets (e.g., due to General Data Protection Requirements (GDPR), ethics, or IP), the reasons must be clearly documented in your DMP.
- Embargoes are permitted for limited durations and must be justified.

5.4 Use of Trusted Repositories

- Use repositories that are:
    - Indexed in **OpenAIRE** or compliant with European Open Science Cloud **(EOSC)-**Europe's shared data infrastructure.
    - Capable of issuing **DOIs** or other persistent identifiers
    - Supporting **long-term preservation** and access controls
- Examples: Zenodo, or similar, or institutional repositories. The NanoBio4Can already has a community on Zenodo.

5.5 Open Licensing

- Datasets must be accompanied by clear licenses, preferably **Creative Commons licenses** (CC BY or CC0). This is further clarified in the Publication Guidelines Document, published on the Zenodo NanoBio4Can community and the NanoBio4Can project website.
- These licenses enable citation, reuse, and transparency (making the data FAIR).

5.6 Ethics and Data Protection

- Your data management plan must respect the General Data Protection Regulation (**GDPR**), ethics approvals, and institutional policies.
- Sensitive or personal data must be anonymized where applicable.
- Informed consent forms should include clauses on data sharing and preservation.

5.7 Reporting and Monitoring

- Your DMP and FAIR data practices will be reviewed during internal project evaluations and EU audits.
- Use the compliance checklist (Section 11) to stay on track.

6 Data Management Plan (DMP): What, Why, How, and When?

A DMP is a structured, evolving document that outlines how research data will be handled during and after your project. For MSCA Cofund fellows, this plan ensures compliance with Horizon Europe rules and demonstrates research integrity.

DMP must include:

- A description of the data you will collect or reuse
- The formats and standards applied (e.g., CSV, TIFF, MIAME, Dublin Core)
- How and where the data will be stored, preserved, and backed up
- Data sharing practices and access restrictions (if any)
- Licenses used for reuse and redistribution (e.g., CC BY)
- Roles and responsibilities for data management
- Ethical and legal compliance, including GDPR where applicable

Backups should be stored on secure institutional servers with regular version control and data recovery plans. Sensitive data must be encrypted during transfer and storage.

7 Choosing Repositories and Metadata Standards

To align with FAIR principles and Horizon Europe obligations, your data must be stored in trusted repositories and accompanied by complete metadata, such as those provided by Zenodo.

- **Choose a repository such as Zenodo that:**
  - Issues persistent identifiers (e.g., DOIs)
  - Is registered with the European Open Science Cloud (EOSC) or OpenAIRE
  - Allows for open, restricted, or embargoed access options
  - It is maintained for long-term preservation (e.g., Zenodo)
- **Use metadata standards such as:**
  - **Dublin Core** (general research): Dublin Core is a very general, lightweight set of 15 core elements (title, creator, date, etc.) that works for almost any research output.

- **DataCite schema** (cross-disciplinary datasets): Builds on Dublin Core to include rich fields (funding references, related identifiers, resource types) and is optimized for citing and discovering datasets across disciplines.
- **MIAME** (gene expression data, minimum information about a microarray experiment) is a detailed checklist of metadata elements specific to gene-expression microarray studies—things like experimental design, sample annotation, array design, and processing protocols.
- **ISO 19115** (geospatial data): is the international standard for describing geospatial ("GIS") data—defining elements for coordinate systems, spatial extent, data quality, and lineage so that maps and spatial datasets can be interoperable, discovered, and used.

The repository must support open harvesting protocols so that your data can be indexed and found via portals such as Zenodo, OpenAIRE, GitHub, Re3data.org, or similar.

8 Common Mistakes to Avoid

Avoid these typical errors to maintain FAIR compliance:

- Submitting incomplete or late DMPs
- Storing data in non-compliant or private cloud platforms
- Omitting persistent identifiers or licenses
- Using proprietary or poorly documented formats
- Assuming data that cannot be shared cannot be FAIR
- Ignoring updates to your DMP after project changes

🎓 **As a Fellow, you are expected to:**

- Draft and regularly update your DMP and inform the coordinating institution
- Select appropriate formats and repositories
- Apply standardized licenses (CC BY, CC0) for your research outputs
- Document every step of your data process (collection, cleaning, versioning) for transparency and audits
- Ensure ethical handling of sensitive data, including anonymization if needed

🏛 **Supervisors must:**

- Provide data management training and infrastructure
- Offer legal and ethical guidance
- Support secure storage and version control systems
- Monitor DMP updates and FAIR compliance as part of progress reporting

9 Zenodo Account

The NanoBio4Can Zenodo community is available on the following website.

https://zenodo.org/

Please first register for the Zenodo website using your ORCID and search for the "NanoBio4Can" community to view the available project outputs in the near future.

After registration, go to the Communities Tab and search for "NanoBio4Can".

All relevant research outputs must be stored in that open-access community.

Unlike other platforms, Zenodo communities are managed by community owners—there's currently no self-service "join" function.

If you need your deposit to appear in a specific community, such as the NanoBio4Can community, **you should identify and contact the community managers (usually via the community's "Contact" link or email)** and request an invitation for your record to be curated into that community.

10 Zenodo Upload Walkthrough

Following these steps will ensure your NanoBio4Can datasets are properly documented, citable, and FAIR-compliant.

Create an account & log in

- Register with email or link via ORCID/GitHub. Once confirmed, sign in at zenodo.org help.zenodo.org.

- Connect to NanoBio4Can community in Zenodo by emailing to community managers → info@nanobio4can.net

Start a new deposit

- Click the **"+"** (plus) icon in the top header and select **New upload** to open the deposit form help.zenodo.org.
- You must choose **NanoBio4Can** from the community selection tool.

Upload your files

- Drag-and-drop or click **Upload files** to add one or more data files (up to 100 files, max 50 GB per record). Note: files cannot be added or removed after publication help.zenodo.org. New version can be added.

Complete the required metadata

- Fill in all fields marked with a red asterisk under **Basic information**:
  - **Title**, **Authors/Creators**, **Publication date**
  - **Resource type** (e.g., Dataset, Software)
  - **Description**, **Keywords**, and **License** (e.g., CC BY 4.0)
  - **DOI assignment**: choose to reserve a new DOI or supply an existing one if applicable help.zenodo.org.

Save as draft & validate

- Click **Save draft** to check for errors. Address any validation messages before proceeding help.zenodo.org.

Publish your record

- When all the data and files are finalized, press **SUBMIT FOR REVIEW**.
- Your submission will be received and reviewed by the Project Management Team.

- Project Management Team will press the share button, where Zenodo will mint your DOI immediately and make your record publicly discoverable at help.zenodo.org.

Post-publication management

The Management team can update metadata or upload new versions via the Zenodo admin dashboard; each new version retains the same DOI with an updated version suffix.

How to Set an Embargo

When preparing your upload on Zenodo, set the visibility of your files to Restricted, then enable the 'Apply an embargo' option. You'll be prompted to choose an "Embargo until" date (the files remain private until midnight UTC on that date) and can optionally add a reason. Once the embargo expires, Zenodo automatically makes your record public without further action on your part

11 FAIR Data Compliance Checklist

Use this list to verify your alignment with FAIR and Horizon Europe obligations:

☑ I have created and updated my DMP template once I received the email from the Project Management Team

☑ All research output (such as open-access publications) has a DOI or equivalent identifier

☑ Metadata is machine-readable and complete

☑ I used a trusted, EOSC-compatible repository, such as Zenodo

☑ Licensing terms (e.g., CC BY or zero) are clearly applied

☑ My approach complies with Article 17 of the model grant agreement.

In legal terms, Article 17-18 (Communication, Dissemination and Visibility) and the "Open Science and Research Data Management" policy of the Horizon Europe Model Grant Agreement require you to apply FAIR principles to all research outputs, regardless of whether the data is shared publicly. **Non-compliance can lead to audit findings, budget corrections, or rejection of deliverables.**

12 Glossary of Terms

Term	Description
FAIR	Findable, Accessible, Interoperable, Reusable
Metadata	Structured information that describes datasets
Persistent Identifier	A permanent reference (e.g., DOI)
Repository	A platform that stores and preserves digital data
License	A legal tool that defines how others may reuse your data
Provenance	The origin and transformation history of a dataset
HTTPS	Hypertext Transfer Protocol Secure (HTTPS) is the standard web protocol for encrypted communication, using TLS to protect data integrity and confidentiality between clients and servers.
OAI-PMH	The Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) is a low-barrier standard that enables repositories to expose and share their metadata in a structured way for efficient aggregation and discovery.

13 Abbreviations

Abbreviation	Full Term
DMP	Data Management Plan
DOI	Digital Object Identifier
EOSC	European Open Science Cloud
GDPR	General Data Protection Regulation
MGA	Model Grant Agreement
MSCA	Marie Skłodowska-Curie Actions

14 Declaration of Generative AI and AI-assisted Technologies in the Writing Process

In preparing this document, the authors utilized Perplexity AI, a licensed ChatGPT Premium service, and Grammarly Premium to assist with information extraction, content review, and language editing. These tools were employed to enhance spelling, grammar, punctuation, clarity, and overall readability and to support the accurate extraction and summarization of information from the original source materials. Following the use of these technologies, all content was thoroughly reviewed and edited by the authors, who accept full responsibility for the accuracy and integrity of the final version.

15 Version History

Version	Date	Authors	Changes
1.0	24.07.2025	Project Management Team	Initial public release on the website

16 Contact

If you have any questions, please contact the project coordination team via email.

Email: info@nanobio4can.net

17 References

- Horizon Europe Model Grant Agreement
- European Commission FAIR Data Guidelines
- OpenAIRE: https://www.openaire.eu
- Zenodo: https://zenodo.org
- Research Data Alliance: https://www.rd-alliance.org
- NanoBio4Can Ethics & Publication Guidelines
- Open Research Europe: https://open-research-europe.ec.europa.eu
- Open Research Data in Horizon Europe (ORDO): https://data.europa.eu/doi/10.2777/20498
- https://rea.ec.europa.eu/open-science_en
- https://www.openaire.eu/horizon-europe-openaire-guides-for-researchers
- https://gdpr-info.eu/
- https://project-thor.readme.io/docs/introduction-for-policy-makers