

# All's FAIR in Love and... Software

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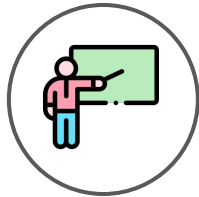


FAIR DATA  
INNOVATIONS HUB

# About This Presentation



40 min + Q&A



Learn why & how to make  
biomedical research software FAIR



Answer poll questions  
throughout the presentation



## Poll Time!

*Respond through the Zoom prompt*

How familiar are you with the FAIR Principles?

1. Not a all
2. I have heard about them
3. I understand them but have never implemented them
4. I have made or helped make data or other research outcomes FAIR



# About Research Software

# About Research Software

## Definition

Any software created **during the research process**  
**or for a research purpose**

Source: Gruenpeter, M. et al. Defining Research Software: a controversial discussion.  
Zenodo <https://doi.org/10.5281/zenodo.5504016> (2021).



**Excel** used to analyze and  
visualize data



**Python script** developed to  
analyze and visualize data

# About Research Software

There are many different types

## Various formats



Python  
script



R code



Jupyter  
notebook

## Various applications



Data analysis



Computational  
model



AI/ML  
model



## Poll Time!

*Respond through the Zoom prompt*

Before today, did you know what a research software was?

1. Yes
2. No
3. Sort of

# About Research Software

It is an essential element of biomedical research...



More and more biomedical research projects include development of research software



Research software is the main outcome of many research projects

<https://www.researchsoft.org/resa-resources>



# About Research Software

... and sharing and making it reusable is thus critical



Enable **reproducible, transparent research**



Prevent **duplicate effort**



Increase the **pace of discoveries** to improve human health

# About Research Software

## Sharing policies

Funders such as NIH may impose  
**stricter software sharing requirements** soon



Closed on February 1st 2024



## Poll Time!

*Respond through the Zoom prompt*

Do you assist researchers with data management plans?

1. Yes
2. No

If yes, have you incorporated research software as elements to be shared and made reusable?

1. Yes
2. No



# **How to Make Research Software Reusable?**

# How to Make Research Software Reusable?

## FAIR Principles – Overview

**FAIR Principles (2016)** were established to optimize the reusability of all digital research objects, including **software**

### To be Findable:

- F1. (meta)data are assigned a globally unique and persistent identifier
- F2. data are described with rich metadata (defined by R1 below)
- F3. metadata clearly and explicitly include the identifier of the data it describes
- F4. (meta)data are registered or indexed in a searchable resource

(and more)

# How to Make Research Software Reusable?

## FAIR Principles – Problem

Many in the research software community found that the  
**FAIR Principles were not suitable for software**



- Granularity
- Dependencies
- Multiple versions

# How to Make Research Software Reusable?

## FAIR4RS Principles – Background



FAIR for Research Software  
(FAIR4RS) Working Group



200+ stakeholders  
involved



2020 – 2022

FAIR Principles for Research Software or **FAIR4RS Principles** (2022)

# How to Make Research Software Reusable?

## FAIR4RS Principles – Overview

**17 principles** tailored for research software

F1. Software is assigned a globally unique and persistent identifier.
F1.1. Components of the software representing levels of granularity are assigned distinct identifiers.
F1.2. Different versions of the software are assigned distinct identifiers.
F2. Software is described with rich metadata.
F3. Metadata clearly and explicitly include the identifier of the software they describe.
F4. Metadata are FAIR, searchable and indexable.

(and more)





## Poll Time!

*Respond through the Zoom prompt*

Before today, how familiar were you with the FAIR Principles for Research Software (FAIR4RS Principles)?

1. Not at all
2. I have heard about them
3. I understand them but have never implemented them
4. I have made or helped make research software FAIR

# How to Make Research Software Reusable?

## FAIR4RS Principles – Problem

The FAIR4RS Principles, by design,  
**do not provide actionable instructions**

How do I assign a unique identifier?

How do I provide rich metadata?





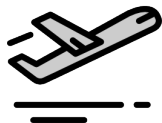
# **FAIR-BioRS Guidelines**

# FAIR-BioRS Guidelines

## About

### FAIR Biomedical Research Software (FAIR-BioRS) Guidelines

Minimal, actionable, step-by-step guidelines for complying with each of the FAIR4RS principles



**December 2021**  
Beginning of this effort

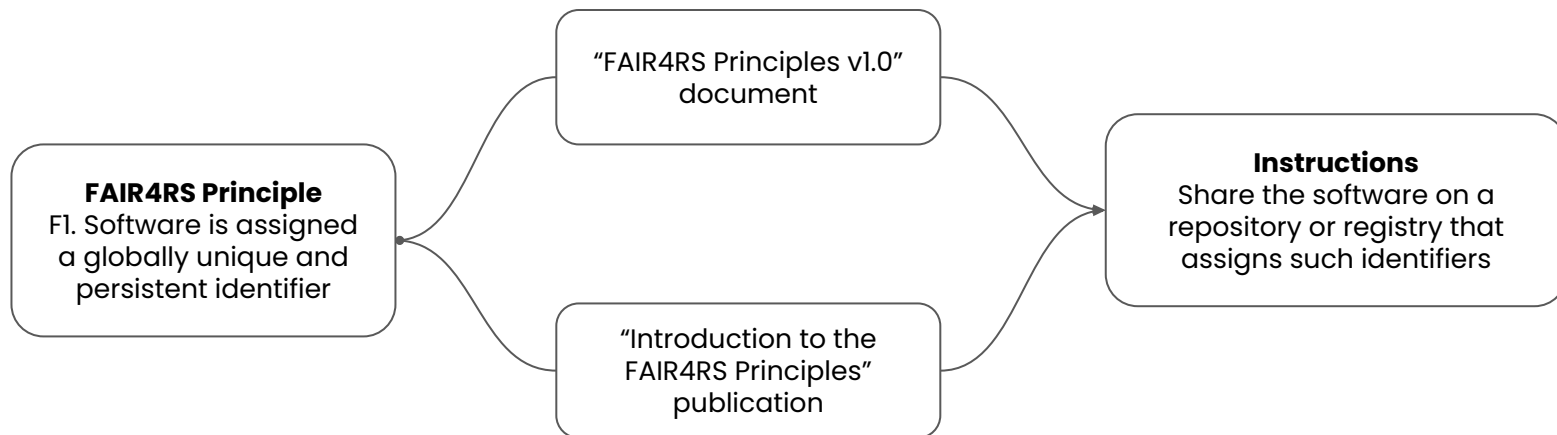


**August 2023**  
Manuscript published

# FAIR-BioRS Guidelines

## Development process

Step 1: Derive **high-level instructions** for fulfilling each of the FAIR4RS principles



# FAIR-BioRS Guidelines

## Development process

Step 2: Combine instructions into **categories** based on common theme

Category 1:  
Develop software  
following  
standards and  
best practices

Category 2:  
Include metadata

Category 3:  
Provide a license

Category 4:  
Share software in  
a repository

Category 5:  
Register in a  
registry

Step 3: Define **outstanding questions** for fulfilling the instructions  
from each category

Category 4: What repositories can be used?  
In what format should research software be shared?

# FAIR-BioRS Guidelines

## Development process

Step 4: Find out **answers** for these questions



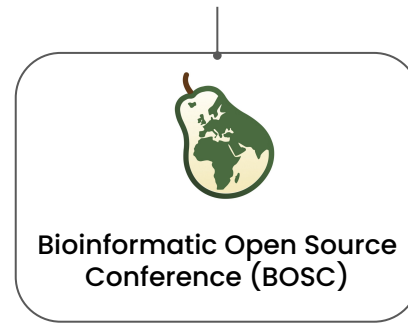
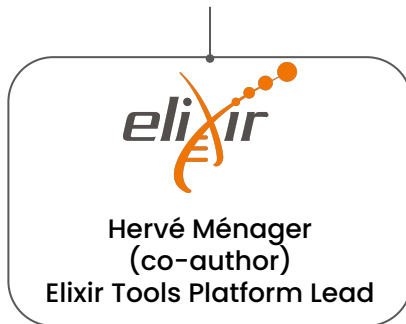
Literature  
review



Our  
assessment



External  
feedback



# FAIR-BioRS Guidelines

## Overview



Full guidelines: [fair-biors.org](https://fair-biors.org)



# FAIR-BioRS Guidelines

They benefit everyone!



For researchers  
developing software

- Increase the impact of your software
- Get recognition for your development effort
- Increase opportunities for collaboration

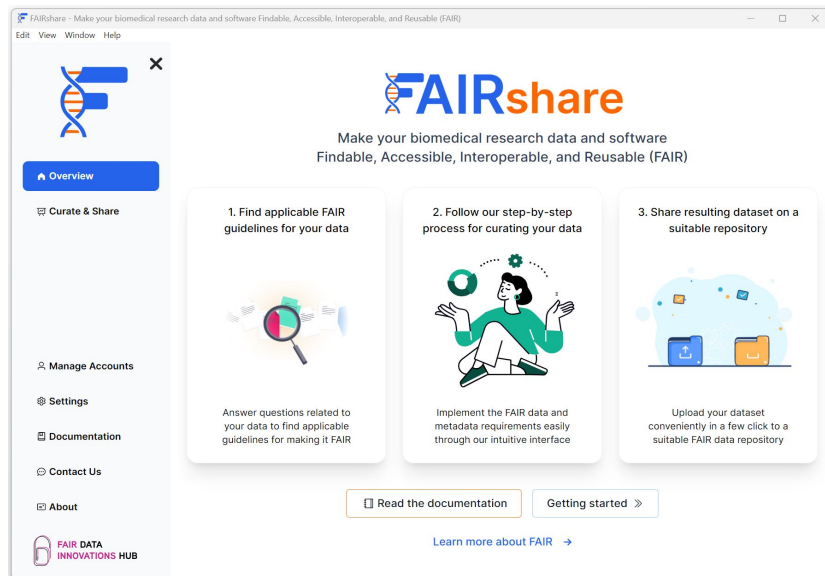


For funders

- Increase your return on investment
- Avoid funding duplicate development effort

# FAIR-BioRS Guidelines

## FAIRshare



Cross-platform



Open source

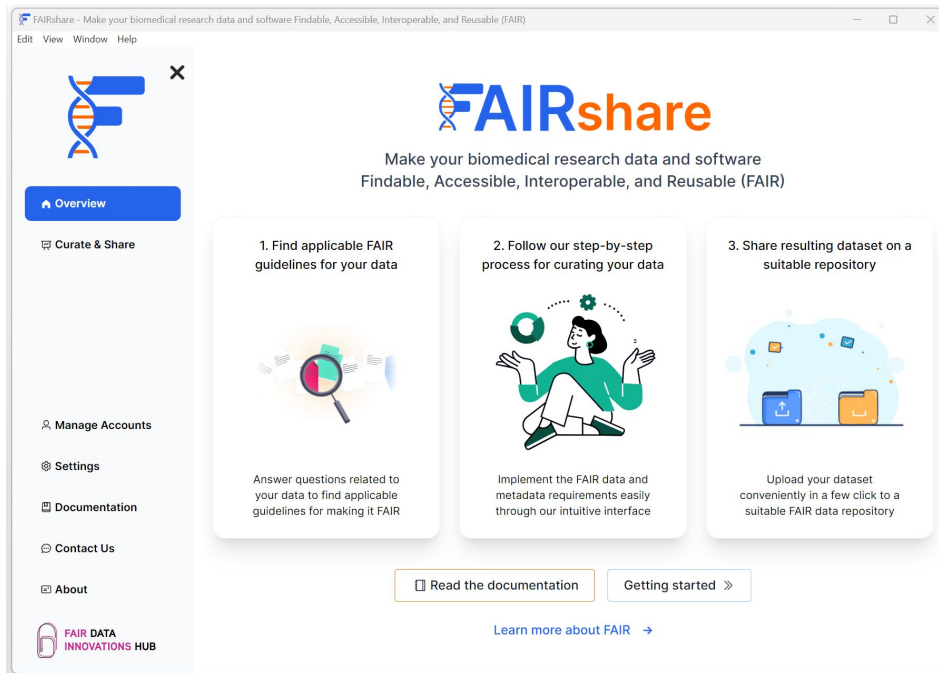


Free

<https://docs.fairshareapp.io>

# FAIR-BioRS Guidelines

FAIRshare



<https://docs.fairshareapp.io>

# FAIR-BioRS Guidelines

What now?



Publish manuscript in Scientific Data (August 2023)

<https://doi.org/10.1038/s41597-023-02463-x>



Promote the guidelines



Setup a working group to review the guidelines periodically



Develop a GitHub app that automates implementation of the FAIR-BioRS guidelines



**How Can You  
Support This Effort?**

# How Can You Support This Effort?

Researchers



Follow the FAIR-BioRS guidelines as you are developing your software ([fair-biors.org](https://fair-biors.org))



Use FAIRshare for support ([docs.fairshareapp.io](https://docs.fairshareapp.io))



Reach out to us with questions or suggestions ([bpatel@calmi2.org](mailto:bpatel@calmi2.org))

# How Can You Support This Effort?

## Librarians



Establish/update your software management guidelines to include the FAIR-BioRS guidelines ([fair-biors.org](https://fair-biors.org))

### University X Guidelines for Managing Research Software

#### 1. Security

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

#### 2. FAIR

→ FAIR-BioRS Guidelines

# How Can You Support This Effort?

## Funders



Require/recommend to make software FAIR  
and refer to the FAIR-BioRS guidelines ([fair-biors.org](https://fair-biors.org))



Support the maintenance of the guidelines  
and development of automation tools





## Poll Time!

*Respond through the Zoom prompt*

If you are a researcher developing software, will you consider using the FAIR-BioRS guidelines?

1. Yes
2. No
3. Maybe



## Poll Time!

*Respond through the Zoom prompt*

If you are a librarian, will the FAIR-BioRS guidelines help you in assisting researchers with their software management plan?

1. Yes
2. No
3. Maybe



# Closing Comments

# Closing Comments

## Summary

### Background

Biomedical research software is an essential element of research and making it FAIR is critical

### Problem

The FAIR4RS principles only provide high-level instructions for making software FAIR

### Solution

We developed minimal and actionable guidelines to make software FAIR called the FAIR-BioRS guidelines

### Support us!

Promote making software FAIR, use the FAIR-BioRS guidelines, and contribute to them!

# Together, Let's Make Sure All's FAIR in Love... and Software

## Thank You!



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[fairdataihub.org](https://fairdataihub.org)



[fairdataihub.org](https://fairdataihub.org)

*Find these slides and  
all resources here*



[tinyurl.com/softwarelove](https://tinyurl.com/softwarelove)

# Resources

- Making Biomedical Research Software FAIR: Actionable Step-by-step Guidelines with a User-support Tool. <https://doi.org/10.1038/s41597-023-02463-x>
- Website for the FAIR-BioRS guidelines and associated resources. [fair-biors.org](https://fair-biors.org)
- GitHub organization of the FAIR-BioRS guidelines. <https://github.com/FAIR-BioRS>
- FAIRshare software. <https://docs.fairshareapp.io>
- Defining Research Software: a controversial discussion. <https://doi.org/10.5281/zenodo.5504016>
- Introducing the FAIR Principles for research software. <https://doi.org/10.1038/s41597-022-01710-x>
- FAIR Principles for Research Software version 1.0. <https://doi.org/10.15497/RDA00068>
- NIH Best Practices for Sharing Research Software. <https://datascience.nih.gov/tools-and-analytics/best-practices-for-sharing-research-software-faq>
- The FAIR Guiding Principles for scientific data management and stewardship <https://doi.org/10.1038/sdata.2016.18>