TOWARDS BEST PRACTICES FOR REPRODUCIBILITY IN RESEARCH MRI

MICHAEL A GREEN [1, 2, 3], STEFFEN BOLLMANN [3, 4, 5], BRYAN PATON [3, 6, 7, 8], ARKIEV D'SOUZA [3, 9, 10, 11]

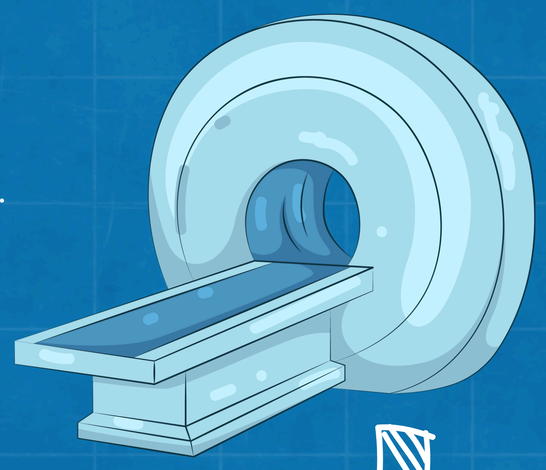
A BLUEPRINT FOR HIGH-QUALITY, REPRODUCIBLE WORKFLOWS WHEN WORKING WITH BIG MRI DATASETS

STARTING WITH... IMAGE ACQUISITION

PRE-REQUISITES FOR ANY RESEARCH MRI

- Assign a DOI for each unique instrument
  - (hardware, software version, acquisition date)
- Optimised protocols validated by phantom measurements.
- Must also be validated in real humans!

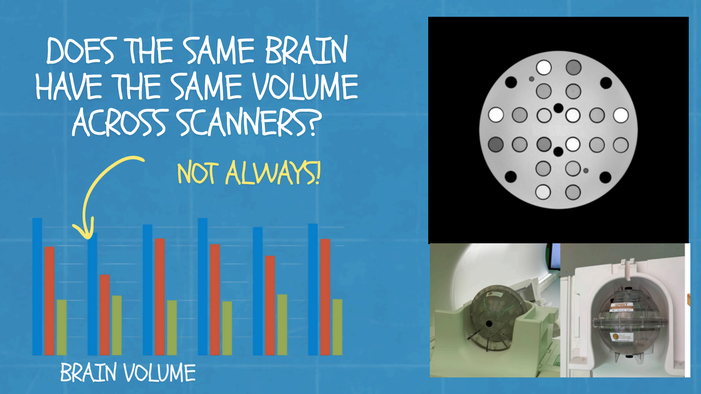
MANY DMANY OLDER MRI DATASETS ARE NOW UNUSABLE WITH MODERN ANALYSIS TOOLS DUE TO POOR ACQUISITION QUALITY AND LACK OF STANDARDISATION.ATASETS NO LONGER



ALL THIS CAN HELP WITH:

- Being confident your measurement matches reality
- Multi-site studies for clinical trials
- High-quality images increases the longevity of data
- Users aren't just acquiring data "like it was acquired before"

QA/QC PROTOCOLS

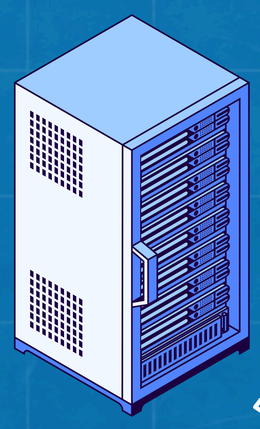


MRI phantoms filled with fluids of known values help monitor scanner consistency - invaluable for harmonising data across sites.

THEN... STORAGE AND DATA ACCESS

STORE DATA IN BIDS FORMAT (Brain Imaging Data Structure)

- **Consistent data** organisation better for collaboration - easier to share, compare, and reproduce results.
- **Streamlines analysis** workflows.
- **Future-proofing data** - BIDS enforces rich metadata standards (e.g. acquisition parameters, participant info, task descriptions) crucial for data provenance and reuse of datasets.



MRI DATA STORAGE: Open Source vs Paid Platforms?

Open-source tools like XNAT offer flexibility and lower upfront costs but require expertise and infrastructure. Commercial platforms like Flywheel simplify setup and access management - ongoing financial commitments.

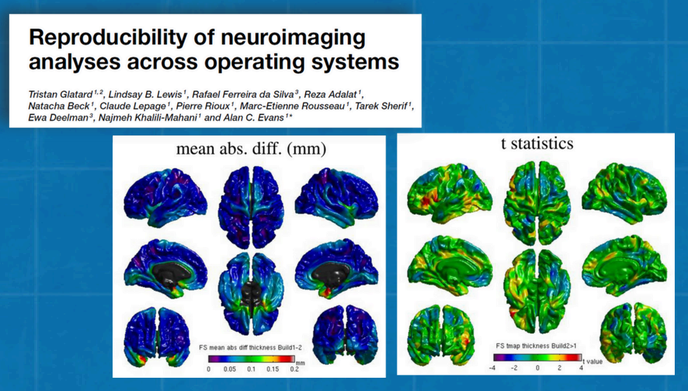
MUST COMPLY with use access agreements, de-identification protocols, and secure storage to protect participant privacy and comply with ethics.

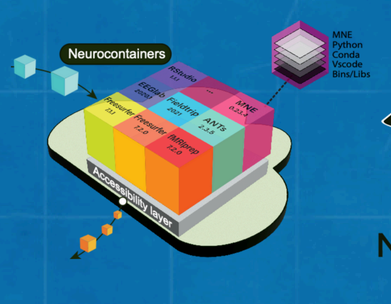
COULD DATA SUPPORT FUTURE INCLUSION IN LARGE, PUBLICLY ACCESSIBLE RESEARCH DATABASES?

AND FINALLY... DATA ANALYSIS AND PUBLICATION

USE NEURODESK FOR DATA ANALYSIS!

Neurodesk is an open-source, container-based platform designed to make reproducible neuroimaging analysis accessible, flexible, and portable across personal computers, HPCs, and cloud environments.

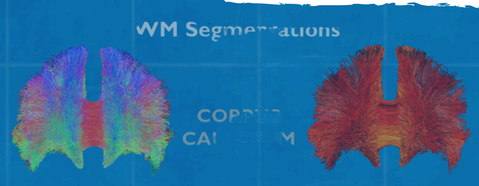




NEURODESK

KEY FEATURES

Containerised software: Suite of neuroimaging tools with all dependencies - consistent results across systems.
Virtual desktop & notebooks: Offers a browser-accessible Linux desktop and JupyterLab for interactive analysis.
Cross-platform support: Runs on Windows, macOS, Linux, HPC clusters, and cloud services.
Reproducibility & FAIR compliance: Supports standardized workflows and integration with platforms like OpenNeuro.
Community-driven: Built by and for researchers, with active contributions and transparent development.



WE'RE WORKING ON IT!

- NIF's MRNet project is streamlining MRI workflows — from high-quality acquisition to secure, shareable storage and reproducible measurements across the national 3T scanner network.
- This work underpins ABIRD, a growing resource of healthy, high-quality MRI scans designed to support large-scale brain imaging research and provide reusable control data for Australian researchers.

WORK IN PROGRESS

NATIONAL IMAGING FACILITY

1. Neuroscience Research Australia, Sydney, Australia
2. School of Clinical Medicine, Medicine & Health, UNSW, Australia
3. National Imaging Facility, a National Collaborative Research Infrastructure Strategy (NCRIS) capability
4. School of Electrical Engineering and Computer Science, The University of Queensland, Brisbane, Australia
5. Queensland Digital Health Centre, The University of Queensland, Brisbane, Australia
6. Brain Health Program, Hunter Medical Research Institute, NSW, Australia
7. Mark Hughes Foundation Centre for Brain Cancer Research, College of Health, Medicine and Wellbeing, University of Newcastle, NSW, Australia
8. School of Psychological Sciences, College of Engineering, Science, and the Environment, University of Newcastle, NSW, Australia
9. Sydney Imaging, the University of Sydney, NSW, Australia
10. School of Biomedical Engineering, the University of Sydney, NSW, Australia
11. Australian Imaging Service, The University of Sydney, NSW, Australia

NeuRA Discover — Conquer — Cure

UNSW SYDNEY

NATIONAL IMAGING FACILITY