



Past, present and future of standardisation of preclinical imaging

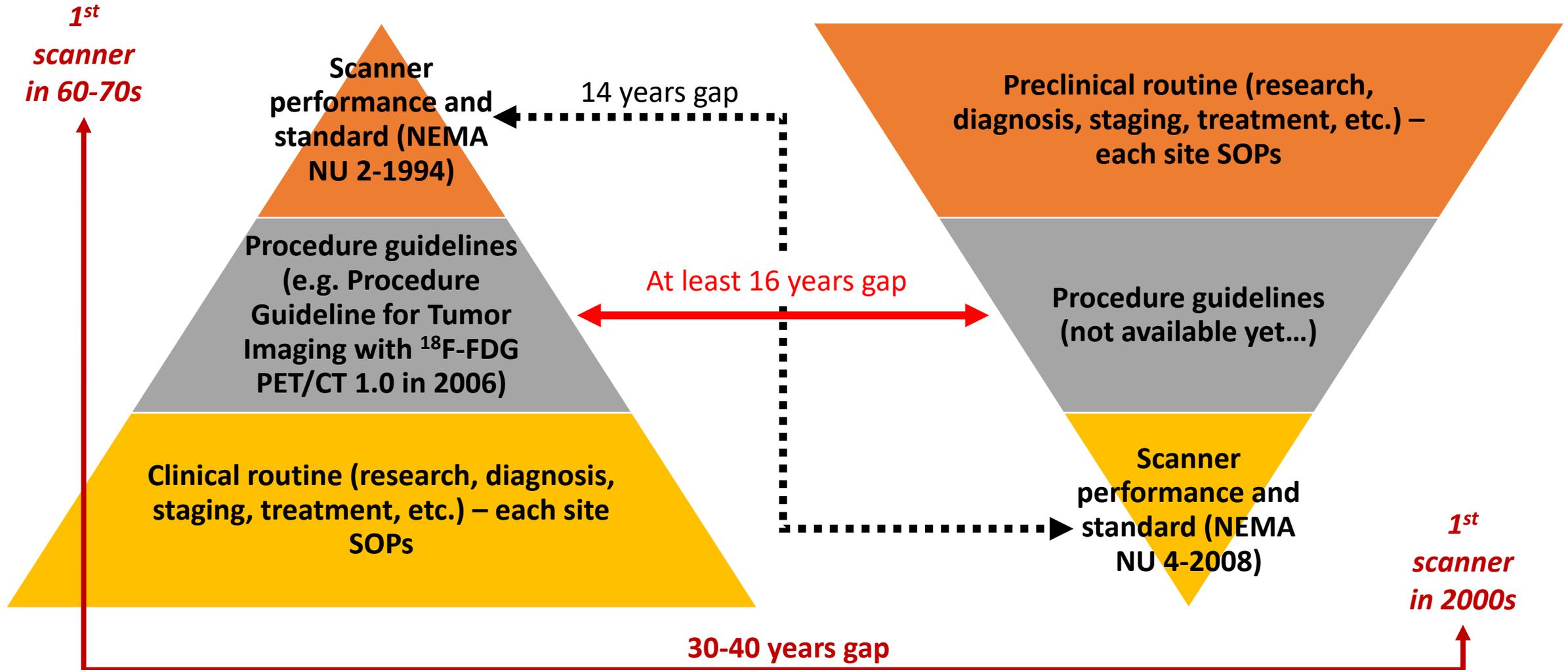
Adriana Tavares

Euro-Bioimaging Virtual Pub
22nd July 2022 at 13:00 CEST

Outline

- Preclinical versus clinical imaging
- Past of standardization of preclinical imaging
- Present of standardization of preclinical imaging
- Future of standardization of preclinical imaging

Clinical versus preclinical PET – timelines in perspective





Clinical



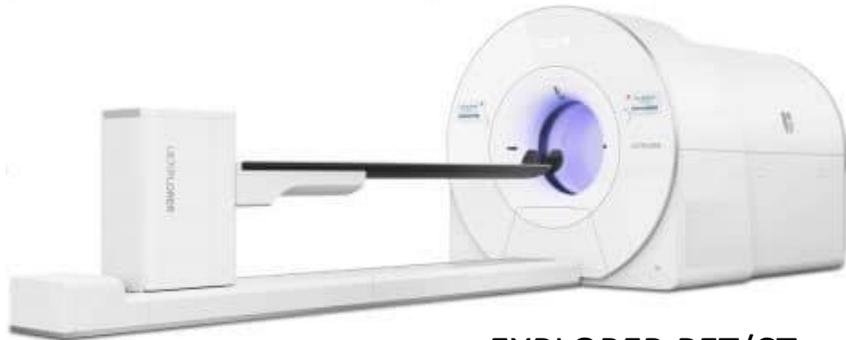
Siemens PET/CT



Siemens PET



Siemens PET/MR



EXPLORER PET/CT



Pre-clinical



Bruker Albira Si PET/SPECT/CT



MILabs VECTOr PET/SPECT/CT



nanoScan SPECT/CT/PET



SOFIE G8 PET/CT



SOFIE G4 PET/X-ray



SOFIE GNEXT PET/CT



Inviscan IRIS PET/CT



NanoScan PET/CT



PNP Xtrim-PET



Molecube beta-cube PET



Raycan Trans-PET/CT

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Preclinical imaging guidance and standards thus far...

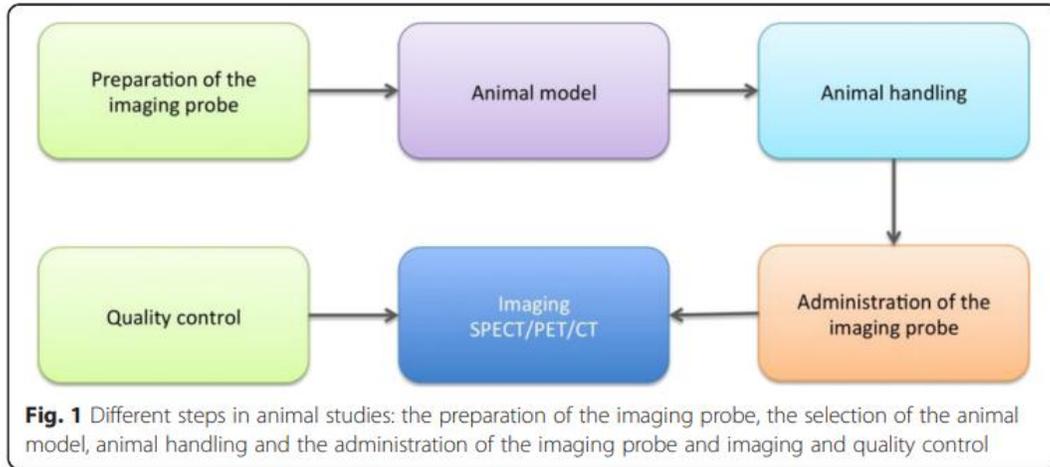


Table 2. MRI QC test overview

Daily	Weekly	Annually
Magnetic field strength and stability	Geometric accuracy	All described QC tests
Phantom signal to noise ratio (SNR)	Image intensity uniformity % Signal ghosting	

TABLE 6
Proposed Preclinical Standard Protocols for Daily Routine Use Irrespective of Scanner/Site

Parameter	Protocol
PET reconstruction	Iterative algorithms OSEM or MLEM total updates (iterations/subsets or iterations) to be in the range of 24 to 36. FBP is also recommended for use in conjunction with iterative methods.
CT image acquisition parameters for FBP reconstruction methods	Tube voltage at 50 kVp Number of projections at 360 Exposer of 300 ms.

- Different imaging systems and software with multiple options for generating data overlooked
=> **need to have good reporting methods.**
- How animals are housed, handled, and treated?
=> **need reproducible and well described methods.**

Scanner performance and standard (NEMA NU 4-2008)

“Guidance for Methods descriptors used in preclinical imaging papers”
Stout et al. 2013, Mol Imaging.

“Accurate molecular imaging of small animals taking into account animal models, handling, anaesthesia, quality control and imaging system performance”
Vanhove et al. 2015, EJNMMI Physics.

“Guidance for Efficient Small Animal Imaging Quality Control”
Osborne et al. 2017, Mol Imaging Biol.

“Standardization of Preclinical PET/CT Imaging to Improve Quantitative Accuracy, Precision, and Reproducibility: A Multicenter Study”
McDougald et al. 2020, J Nuc Med.

Preclinical imaging and different imaging societies



Standardization in Small Animal Imaging | STANDARD Study Group

<https://e-smi.eu/esmi-study-groups/standard/>



GUIDELINES

Preclinical and translational nuclear medicine

-  EANM recommendations based on systematic analysis of small animal radionuclide imaging in inflammatory musculoskeletal diseases (2021)
-  Guidelines to PET measurements of the target occupancy in the brain for drug development (2016)
-  Guideline for the preparation of an Investigational Medicinal Product Dossier (IMPD) (2014)
-  Guideline to Regulations for Radiopharmaceuticals in Early Phase Clinical Trials in the EU (2008)



Welcome to Best Practices in Preclinical Imaging

The goal of the SNMMI Best Practices in Preclinical Imaging Initiative is to provide guidelines based on the community experience in designing and conducting preclinical imaging experiments. This collaborative effort aims to bring together the best solutions for various imaging modalities and to highlight alternatives and specifics for targeted applications. By providing a common set of information, along with some specific examples of working solutions, we hope to improve the standards of imaging in all preclinical laboratories.

This initiative provides voluntary guidelines and in no way seeks to impose any restrictions on research projects.

Animal handling: anesthesia, heating, contrast agents, injections

Infection control and biosafety

Animal housing and procedures areas

Database, archival and computer infrastructure

Data analysis and imaging software

Training of staff and investigators

Animal models and imaging probes

Development of standardized image format, NEMA or DICOM

Imaging center design recommendations

Featured Content

Getting Started in Preclinical Imaging Presentation

View our recent webinar presented by David Stout, PhD, of the UCLA Crump Institute for Molecular Imaging and moderated by Todd Peterson, Molecular Imaging Center of Excellence.

[View Presentation](#)

IEEE Nuclear Science Symposium and Medical Imaging Conference

[More Information](#)

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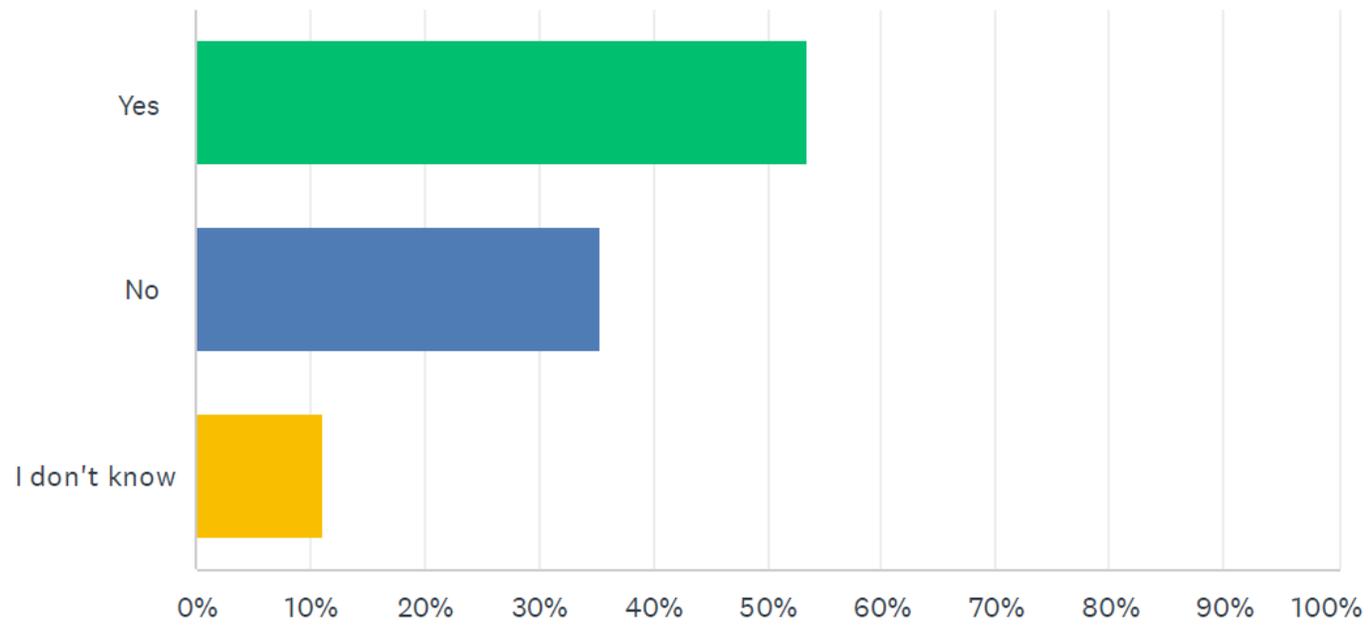
ESMI STANDARD survey aims

- To gather knowledge on the current state-of-the-art of preclinical imaging QC, QA and standardisation procedures routinely used at different sites.
- To evoke discussion on current status of preclinical imaging standardisation and what is needed to increase impact of preclinical imaging findings in the translational pipeline towards the clinic.
- **To initiate a consensus community-led paper on best practice when collecting, analysing and publishing preclinical imaging data.**

46.6% survey responders don't have or don't know if they have QC/QA guidelines at their institutes

Q1 Are there binding/recommended guidelines on QC/QA for preclinical scanner(s) in your institute?

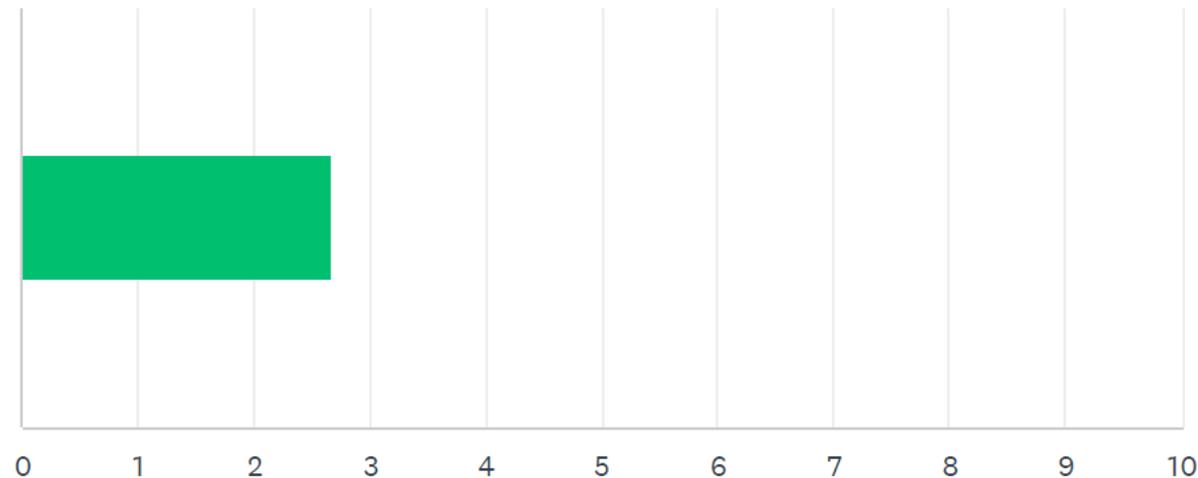
Answered: 144 Skipped: 7



... and most responders don't think it is important to report/state QC/QA programmes used at their institutes

Q9 How important do you consider that a (medical) journal requires authors to report/state on QC/QA programmes used at their imaging centre?

Answered: 93 Skipped: 58

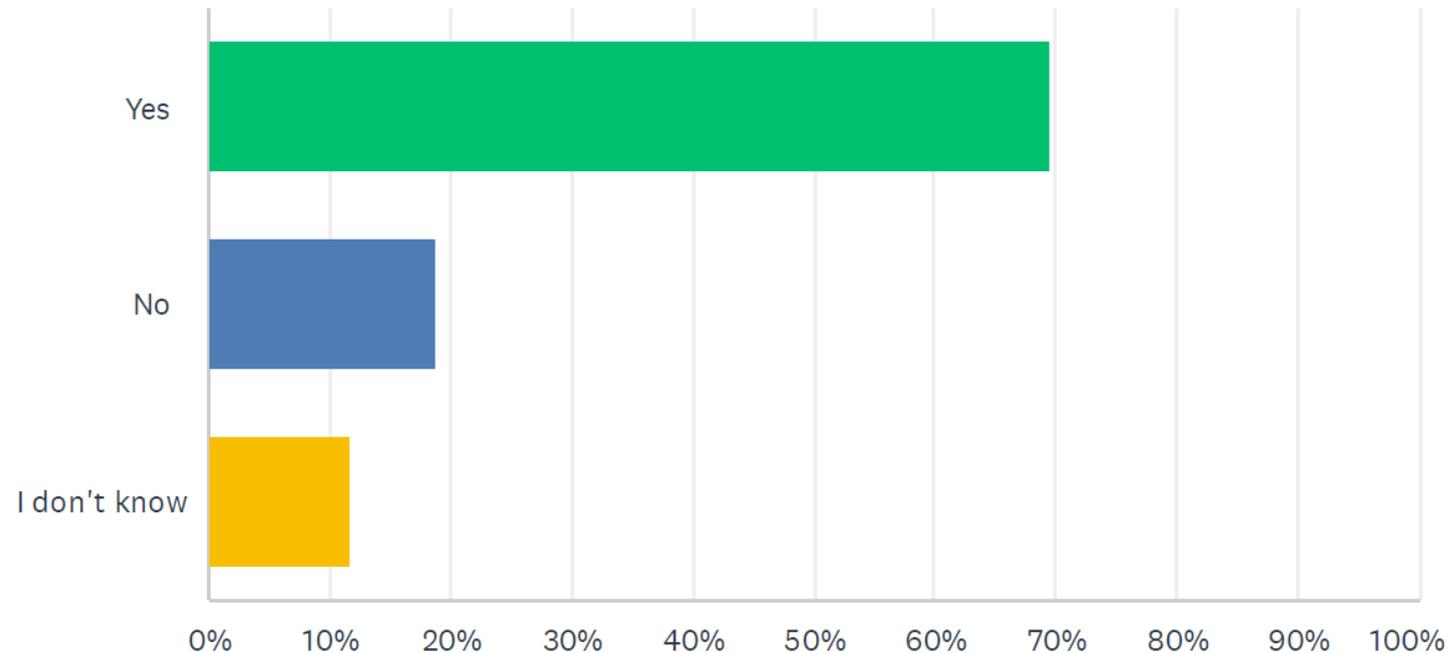


... nor accreditation for preclinical imaging scanners

But when survey responders do have QC/QA procedures in house, then they keep records!

Q2 Do you keep records of QC/QA performance of scanners, maintenance, and system failures?

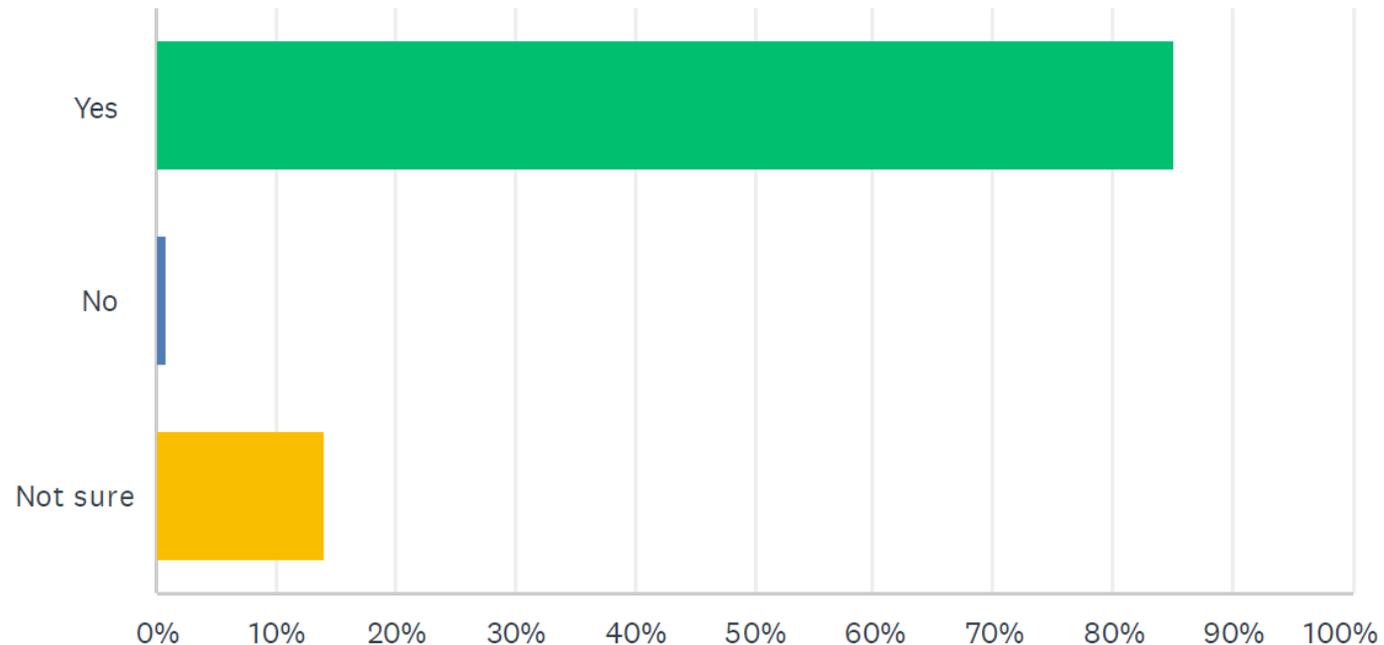
Answered: 144 Skipped: 7



... and there is strong support for community-lead consensus procedures!

Q11 Would you agree to publish details of your acquisition/processing protocols in accordance with a community-lead consensus procedure?

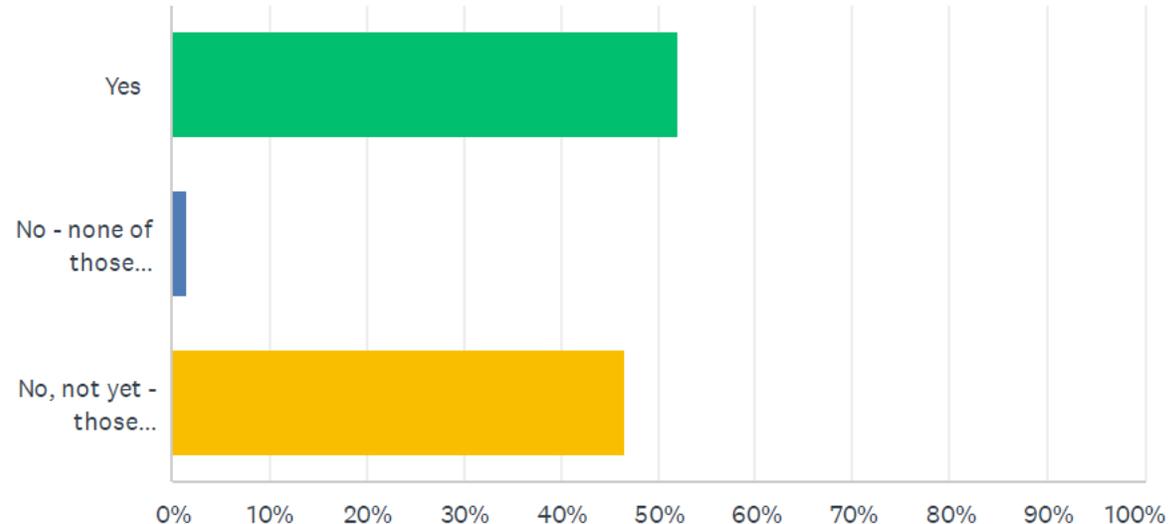
Answered: 127 Skipped: 24



Only about 50% responders know about ARRIVE guidelines

Q12 When publishing, do you follow certain reporting guidelines for in vivo imaging experiments in animals e.g. ARRIVE*? The ARRIVE guidelines (Animal Research: Reporting of In Vivo Experiments) are a checklist of recommendations to improve the reporting of research involving animals originally published in PLOS Biology, July 2020. <https://arriveguidelines.org/>

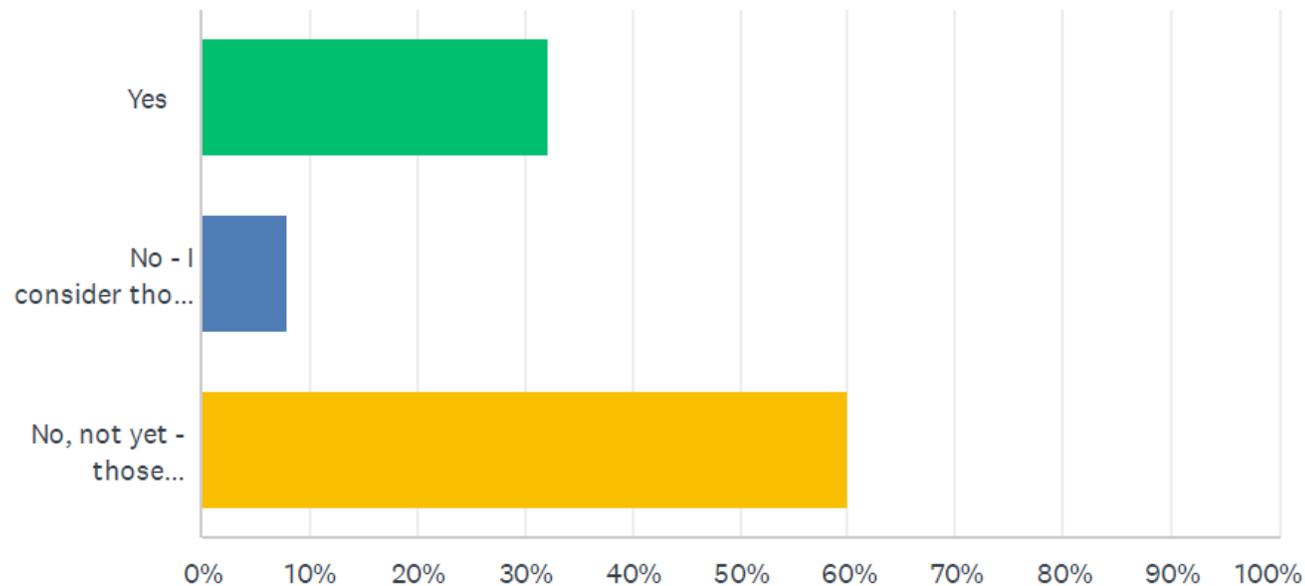
Answered: 127 Skipped: 24



Majority of responders are not familiar with FAIR principles

Q14 Do you share your imaging data publicly (in accordance to established guidelines*)?*e.g. The FAIR Guiding Principles for scientific data management and stewardship published in Scientific Data in 2016 www.nature.com/articles/sdata201618

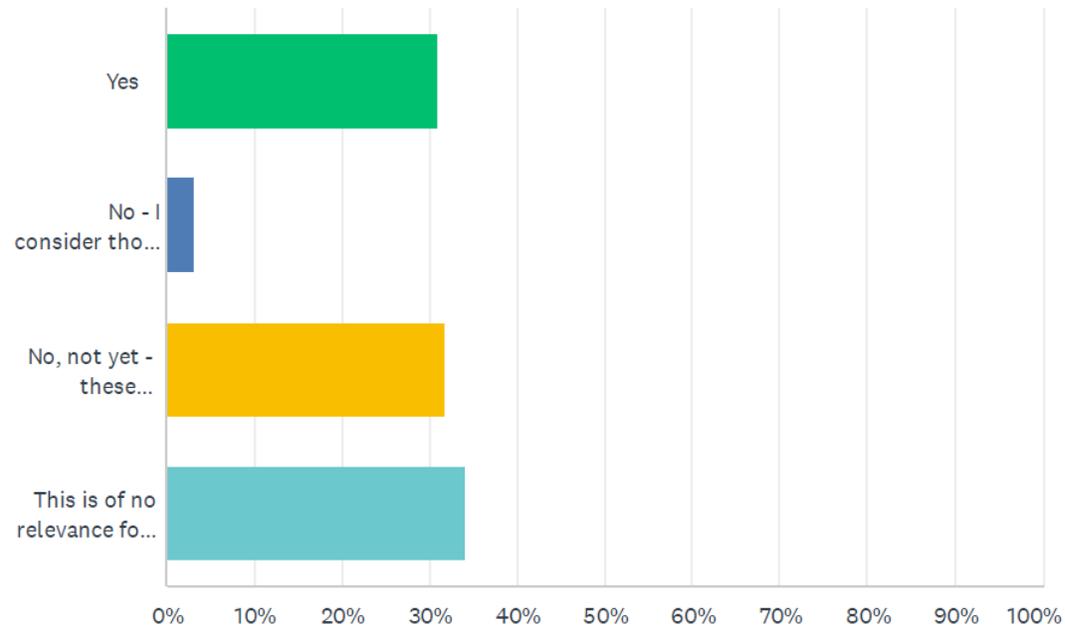
Answered: 127 Skipped: 24



Many responders are not familiar with AQARA principles

Q13 Do you or would you agree to follow the AQARA* Requirements for Radionuclide-Based Images?*The AQARA principle – proposing standard requirements for radionuclide-based images in medical journals. J Nucl Med. 2020;61(1):1-2 <https://jnm.snmjournals.org/AQARA>

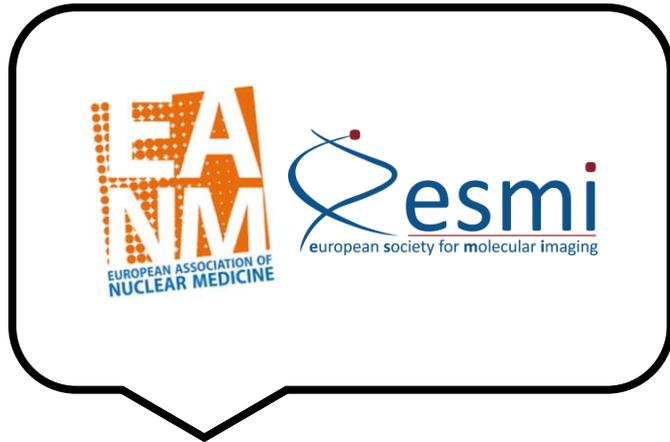
Answered: 126 Skipped: 25



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Pulling the community together



Guidelines for preclinical PET and SPECT imaging



Spread the word



Engage with vendors to implement standard protocols



Provide training / forums for discussion on ARRIVE, FAIR, and AQARA principles



Summary

- Many resources already available to support efforts towards standardization of preclinical imaging (mostly review papers).
- Community survey results show that standardization of preclinical imaging techniques remains a challenge.
 - Lack of communication ?
 - Institutional cost-benefit ?
 - External demand on preclinical imaging centres ?
- **Need to disseminate widely resources available and in the process of being generated.**

Thank you!

<https://totalbodypet2021.org/>

Total-body PET 2021-2022

22nd-24th Sep 2021 | 24th-26th Sep 2022

Online | Edinburgh, Scotland



Conference endorsed by:



Photo of Edinburgh Castle, Scotland, ExFlow, Getty Images

