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The road to the ISMRM OSIPI: A community-led initiative for reproducible perfusion MRI

Reproducibility is increasingly recognized as a key prerequisite for wider adoption of perfusion MRI in clinical practice, drug development, and basic science. To improve reproducibility and increase harmonization in MRI perfusion, the ISMRM Perfusion Study Group (SG) launched a community-led initiative to promote open science for perfusion imaging (OSIPI)^{1–3} (<https://osipi.ismrm.org>). As the results of the first roadmap are appearing in print, we describe here the road to OSIPI and the grass-roots experience that we anticipate will make OSIPI a sustainable initiative of the SG in the long term.

In the fall of 2018, a call-to-action survey was sent out through the ISMRM Perfusion SG (626 members) originally centered on open-source software development. This survey asked “How are you interested in helping out?” with five categories presented that revolved around open-source software development and data sharing, plus an opportunity to comment in free text. A total of 102 (16%) individual responses were returned, with some members willing to contribute in more than one way. Strong interest came from Europe (60% of survey participants) compared with the makeup of the study group (37% of members). Although the ISMRM full members are only 26% of the study group, 59% of the responses with “strong interest” were from full members. All responses were in support of this proposed initiative. Most indicated interest to develop (29%) and share code (24%), and to provide data for testing (25%). Twenty percent indicated willingness to help in nontechnical ways such as managing, consulting, or advertising. Many participants (47%) provided additional comments, from which the OSIPI founders noted a strong community desire for standardization, validation, and software tool support.

By early 2019, eight OSIPI founders were identified from the survey respondents. They organized events during and after the 2019 ISMRM in Montreal and defined the mission and governance of OSIPI. The plans were approved by the ISMRM Perfusion SG committee in November 2019, and OSIPI was launched in December 2019.

OSIPI’s mission was defined to create open-access resources for perfusion imaging research in order to (1) eliminate the practice of duplicate development, (2) improve reproducibility of perfusion imaging research, and (3) speed up the translation of fundamental scientific software to software used for drug development and clinical practice. Six specific aims were identified to execute the mission (Figure 1). Each aim is supported by one to three task forces (TFs), generally split by noncontrast (arterial spin labeling) and contrast agent-based (dynamic susceptibility contrast and dynamic contrast enhanced) perfusion MRI. The aims included the creation of inventories for complete pipelines, code snippets, and data and reference objects. Additionally, an aim existed to build a standardized lexicon for reporting and to compare existing pipelines through challenges. These aims were designed to be generalizable such that they can adapt for future work cycles.

A governance structure was defined for OSIPI mirroring that of the ISMRM study groups, with a management board consisting of four members who cycle yearly through their roles as secretary, co-chair, chair, and past chair, respectively. Each TF has a lead and co-lead, comparable with a senior and junior author of a manuscript. The OSIPI executive management board consists of the management board plus all TF leads and co-leads, and it meets every 3 months. In addition to the oversight from ISMRM Perfusion SG, there is a yearly strategy board meeting where stakeholders (e.g., representatives of the Quantitative Imaging Biomarker Alliance (QIBA) and the ISMRM Board of Trustees) meet to discuss OSIPI efforts, opportunities, challenges, and plans. The work within OSIPI is carried out in 2-year cycles, with milestones and deliverables predetermined for each TF in a roadmap. During the construction of the roadmap, TFs are designed to be open or closed depending on community interest.

For the first 2020–2022 OSIPI roadmap, aims 1–4 and 6 were open. The platform for exchange (aim 5) was purposely closed for our first cycle to focus on producing resources from the remaining aims. Here we share



OSIPI Open Science Initiative for Perfusion Imaging

AIM 1: SOFTWARE INVENTORY

Develop a comprehensive inventory of complete perfusion packages

- Task Force 1.1 – ASL Inventory
- Task Force 1.2 – DCE/DSC Inventory

AIM 2: TOOLBOX

Develop a library of open-source functions, scripts, and pipelines for analysis

- Task Force 2.1 – Library Structure and Management
- Task Force 2.2 – ASL Contributions
- Task Force 2.3 – DCE/DSC Contributions

AIM 3: DATA INVENTORY

Develop an inventory of data for evaluation of software and guidelines on how to share data

- Task Force 3.1 – Digital Reference Objects and Phantoms
- Task Force 3.2 – Clinical and Preclinical Data

AIM 4: REPORTING

Develop guidelines for reporting image acquisition and analysis

- Task Force 4.1 – ASL Lexicon
- Task Force 4.2 – DCE/DSC Lexicon
- Task Force 4.3 – DICOM standard amendment

AIM 5: PLATFORM FOR EXCHANGE

Develop a platform for discussion and exchange between developers and users

- Task Force 5.1 – Teaching and Education
- Task Force 5.2 – Dissemination and Events

AIM 6: BENCHMARKING

Development of benchmarks and application to existing software

- Task Force 6.1 – ASL Challenges
- Task Force 6.2 – DCE/DSC Challenges

FIGURE 1 The Open Science Initiative for Perfusion Imaging (OSIPI) is supported by six aims in order to support reproducibility across perfusion MRI methods. Each aim has 2–3 task forces (TFs) that are led by a lead and a co-lead who design and commit to serving for a 2-year roadmap. The TFs are designed to be open or closed during a 2-year roadmap, depending on community interest. ASL, arterial spin labeling; DCE, dynamic contrast enhanced; DSC, dynamic susceptibility contrast.

the results of seven task forces (TF1.1, 2.2, 2.3, 4.1, 4.2, 6.1, and 6.2) from the first 2020–2022 OSIPI roadmap, ranging from consensus recommendations to original manuscripts. These manuscripts are endorsed by the ISMRM Perfusion SG, Publications Committee, and Board of Trustees.

Looking ahead, OSIPI is finalizing its 2023–2025 roadmap, with all aims open. In the 5 years since initial discussions, OSIPI has grown to a community of over 75 contributing volunteers. Through these grass-roots beginnings, OSIPI is positioned to be sustainable through its clear governance and 2-year working cycles, and with that serve as a centralized platform for perfusion resources for any researcher and/or clinician.

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CONFLICT OF INTEREST

Laura Bell is an employee of Genentech, Inc., and shareholder of F. Hoffmann La Roche, Ltd.

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