

Code review facility in Magnetic Resonance in Medicine

Open sharing of computer code has become an increasingly important aspect of ensuring reproducibility of research, due to the complexity of modern methods and their reliance on sophisticated computer implementations.¹ To underline the importance of this topic and to help authors share code alongside data and other materials, *Magnetic Resonance in Medicine* (*Magn Reson Med*) formally introduced Data Availability Statements in 2020, and sought to highlight reproducible contributions via *MRM Highlights*. Authors were thus encouraged (but not required) to share code, and the reception has been very positive – from a baseline of approximately 1 in 10 papers in 2019 including shared code, the figure increased to 1 in 3 papers 2 years later.² While this is undoubtedly a continuing success, there is room for improvement beyond simply increasing this fraction further. Discussion initiated during the 2023 ISMRM Workshop on Data Sampling and Image Reconstruction, and that continued with the ISMRM Reproducible Research Study Group (RRSG), raised the issue that it is relatively common to find code with missing parts or incomplete documentation, limiting the potential utility of these shared resources. It should be noted that these are most often “good-faith” mistakes; many labs use the same software setup among all members, making cross-system compatibility testing challenging despite authors’ best efforts.

In April 2023, the RRSG approached the Editor-in-Chief of *Magn Reson Med* with the offer to provide and support a “Code Review” for authors who wished to have one. This Code Review explicitly does not consider any scientific aspects of the work, nor does it consider the efficiency or elegance of the code (untidy coders are still welcome!). Instead, the review focuses only on ease of download/installation, quality of documentation, and whether the code works to achieve its stated objective. In order to avoid introducing additional hurdles for those who wanted to share their code, which would have effectively disincentivized the practice, it was agreed that this would be voluntary and would be independent of the scientific review of the manuscript. By August 2023, discussions on the practicalities were completed and the journal began offering this facility to its authors. We hope that sharing the processes used and the experience of deploying it will be of help to *Magn Reson Med*

authors who are considering a Code Review, and could offer guidance to other journals who wish to emulate this scheme.

Authors who wish their code to be reviewed indicate this by checking an appropriate box during initial submission of their paper. They are also directed to a Web link that summarizes some “Frequently Asked Questions” about the benefits and practicalities of the process.³ The scientific reviewers are not made aware that a Code Review has been requested. They may, however, choose to download the code that is referenced in the Data Availability Statement themselves if they so wish.

To avoid unnecessary burden on Code Reviewers, no action is taken on the Code Review unless and until the paper proceeds to first revision (most papers that are invited to be revised will ultimately be published, and very few papers are accepted without some revision). At this point, the journal Editor notifies the RRSG Code Review Coordinator and passes them the paper. The Code Review Coordinator maintains a list of potential Code Reviewers, drawn primarily from the RRSG membership who volunteered for this role. Upon receiving a paper, the Coordinator solicits for a Code Reviewer from this list, usually passing on a limited description of the subject area and technical information, such as the programming language(s), to encourage an interested reviewer to come forward. Often a volunteer is identified the same day, and they are sent the paper containing the link to the public version of the code in its Data Availability Statement. The authors have the opportunity in their cover letter to veto the full paper being passed to the Code Reviewer, in which case only the Data Availability Statement is sent; this is, however, a rare occurrence. Regardless of whether the paper is sent, the Code Reviewer is informed that their role does not include any scientific review of the paper (or code), although they are welcome to contact the Editorial Office if they spot any scientific errors that they wish to share with the authors. The Code Reviewer is then asked to return a review within (ideally) 14 days, during which time the paper is also being revised by the authors and is rarely returned before the Code Review. A template is provided for the Code Reviewer to complete (described in Ref. 3) and is returned to the journal Editorial Office by the Code Reviewer. The outcome (Pass; Conditional Pass; or Fail) is then commu-

nicated to the authors. It is stressed to the authors that the outcome of the Code Review has no bearing on the scientific review of the paper. If the authors update their code during the review process, following feedback from either the scientific reviewers or the Code Reviewer, then the corresponding author is asked to immediately contact the Editorial Office so that the Code Reviewer and potentially scientific reviewer(s) can be informed.

In the case that the code passes the Code Review, or conditionally passes (and the authors act on the Code Reviewer recommendations), the authors are invited to add a short statement to the Acknowledgements section of their paper, thanking the ISMRM Reproducible Research Study Group for reviewing their code, and clarifying the nature of the Code Review. Code Reviewers are not acknowledged by name in the paper, but are considered of equal status to scientific reviewers, by mentioning them in the yearly journal acknowledgment listing, and by allowing the Code Review to be added to the Code Reviewer's Web of Science record of reviewing activities.

The Code Review facility has been offered by *Magn Reson Med* for just over a year and has elicited a healthy interest from authors. Disregarding editorial rejects (papers that are unsuitable for *Magn Reson Med* or of very poor quality), 68 papers have requested a Code Review. Figure 1 shows a full breakdown of papers submitted between 1 August 2023 and 31 July 2024 that have gone through the Code Review pipeline. Of the 40 papers that have undergone a Code Review to date, 35%

passed, 47.5% had a conditional pass, and 17.5% failed their Code Review. Authors who passed conditionally or failed the Code Review were asked to try to fix the errors identified. Authors that passed also sometimes got recommendations for improvements. A majority of authors have made changes to their code repositories following the Code Review (but the code has not been re-reviewed).

These outcomes highlight the importance and value of the process, yielding many more usable and impactful pieces of code than would otherwise have been the case. The Code Review process both helped authors in sharing good code, and readers in identifying papers where the shared code is usable. We also note that, where the Code Review did not pass straightforwardly, the most common reason was missing files, missing libraries, or missing data: we encourage authors to consider this when testing their code, and note that tools, such as containerization which could mitigate this, are not yet widely used for code accompanying papers submitted to *Magn Reson Med*.

In closing, the authors thank all those involved in trialing the Code Review facility, including the authors who agreed to subject their code to inspection by the ISMRM Reproducible Research Study Group, the RRSg leadership for helping shape the process, and the many anonymous RRSg Code Reviewer volunteers who allocated their time to conducting a thorough Code Review that has greatly contributed to the Journal's goal of Reproducible Research. We encourage other authors (and journals) to engage with this model.

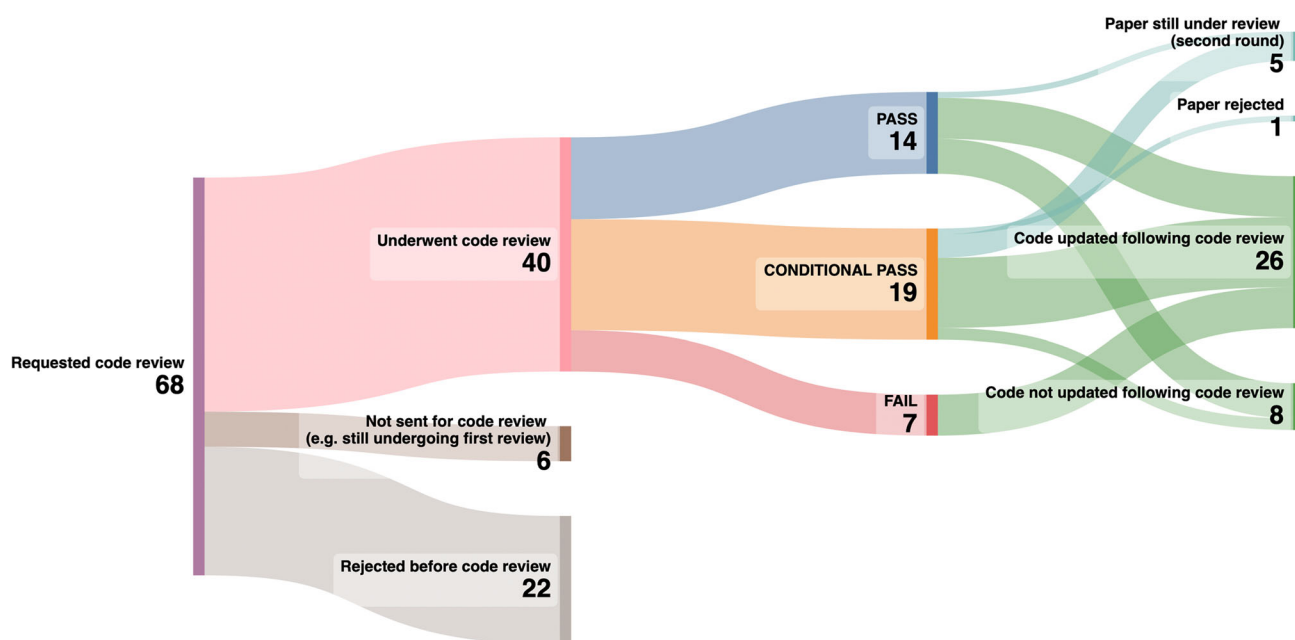




FIGURE 1 Papers that have gone through the Code Review process in the first year of the initiative. The majority of papers that were reviewed passed, or conditionally passed. Many authors made changes to their code to address the recommendations from the Code Review, especially the ones that failed or conditionally passed their Code Review.

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