Magnetic Resonance Research Center
University of Pittsburgh
MRRC 008: Physics Support
Standard Operating Procedure (SOP)

1. Purpose:

This SOP defines the role of MRRC Physicists and explains how research protocols are technically supported at the MRRC. This SOP was developed in the context of the 3T research program.

2. Definitions:

Development (as in "development work"): The MRRC defines development work as work that is not yet ready to be run on enrolled research participants in a study. Development work is typically conducted via phantom testing and limited human pilot testing. The goal of development is to create a product/program that can reliably/consistently measure the construct or biological process of interest.
Production (as in "production sequence"): The MRRC defines production quality products as having sufficient quality to use in studies of enrolled research participants. Production work (e.g., a sequence obtained through C2P/MTA agreement) is usually accompanied by white papers or peer-reviewed manuscripts.

3. Background:

In document, Physicist is a placeholder for individuals employed within the Department of Radiology as faculty physicists with research/service obligations to the MRRC. Every research protocol at the MRRC is supported by an MRRC Physicist. External physicists can work with an MRRC physicist to support a research protocol but cannot be the sole physicist supporting a protocol.

4. Operations and Procedures:

a. Selection of MRRC Physicist

PIs may begin the onboarding process with a preselected Physicist (i.e., has an existing relationship with an MRRC faculty member who will implement the new protocol). No additional selection of Physicist by MRRC leadership is needed in this circumstance.

For protocol onboarding initiated through the Director of Research Operations, MRRC leadership will select the Physicist who will support the new protocol. Physicists are selected by the Director of Research Operations in optional consultation with Technical Director, Director, Scientific Director, and/or members of the MRRC Advisory Council.

The selected physicist will sign the MRRC Intent Form on the line labelled "MRRC Faculty Physicist" to indicate they accept the responsibility of protocol implementation.

b. Scope of Physicist's involvement in research protocol

Overall, the Physicist will be responsible for the technical aspects of the imaging protocol.

In the planning phase of a study, Physicist will advise PI and study team on protocol-related topics including desired sequences and duration of sequences/sessions. At the time of completing the MRRC Intent Form, Physicist will advise whether "Works in Progress" (WIPs) sequences (i.e., those pulse sequences not provided directly by Siemens) are needed. See **"Works in Progress" (WIP) policy** below for more details about using third party sequences.

The implementation phase of onboarding begins after funding for a study is obtained by the study team. In the implementation phase of the study, Physicists are responsible for all technical details of the onboarding process. Physicist (along with PI, study team, and Director of Research Operations) will attend a protocol meeting either in person or via teleconferencing software to discuss the general goals of the project, ideal sequence parameters, equipment needs (e.g., which/how many scanners are needed, which coils are needed), details of the participant population including whether any special technical accommodations are needed, and possible times to schedule a

pilot test. During the protocol meeting and beyond, Physicist will advocate for technical details that maximize the quality of data produced at the MRRC while also maximizing satisfaction of constraints from the study team. If there is uncertainty about a specific sequence or parameter, Physicist will add the issue to the weekly MRRC physics meeting agenda so peers can assist.

After the protocol meeting, via email, Physicist will confirm protocol details. Physicist assigned to the protocol will start the process of creating a production protocol on the assigned scanner/scanners. The protocol will be named using a protocol name provided by the Director of Research Operations. Physicist will create a note at the top of the exam card declaring the correct coil to be used for the study and the name of the physicist responsible for the protocol. Physicist will utilize “ReproIn” naming conventions for sequence names to maximize compatibility with Flywheel, other analysis platforms, and open science standards. When configuring the protocol, the Physicist will attempt to make it as user friendly as possible to minimize technologist error. If protocol involves collection of raw data for reconstruction after the conclusion of a scan, technologist training should be provided according to MRRC established TWIX data storage and transfer practices (i.e., provide list of desired TWIX data for technologist to transfer to “TWIX Raid” for study team to access later via OneDrive sync or SFTP as arranged by MRRC IT manager). Portable storage devices should not be used for data transfer. Special care should be taken to minimize the well-known phase encoding error problems that can be encountered in the Siemens user interface. Special care should be taken to ensure protocol is set up for optimal shimming practices. When a draft protocol is complete, Physicist will conduct standard internal testing of the protocol using a phantom to validate sequence parameters, assess data quality/SNR, and notify study team of success or recommend modifications. Physicist should attempt to minimize the impact of testing on the scanner schedule.

MRRC allocates one no-cost pilot test scanning session to every prospective protocol. Physicist should encourage study team to conduct a human pilot test or document waiver of this step. Prior to the pilot test, Physicist will advise Lead Technologist on protocol and supervise MR technologist operating the scanning computer during pilot testing. Physicist will monitor data quality throughout the testing session.

After the testing session, the study team is required to review the data in detail to ensure the images meet expectations. MRRC recommends analyzing the data through all stages of pre- and post-processing. If the data is not satisfactory, Physicist will iterate the loop of communication > protocol modification > testing/validation > communication … until the study team accepts the protocol via email. The MRRC should be CC’d on all communications relevant to protocol approval. Once study team has accepted the protocol, Physicist will email Director of Research Operations the final production protocol PDF and Siemens exam file to be deposited in MRRC's internal repository.

After the study is running, Physicist will respond to any technical inquiries from the study team about the protocol and associated data. If a protocol modification is requested by the PI or funder, the physicist should schedule time to make the change, make the change, and email the new protocol pdf to the PI and Director of Research Operations with a summary of the request and changes.

If the Physicist if supported by the study (i.e, salary support is provided by the study team for the Physicist), the Physicist may accrue additional responsibilities such as data management and MR spectroscopic reconstructions. Additional responsibilities should be clearly established at the time of study planning and onboarding.

5. “Works in Progress” (WIP) Policy

WIP sequences are those pulse sequences not provided by the scanner vendor, Siemens, and include sequences provided by entities outside the MRRC (e.g., ABCD sequence provided by Athinoula A. Martinos Center). WIP sequences must be approved by the Scientific or Technical Director of the MRRC prior to being used. If the Scientific or Technical Director of the MRRC determines a C2P agreement is needed, Physicist will advise the study team on the C2P process and ensure a C2P is secured. Physicists should encourage study teams to start this process early to ensure swift onboarding. C2P agreements can be initiated with Siemens by contracting Dr. Yulin Chang or equivalent. The PI will sign the C2P in the “INVESTIGATOR” field. A representative of the Radiology department will sign in the “RECIPIENT INSTITUTION” field. Siemens R&D representatives will sign in the “SIEMENS” field. The PI and Physicist are responsible for keeping a copy of the C2P agreement and should ensure the terms are followed. Physicist must install the WIP

sequence. Technical Director should review all installed WIP sequences. WIP sequences created by MRRC and Pitt faculty must also be approved by the Technical or Scientific Director of the MRRC prior to being used on the scanner.

C2P agreements are independent from Material Transfer Agreement (MTA) guidelines which are intellectual property agreements that need to be processed through the Office of Sponsored projects using the myRA portal. MTAs are the responsibility of the PI. Radiology and the MRRC does not track acquisition of MTAs.

6. Role of External Physicists

The goal of the following external physicist policy is to preserve the function of all MRRC hardware and remain compliant with UPMC and Department of Radiology policy.

The most common way an external physicist supports a study is providing a WIP sequence or providing a reference exam card/PDF.

External physicists can assist in the technical support of a protocol in a more “hands on” manner. An external physicist cannot be the sole technical support for a protocol and cannot sign the MRRC Intent Form in the role of “MRRC Faculty Physicist”.

External physicists must schedule and pay for all uses of a scanner when an MRRC physicist is not actively assisting in the development of a protocol. External physicists must be supervised by a member of the MRRC (either technologist or faculty) while using MRRC hardware. External physicists may not turn hardware on or off without the permission and supervision by a member of the MRRC. External physics must not compromise MRRC hardware. External physicist must not cause delays to the MRRC schedule. The external physicist may not enter Zone II+ areas without proper safety screening and supervision from a member of the MRRC. The MRRC may create an access agreement specific to the external physicist that must be followed at all times. External physicists must ensure the state of all hardware stays fully operational. If testing and validation of a sequence results in crashes, freezes, or any other scanner issue, the external physicist must notify the MRRC and share all relevant details to help prevent future issues. External physicists must comply with **“Works in Progress” (WIP) policy** above and all general physics support policies described in **Scope of Physicist’s involvement in research protocol**.

External physicists must comply with all standards imposed upon MRRC Physicists, including maximizing user friendliness of the protocol. If a protocol modification is requested by the PI or funder, external physicist should inform the Director of Research Operations about this request. External physicists must schedule a time to make the change, make the change, and email the new production protocol PDF to the PI, MRRC Physicist, and Director of Research Operations with a summary of the request and changes. Changes to production protocols (e.g., addition of sequences) cannot be made on-the-fly.

Use of the MRRC by external physicists is a courtesy. Failure to comply with MRRC policy will, at the discretion of the Scientific Director, Radiology Department Chair, MRRC Advisory Council, and/or Director of Research Operations, result in MRRC physicists assuming all functionality of noncompliant external physicists and forfeiture of access to the MRRC.

7. Change Log

7/17/2025 – added new Siemens contact Dr. Yulin Chang after departure of previous Siemens C2P contact
5/12/2025 – added details about TWIX raw data transfer
8/23/2023 – initial version