

# Democratizing Neuroimaging: A Global MRI Training Program to Strengthen Neuroimaging Capacity in Resource-Constrained Settings

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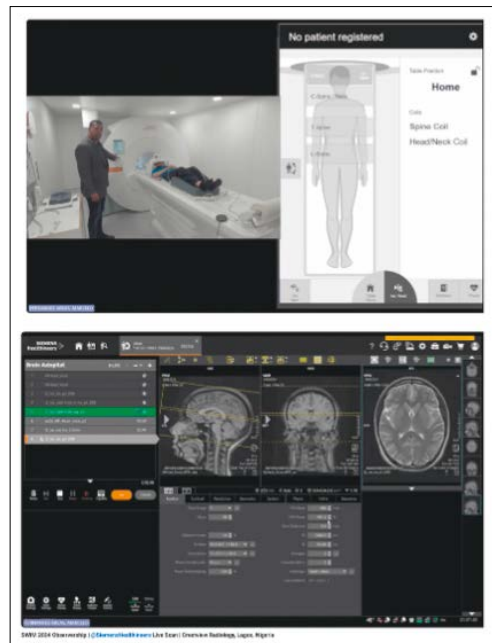
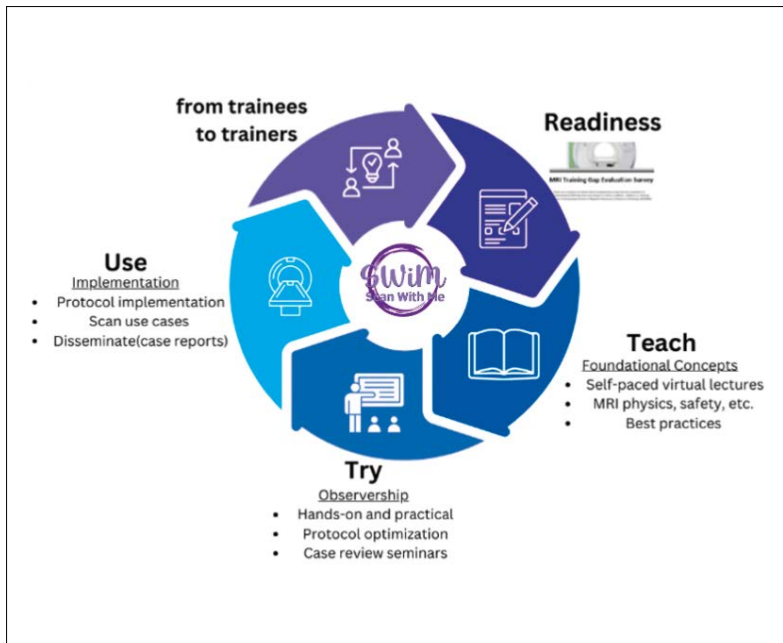
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Neurological disorders are a public health challenge in low- and middle-income countries (LMICs), particularly in sub-Saharan Africa (SSA). These regions face significant barriers, including limited healthcare resources, shortage of trained medical professionals, and persistent cultural challenges that impact access to care [1]. These challenges are exacerbated by other regional health concerns — such as malnutrition, adverse perinatal conditions, HIV/AIDS, and infectious disease (encephalitis, meningitis, tuberculosis, malaria) — which impact brain health and further compromise the effectiveness of prevention, diagnosis, and treatment strategies for neurological disorders [2].

Take dementia, for example: According to the World Health Organization, more than 68% of individuals living with dementia will reside in LMICs by 2050, with a substantial proportion in African countries [3]. Neuroimaging plays a critical role in improving diagnosis and informing

management to reduce the rising health and economic impacts. Magnetic resonance imaging (MRI) is a key tool in managing dementia and other neurological diseases, but its use in LMICs remains limited due to infrastructure constraints, workforce shortages, unreliable power supply, and restricted financing options [4]. Nevertheless, as we will see later with the resource-efficient MAGNETOM Free.Max in Rwanda, new MRI installations are growing across African countries and other LMICs. However, democratizing advanced MRI protocols tailored to these unique health environments remains a challenge.

To help bridge this gap, we partnered with Siemens Healthineers to introduce the Scan With Me (SWiM) training program (Fig. 1) through the Consortium for Advancement of MRI Education and Research in Africa (CAMERA) [5].



**1** The Scan With Me (SWiM) curriculum and its structured training approach upskill practicing MRI technologists. It does this through best practices in MRI acquisition and protocol optimization, as well as hands-on demonstrations of advanced imaging techniques in simulated and live scanning environments. This includes a live scan session from Erlangen, Germany, with MRI technologists and application specialists from Siemens Healthineers.

### Scan With Me (SWiM): Optimizing MRI infrastructure by training trainers

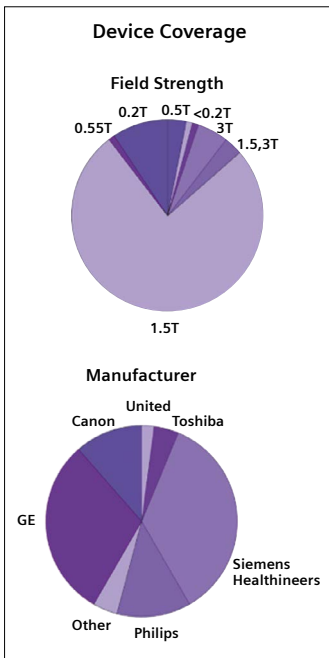
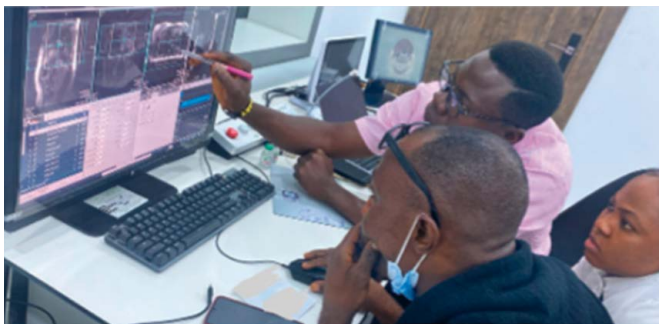
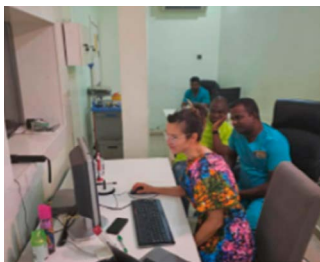
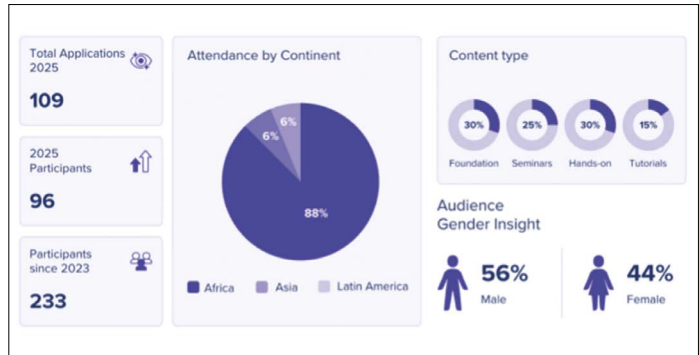
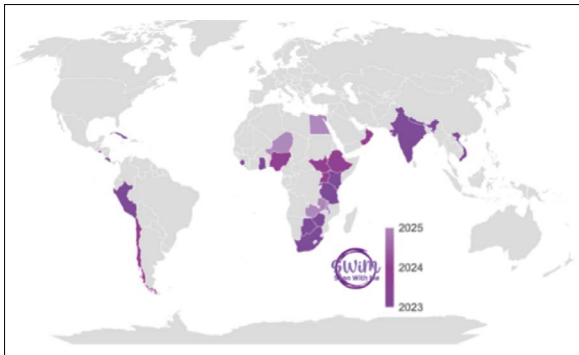
The SWiM program is a global initiative designed to strengthen MRI capacity in LMICs through a structured, train-the-trainer model that upskills practicing MRI technologists (Fig. 1) [6]. The annual program delivers an eight-week curriculum that integrates foundational MRI principles, hands-on observerships, expert-led seminars from members of ISMRM and ISMRT, and collaborative team-based capstone projects that are delivered using a case-based and peer-to-peer learning approach based on RAD-AID’s Teach-Try-Use framework [7].

Since 2023, SWiM has trained 233 MRI technologists from 25 LMICs across Africa, Latin America, and Southeast Asia (Fig. 2). A total of 30% of the alumni have now joined the program as faculty or are leading local MRI capacity-building and mentorship initiatives, such as ISMRT chapters and divisions.

The 2023 program focused on cardiac imaging, while the following two years emphasized brain imaging, which is the most common MRI indication in LMICs. Over the

three-year period, participants received 220 hours of specialized instruction, complemented by 80 hours of weekly peer-to-peer engagement that enabled the technologists to collaboratively implement and share optimized scan protocols for common cardiac and brain indications on their local scanners (Fig. 2).

The structure and outcomes of the 2023 cardiac imaging program have been reported previously [6]. For the 2024/2025 brain imaging programs, 28 of the live online sessions covered advanced techniques such as functional MRI (fMRI), diffusion tensor imaging (DTI), arterial spin labeling (ASL), and magnetic resonance spectroscopy (MRS). Training was delivered through seminars, simulations using the SmartSimulator from Siemens Healthineers, and hybrid live scans in Kenya, Nigeria, and Rwanda (Figs. 1, 2). Despite 80% of participants having fewer than five years of MRI experience, 82.85% reported improved knowledge of brain MRI scanning, including safety, positioning and landmarking, artifact recognition and mitigation, and standard-of-care best practices.



### Tailored Protocols

Product Solutions Resources Open Source Enterprise Pricing

CAMERA-MRI / SWiM Public

Protocols	Update README.md	9 months ago
Training Materials	Update Day 4 content.md	2 months ago
README.md	Update README.md	last year
SWiM_banner.png	Add files via upload	last year

#### SWiM Cardiac MRI (CMR) Protocols

The CMR protocols from the 2023 SWiM Program are listed by scanner type, sites complete the implementation of their optimized parameters and share it below:

Scanner	Comments
1 Siemens	-
2 GE	-
3 Philips	In progress

#### Before SWiM

Original CMR imaging protocol

- 3 plane localizers
- Dark blood axial brain
- One imaging (DFO, 30s, 40s, short axis stack)
- LVOT
- RVOT
- Aortic valve phase-contrast flow
- Pulmonary valve phase-contrast flow
- 12 MRI (short axis stack)
- Cardiacium injection
- Early gadolinium enhancement
- Late gadolinium enhancement

Scan time: 3.5 hours

#### After SWiM

**Coronary heart disease**

- 3 plane localizers
- Axial and sagittal stack
- One imaging (MCA, 20s, 30s, short axis stack)
- LVOT
- RVOT
- Aortic valve phase-contrast flow
- Pulmonary valve phase-contrast flow

Scan time: 45 minutes

**Cardiomyopathies**

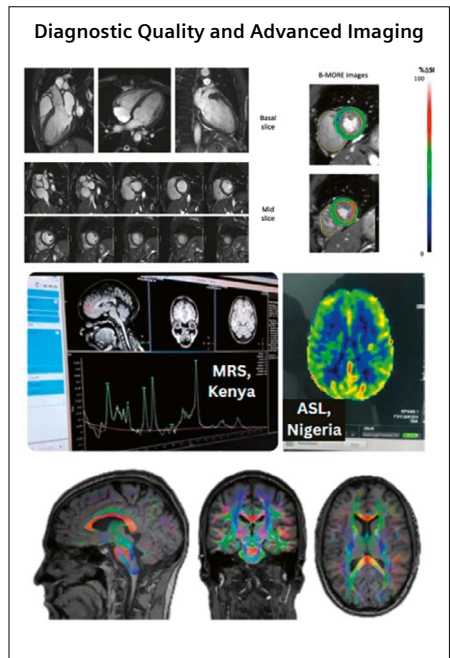
- 3 plane localizers
- Dark blood axial brain
- One imaging (MCA, 20s, 30s, short axis stack)
- 12 MRI (short axis stack)
- GE-CMR
- Gadolinium injection
- Late gadolinium enhancement

Scan time: 40 minutes

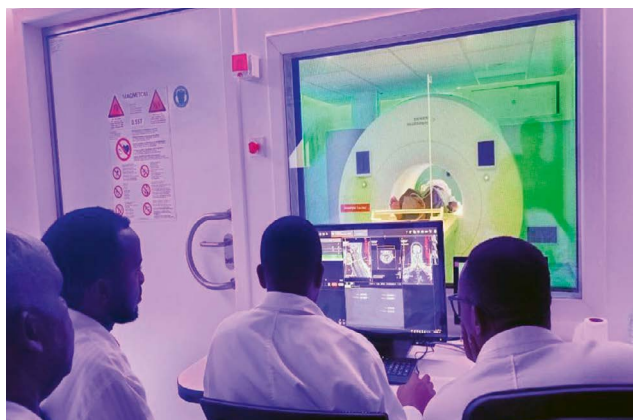
**Vascular disease**

- 3 plane localizers
- One imaging (MCA, 20s, 30s, short axis stack, stack transverse line of jet for stenosis)
- LVOT
- RVOT
- Velocity encoded imaging perpendicular and parallel to vessel in question

Scan time: 30 minutes



2 The impact of the SWiM program from its inception in 2023 to the most recent program in 2025.



**3** A 0.55T MAGNETOM Free.Max with DryCool technology. The system is installed in a mobile unit at the University Teaching Hospital of Kigali, Rwanda.

## Breaking barriers across Africa: Rwanda installs its first 0.55T MAGNETOM Free.Max

Limited access to MRI in LMICs is also due to challenges in deploying the scanners themselves. The installation of a 0.55T MAGNETOM Free.Max at CHUK, the University Teaching Hospital of Kigali (Fig. 3), a 519-bed teaching hospital in Rwanda, shows how innovative MRI technology can overcome traditional barriers and expand access to high-quality diagnostic imaging in emerging healthcare environments.

### Simplifying installation

Conventional MRI systems often require extensive site preparation, including reinforced flooring, complex radiofrequency (RF) shielding, quench pipe installation, and substantial power and cooling infrastructure. These requirements can pose considerable challenges to healthcare facilities in resource-constrained regions.

The MAGNETOM Free.Max introduces a new paradigm in MRI deployment: Its lightweight design, reduced helium dependency thanks to DryCool technology, and simplified installation requirements make it ideal for clinical environments that would be unsuitable for conventional MRI systems. In Rwanda, these advantages facilitated the smooth installation of a mobile unit (Fig. 3) and minimized infrastructure modifications and costs. This flexibility represents a major step forward in making MRI more accessible across Africa and other resource-constrained settings.

## Expanding clinical capabilities

The MAGNETOM Free.Max significantly improves the diagnostic capabilities available to clinicians in Rwanda. The system supports a wide range of clinical applications, including:

- Neurological imaging for stroke, tumors, and neuro-degenerative diseases
- Spine imaging for degenerative and traumatic conditions
- Musculoskeletal imaging for orthopedic and sports injuries
- Abdominal and pelvic imaging for comprehensive diagnostic evaluation

The system's design also improves patient comfort, helping reduce motion artifacts and improving overall image quality. By enabling advanced imaging locally, MAGNETOM Free.Max reduces the need for patients to be referred abroad and shortens diagnostic timelines.

## Supporting sustainable MRI in Africa

One of the key challenges in expanding MRI across Africa is ensuring sustainability. The MAGNETOM Free.Max addresses this through reduced energy consumption, simplified maintenance, and lower infrastructure demands. These features make MRI operations more sustainable and support long-term healthcare development. The scanner also provides valuable opportunities for local capacity building (Fig. 4). Technologists, radiologists, and MRI specialists gain hands-on experience with advanced MRI technology, strengthening local expertise and supporting the continued growth of medical imaging services.



**4** Structured training in MRI acquisition and protocol optimization, as well as hands-on demonstrations of advanced imaging techniques.

## A milestone for Rwanda and the African continent

The installation of Rwanda's first MAGNETOM Free.Max represents more than the introduction of a new imaging system. It reflects a broader transformation in how MRI can be deployed in resource-optimized environments. It shows that advanced MRI is no longer limited to highly specialized centers, and can now be successfully implemented in diverse healthcare settings across Africa. It is a model for future installations and highlights the importance of innovation in addressing global healthcare disparities.

## Conclusion

Breaking traditional barriers to MRI access requires technological innovation, collaboration, and a commitment to expanding diagnostic capabilities worldwide. The success of the scalable, long-term capacity-building initiatives like SWiM and the installation of the 0.55T MAGNETOM Free.Max in Rwanda are major steps toward this goal. They show how innovative MRI solutions can empower healthcare professionals, democratize access, enhance diagnostic precision and clinical decision-making, and ultimately improve patient outcomes across resource-constrained settings.

## Acknowledgment

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