March 26, 2024

SyntheticMR AB (Publ)
Madeleine Enström
Quality Assurance & Regulatory Affairs Manager
Storgatan 11
Linköping, Östergötland SE-582 23
Sweden

Re: K233733
Trade/Device Name: SyMRI
Regulation Number: 21 CFR 892.1000
Regulation Name: Magnetic Resonance Diagnostic Device
Regulatory Class: Class II
Product Code: LNH
Dated: November 21, 2023
Received: February 27, 2024

Dear Madeleine Enström:

We have reviewed your section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (the Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. Although this letter refers to your product as a device, please be aware that some cleared products may instead be combination products. The 510(k) Premarket Notification Database available at https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpmn/pmn.cfm identifies combination product submissions. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration. Please note: CDRH does not evaluate information related to contract liability warranties. We remind you, however, that device labeling must be truthful and not misleading.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Additional information about changes that may require a new premarket notification are provided in the FDA guidance documents entitled "Deciding When to Submit a 510(k) for a Change to an Existing Device" (https://www.fda.gov/media/99812/download) and "Deciding When to Submit a 510(k) for a Software Change to an Existing Device" (https://www.fda.gov/media/99785/download).

Your device is also subject to, among other requirements, the Quality System (QS) regulation (21 CFR Part 820), which includes, but is not limited to, 21 CFR 820.30, Design controls; 21 CFR 820.90, Nonconforming product; and 21 CFR 820.100, Corrective and preventive action. Please note that regardless of whether a change requires premarket review, the QS regulation requires device manufacturers to review and approve changes to device design and production (21 CFR 820.30 and 21 CFR 820.70) and document changes and approvals in the device master record (21 CFR 820.181).

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801); medical device reporting (reporting of medical device-related adverse events) (21 CFR Part 803) for devices or postmarketing safety reporting (21 CFR Part 4, Subpart B) for combination products (see https://www.fda.gov/combination-products/guidance-regulatory-information/postmarketing-safety-reporting-combination-products); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR Part 820) for devices or current good manufacturing practices (21 CFR Part 4, Subpart A) for combination products; and, if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR Parts 1000-1050.

Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21 CFR 807.97). For questions regarding the reporting of adverse events under the MDR regulation (21 CFR Part 803), please go to https://www.fda.gov/medical-devices/medical-device-safety/medical-device-reporting-mdr-how-report-medical-device-problems.

For comprehensive regulatory information about medical devices and radiation-emitting products, including information about labeling regulations, please see Device Advice (https://www.fda.gov/medical-devices/device-advice-comprehensive-regulatory-assistance) and CDRH Learn (https://www.fda.gov/training-and-continuing-education/cdrh-learn). Additionally, you may contact the Division of Industry and Consumer Education (DICE) to ask a question about a specific regulatory topic. See the DICE website (https://www.fda.gov/medical-devices/device-advice-comprehensive-regulatory-assistance/contact-us-division-industry-and-consumer-education-dice) for more information or contact DICE by email (DICE@fda.hhs.gov) or phone (1-800-638-2041 or 301-796-7100).

Sincerely,

Daniel M. Krainak, Ph.D.
Assistant Director
DHT8C: Division of Radiological Imaging
and Radiation Therapy Devices
OHT8: Office of Radiological Health
Office of Product Evaluation and Quality
Center for Devices and Radiological Health

Enclosure

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Food and Drug Administration

Indications for Use

Form Approved: OMB No. 0910-0120
Expiration Date: 07/31/2026
See PRA Statement below.

510(k) Number *(if known)*
K233733

Device Name
SyMRI

Indications for Use *(Describe)*

SyMRI is a post-processing software medical device intended for use in visualization of soft tissue. SyMRI analyzes input data from MR imaging systems. SyMRI utilizes data from supported MR sequences to generate parametric maps of R1, R2 relaxation rates, and proton density (PD)

SyMRI is intended for automatic labeling, visualization and volumetric quantification of segmentable brain tissues from a set of MR images. Brain tissue volumes are determined based on modeling of parametric maps from SyMRI.

When interpreted by a trained physician, the parametric maps, tissue maps, and volumetrics from SyMRI can provide information useful in determining diagnosis. SyMRI is indicated for head imaging.

SyMRI can also generate multiple contrast weighted images from the parametric maps generated by post-processing data from M2D-MDME sequence. SyMRI enables post-acquisition image contrasts adjustments from acquisition using M2D-MDME sequence.

When M2D-MDME acquisition data is used as input to SyMRI the synthetic contrast weighted images can also provide information useful in determining diagnosis. SyMRI is intended to be used in combination with at least one other, conventional MR acquisition (e.g. T2-FLAIR).

Type of Use *(Select one or both, as applicable)*

☒ Prescription Use (Part 21 CFR 801 Subpart D) ☐ Over-The-Counter Use (21 CFR 801 Subpart C)

CONTINUE ON A SEPARATE PAGE IF NEEDED.

510(K) SUMMARY

SyntheticMR's SyMRI

Submitter

SyntheticMR AB, (Publ.),
Storgatan 11, 582 23 Linköping, Sweden

Phone: +46 (0)730 69 04 90

Facsimile:

Contact Person: Madeleine Enström

Date Prepared: 2024-03-11

Name of Device: SyMRI

Common or Usual Name: SyMRI

Classification Name: Magnetic resonance diagnostic device

Regulatory Class: Class II

Regulation Number: 21 CFR 892.1000

Product Code: LNH

Predicate Device

SyntheticMR's predicate device SyMRI (K203372)

Device Description

SyntheticMR's SyMRI is a Class II Magnetic resonance diagnostic device (Regulation # 892.1000) with product code LNH. The device has no components and/or accessories.

SyMRI works by post-processing a multi-delay, multi-echo acquisition into parametric maps. The acquisition is either a multi-slice 2D approach (M2D-MDME), consisting of 4 delays with a short and a long echo time each (8 images per slice), or a 3D approach (3D-QALAS) consisting of 4 delays with a short echo and 1 delay with a long echo time (5 images per slice).

Quantification and Segmentation

Supported acquisition sequence: M2D-MDME and 3D-QALAS
The parametric maps are R1, R2 relaxation rates, and proton density (PD). The inverse relaxation parameters, T1 relaxation time (1/R1), and T2 relaxation time (1/R2) are also provided as parametric maps.

SyMRI enables the users to obtain volumetric information in the head, including white matter (WM), grey matter (GM), cerebrospinal fluid (CSF), Myelin correlated (MyC) partial volume, brain parenchyma (BP) and intracranial cavity (IC). This is accomplished by using tissue definitions based on the parametric maps. The tissue definitions provide tissue partial volume, or tissue fraction, per voxel. SyMRI also provides image processing tools to extract the values of the parametric maps, and tissue partial volume, per individual voxel, per region of interest, or the entire imaging volume.

Contrast Weighted Images

Supported acquisition sequence: M2D-MDME
The parametric maps can also be visualized as contrast weighted MR images, such as T1, T2, PD, and Inversion Recovery (IR) weighted images (including T1-FLAIR, T2-FLAIR, STIR, Double IR, and PSIR weighted images). SyMRI calculates the pixel signal intensity as a function of R1, R2, PD, and desired MR scanner settings, such as echo time (TE), repetition time (TR), and inversion delay time (TI). A number of default settings for TE, TR, and TI are provided, but the user has the ability to change the contrast of the images.

SyMRI generates all the different image contrasts from the same parametric maps, derived from the same acquisition. This leads to enhanced image slice registration, owing to the absence of inter-acquisition patient movement. SyMRI provides the user the ability to change the contrast of the images after the acquisition. This is performed by adjusting the TE, TR, and/or TI parameters post-acquisition, to generate the specific contrast desired.

SyMRI is intended to be used to process data produced by any of the following acquisition sequences:

- M2D-MDME sequence data from GE MAGiC
- M2D-MDME sequence data from Philips SyntAc
- M2D-MDME sequence data from Siemens TSE_MDME
- 3D-QALAS sequence data from Philips 3DSyntAc - Only 3T

SyMRI can also create contrast weighted images from 3D-QALAS but these are only available in the product for quality assurance purposes as a risk mitigation regarding acquisition related artifacts that could affect quantification and segmentation, and should not be used for clinical purposes.

Intended Use / Indications for Use

SyMRI is a post-processing software medical device intended for use in visualization of soft tissue. SyMRI analyzes input data from MR imaging systems. SyMRI utilizes data from supported MR sequences to generate parametric maps of R1, R2 relaxation rates, and proton density (PD)

SyMRI is intended for automatic labeling, visualization and volumetric quantification of segmentable brain tissues from a set of MR images. Brain tissue volumes are determined based on modeling of parametric maps from SyMRI.

When interpreted by a trained physician, the parametric maps, tissue maps, and volumetrics from SyMRI can provide information useful in determining diagnosis. SyMRI is indicated for head imaging.

SyMRI can also generate multiple contrast weighted images from the parametric maps generated by post-processing data from M2D-MDME sequence. SyMRI enables post-acquisition image contrasts adjustments from acquisition using M2D-MDME sequence.

When M2D-MDME acquisition data is used as input to SyMRI the synthetic contrast weighted images can also provide information useful in determining diagnosis. SyMRI is intended to be used in combination with at least one other, conventional MR acquisition (e.g. T2-FLAIR).

The subject device has the same intended use and similar indication for use as the predicate device with the following minor differences: (1) the subject device can use data from multiple supported sequences, (2) clarification on the device outputs. These changes are clarifying in nature and therefore do not affect the safety or effectiveness of the device.

Summary of Technological Characteristics

The subject device has the same fundamental design characteristics and is based on the same technologies as found in the currently marketed predicate device SyMRI (K203372). The technological differences between SyMRI and its predicates are: (1) Ability to analyze data from the 3D-QALAS sequence 3DSyntAc from Philips 3T; (2) Ability to visualize segmentation maps in three planes (Ax, Cor, Sag). These differences do not present any additional questions of safety or effectiveness than for the predicate device because the segmentation and volumetric verification and performance data show that all of the same acceptance criteria's are met for both the 3D-QALAS sequence and M2D-MDME sequences. Thus, SyMRI is substantially equivalent to SyMRI.

	SyMRI	**PREDICATE DEVICE** **SyMRI (K203372)**
Product Code	LNH	LNH
Regulation	892.1000	892.1000
Classification	Class II, 510(k)	Class II, 510(k)
Intended User	SyMRI is intended to be used by healthcare professionals, e.g. radiologists interpreting the resulting images and quantitative values	SyMRI is intended to be used by healthcare professionals, e.g. radiologists interpreting the resulting images and quantitative values
Intended use environment	SyMRI is intended to be used in a hospital/clinic setting.	SyMRI is intended to be used in a hospital/clinic setting.
Design	Automatic segmentation and quantification of brain tissues using parametric maps, based on the MR pixel intensity. Automated measurement of brain tissue volumes.	Automatic segmentation and quantification of brain tissues using parametric maps, based on the MR pixel intensity. Automated measurement of brain tissue volumes.
Technology	Generates images and volumes from parametric maps of PD, R1 and R2.	Generates images and volumes from parametric maps of PD, R1 and R2.
Processing Architecture	Automated internal pipeline that performs: • Quantification by post-processing supported sequences to generate Parametric maps • Segmentation from Parametric maps to Tissue maps • Volume calculation from Tissue maps • Segmentation table summarizes results from Volume calculations.	Automated internal pipeline that performs: • Quantification from MDME input to Parametric maps • Segmentation from Parametric maps to Tissue maps • Volume calculation from Tissue maps • Segmentation table summarizes results from Volume calculations.

	• Generating adjustable synthetic images from Parametric maps	• Generating adjustable synthetic images from Parametric maps
Physical Characteristics	Software package. Operates on off-the shelf hardware.	Software package. Operates on off-the shelf hardware.
Operating system	Supports Windows, macOS, and Linux	Supports Windows, macOS, and Linux
Data Source 1	GE “MAGiC” sequence	GE “MAGiC” sequence
Data Source 2	Philips “SyntAc” sequence	Philips “SyntAc” sequence
Data Source 3	Siemens “tse_mdme” sequence	Siemens “tse_mdme” sequence
Data Source 4	Philips “3DSyntAc” sequence	-
Output	Volumetric measurements of segmented tissues (WM, GM, CSF, MyC, BP, ICV)	Volumetric measurements of segmented tissues (WM, GM, CSF, MyC, BP, ICV)
	Color overlays for segmentation maps (WM, GM, CSF, MyC, NoN)	Color overlays for segmentation maps (WM, GM, CSF, MyC, NoN)
	Contrast weighted images (T1w, T2w, FLAIR, PDw, STIR, DIR, PSIR)	Contrast weighted images (T1w, T2w, FLAIR, PDw, STIR, DIR, PSIR)
	Visualize segmentations in three planes (Ax, Cor, Sag)	Visualize segmentations in 2D in acquisition plane
	Supports DICOM format as output of results that can be displayed on DICOM workstations and PACS	Supports DICOM format as output of results that can be displayed on DICOM workstations and PACS
Safety Features	Additional conventional scan. Too many failed pixels check. Sufficient dynamic variation check. Results must be reviewed by a trained physician.	Additional conventional scan. Too many failed pixels check. Sufficient dynamic variation check. Results must be reviewed by a trained physician.

Performance Data

The subject device is a software and complies to:

- NEMA PS 3.1-3.20 2022d

Non-Clinical verification tests have been performed with regards to the requirement specifications and the risk management results. The testing was completed with passing results per the pass/fail criteria defined in the test cases.

The accuracy of R1/R2/PD quantification was evaluated compared to gold standard inversion recovery (R1), CPMG multi-echo (R2), heavy water phantoms (PD) and standard system Model 130 NIST/ISMRM phantom. The R1, R2 and PD measurements show a good correspondence with the reference values, and the subject device met the same predefined acceptance criteria as the predicate device. It can be concluded that the accuracy and precision of SyMRI is good.

The precision of segmentation results was evaluated by scanning healthy volunteers multiple times and analyzing the difference in segmentation volumes. This is evaluated in terms of repeatability as within-subject standard deviation on the scan-rescan on the same model and field strength. The evaluation of precision was done on healthy volunteers. The segmentation results were normalized to a percentage of the intracranial volume to remove differences due to different geometric distortion on different scanner models and field strengths.

A bench test on 45 healthy volunteers scanned with both M2D-MDME and 3D-QALAS was analyzed to compare the volumetric results from SyMRI between the two acquisition methods. The performance data show that segmentation fractions BPF, MyCPF, WMF and GMF from SyMRI using 2D or 3D are statistically equivalent within the clinically determined equivalence margin on both mean difference and slope between the two acquisition methods.

The verification results demonstrate that the subject device SyMRI meets the same pre-defined performance criteria as the predicate in terms of accuracy and precision for quantification and segmentation, and that the new acquisition method 3D-QALAS provides clinically equivalent volumetric results to the M2D-MDME acquisition. Performance data therefor demonstrate that the device is as safe and effective as the predicate and is adequate for its intended use.

Conclusions

The subject device SyMRI is as safe and effective as the predicate device SyMRI. The subject device has the same intended uses and similar indications, technological characteristics, and principles of operation as its predicate device. The minor differences in indications do not alter the intended diagnostic ability of the device and do not affect its safety and effectiveness when used as labeled. In addition, the minor technological differences between the subject device and its predicate devices raise no new issues of safety or effectiveness. Performance data demonstrate that the subject device is as safe and effective as the predicate device. Thus, it is substantially equivalent.