TheraPanacea
℅ Edwin Lindsay
QA/RA consultant
Pépinière Cochin Paris Santé, 29 rue du Faubourg Saint-Jacques
Paris, 75014
FRANCE

Re: K220813
    Trade/Device Name: ART-Plan
    Regulation Number: 21 CFR 892.2050
    Regulation Name: Medical Image Management and Processing System
    Regulatory Class: Class II
    Product Code: QKB
    Dated: March 16, 2022
    Received: March 21, 2022

Dear Edwin Lindsay:

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 (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 located 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.

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 803) for

devices or postmarketing safety reporting (21 CFR 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 4, Subpart A) for combination products; and, if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21 CFR Part 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,

for

Julie Sullivan, Ph.D.
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

Indications for Use

510(k) Number *(if known)*
K220813

Device Name
ART-Plan

Indications for Use *(Describe)*

ART-Plan is indicated for cancer patients for whom radiation treatment has been planned. It is intended to be used by trained medical professionals including, but not limited to, radiologists, radiation oncologists, dosimetrists, and medical physicists.

ART-Plan is a software application intended to display and visualize 3D multi-modal medical image data. The user may import, define, display, transform and store DICOM3.0 compliant datasets (including regions of interest structures). These images, contours and objects can subsequently be exported/distributed within the system, across computer networks and/or to radiation treatment planning systems. Supported modalities include CT, PET-CT, CBCT, 4D-CT and MR images.

ART-Plan supports AI-based contouring on CT and MR images and offers semi-automatic and manual tools for segmentation.

To help the user assess changes in image data and to obtain combined multi-modal image information, ART-Plan allows the registration of anatomical and functional images and display of fused and non-fused images to facilitate the comparison of patient image data by the user.

With ART-Plan, users are also able to generate, visualize, evaluate and modify pseudo-CT from MRI images.

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.

TheraPanacea
Traditional 510(k)
ART-Plan

510(k) Summary

This 510(k) Summary is submitted in accordance with 21 CFR Part 807, Section 807.92.

Submitter's Name:

TheraPanacea

Submitter's Address:

Pépinière Paris Santé Cochin
29 rue du Faubourg Saint-Jacques
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France

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Establishment Registration Number:

3019834893

Contact Person:

Edwin Lindsay

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Date Prepared:

16 Mar 2022

Below summaries the Device Classification Information regarding the TheraPanacea ART-Plan:

Primary Product Code:

Regulation Number	Device	Device Class	Product Code	Classification Panel
892.2050	Medical image management and processing system	Class II	QKB	Radiology

Device Trade Name:

ART-Plan

Device Common Name:

ART-Plan

Intended Use:

TheraPanacea
Traditional 510(k)
ART-Plan

ART-Plan is a software for multi-modal visualization, contouring and processing of 3D images of cancer patients for whom radiotherapy treatment has been prescribed.

It allows the user to view, create and modify contours for the regions of interest. It also allows to generate automatically, and based on medical practices, the contours for the organs at risk and healthy lymph nodes and to register combinations of anatomical and functional images. Contours and images require verifications, potential modifications, and subsequently the validation of a trained user with professional qualifications in anatomy and radiotherapy before their export to a Treatment Planning System.

ART-Plan offers the following visualization, contouring and manipulation tools to aid in the preparation of radiotherapy treatment:

- Multi-modal visualization and rigid- and deformable registration of anatomical and functional images such as CT, MR, PET-CT, 4D-CT and CBCT
- Display of fused and non-fused images to facilitate the comparison and delineation of image data by the user
- Manual modification and semi-automatic generation of contours for the regions of interest
- Automatic generation of contours for organs at risk and healthy lymph nodes, based on medical practices, on medical images such as CT and MR images.
- Generation of pseudo-CT for supported anatomies

The device is intended to be used in a radiation therapy clinical setting, by trained professionals only.

Indications for Use:

ART-Plan is indicated for cancer patients for whom radiation treatment has been planned. It is intended to be used by trained medical professionals including, but not limited to, radiologists, radiation oncologists, dosimetrists, and medical physicists.

ART-Plan is a software application intended to display and visualize 3D multi-modal medical image data. The user may import, define, display, transform and store DICOM3.0 compliant datasets (including regions of interest structures). These images, contours and objects can subsequently be exported/distributed within the system, across computer networks and/or to radiation treatment planning systems. Supported modalities include CT, PET-CT, CBCT, 4D-CT and MR images.

ART-Plan supports AI-based contouring on CT and MR images and offers semi-automatic and manual tools for segmentation.

To help the user assess changes in image data and to obtain combined multi-modal image information, ART-Plan allows the registration of anatomical and functional images and display of fused and non-fused images to facilitate the comparison of patient image data by the user.

With ART-Plan, users are also able to generate, visualize, evaluate and modify pseudo-CT from MRI images.

TheraPanacea
Traditional 510(k)
ART-Plan

Summary of Substantial Equivalence:

The following predicate devices have been chosen that the ART-Plan can claim equivalence with and these are detailed below

General Comparison

Property	General Information							
	Proposed Device ART-Plan v1.10.0	*Primary Predicate* ART-Plan v1.6.1	*Reference device* Contour ProtégéAI	*Reference device* MIM 4.1	*Reference device* MRCAT Pelvis	*Reference device* MRCAT Brain	*Reference device* Syngo.via RT Image Suite	Comment
Common Name	Radiological image processing software for radiation therapy	Radiological image processing software for radiation therapy	Radiological Image Processing Software For Radiation Therapy	System, image processing, radiological	System, Planning, Radiation Therapy Treatment	System, Planning, Radiation Therapy Treatment	System, Planning, Radiation Therapy Treatment	N/A
Device Manufacturer	TheraPanacea	TheraPanacea	MIM Software, Inc	MIMvista Corp (now MIM Software Inc)	Philips Medical Systems	Philips Medical Systems	Siemens Medical Solutions USA, Inc.	N/A
510k	N/A	K202700	K210632	K071964	K182888	K193109	K173635	N/A
Device Classification	II	II	II	II	II	II	II	N/A
Primary Product Code	QKB	QKB	QKB	LLZ	MUJ	MUJ	MUJ	The primary product code is QKB "Radiological Image Processing Software For Radiation Therapy" as the software uses AI algorithms and is intended for radiation therapy, just like the primary predicate device
Secondary Product Code	LLZ, MUJ	LLZ	-	-	-	-	LLZ	As secondary product code: - LLZ (System, Image Processing, Radiological) was included as the software is used in

								image processing and some predicates use it as primary or secondary product code; - MUJ (System, Planning, Radiation Therapy Treatment) was includes as it is a software used in the planning of radiotherapy treatment and some of the reference devices use it as their primary code
Target Population	Any patient type for whom relevant modality scan image data is available	Any patient type for whom relevant modality scan data is available	Not stated	Not stated	Any patient with soft tissue cancers in the pelvic region for whom radiotherapy treatment has been planned	Any patient with primary and metastatic brain tumor for whom radiotherapy treatment has been planned	Not stated	The proposed device has identical target populations to the primary and reference devices.
Environment	Hospital	Hospital	Hospital	Hospital	Hospital	Hospital	Hospital	The proposed device and predicates have identical target environments
Intended Use/ Indication for Use	**Intended Use** ART-Plan is a software for multi-modal visualization, contouring and processing of 3D images of cancer patients for whom radiotherapy treatment has been prescribed. It allows the user to view, create and modify contours for the regions of interest. It also allows to generate automatically, and based on medical	**Intended Use** ART-Plan is a software designed to assist the contouring process of the target anatomical regions on 3D-images of cancer patients for whom radiotherapy treatment has been planned. The SmartFuse module allows the user to register combinations of anatomical and	**Intended Use** Contour ProtégéAI is an accessory to MIM software used for the contouring of anatomical structures in imaging data using machine-learning-based algorithms automatically. Appropriate	**Intended Use** MIM 4.1 (SEASTAR) software is intended for trained medical professionals including, but not limited to, radiologists, oncologists, physicians, medical technologists, dosimetrists and physicists.	**Intended Use:** MRCAT imaging is intended to provide the operator with information of tissue properties for radiation attenuation estimation purposes in photon external beam radiotherapy	**Intended Use:** MRCAT imaging is intended to provide the operator with information of tissue properties for radiation attenuation estimation purposes in photon external beam radiotherapy	**Intended use:** Not available in the summary **Indication for use:** syngo.via RT Image Suite is a 3D and 4D image visualization, multimodality manipulation and contouring tool that helps the	The intended use and indications for use of the proposed device, ART-Plan v1.10.0 and the primary predicate ART-Plan v1.6.1 are similar as they are both intended for medical image registration and segmentation in the context of radiotherapy treatment planning: they allow multi-modal and mono-modal rigid

practices, the contours for the organs at risk and healthy lymph nodes and to register combinations of anatomical and functional images. Contours and images require verifications, potential modifications, and subsequently the validation of a trained user with professional qualifications in anatomy and radiotherapy before their export to a Treatment Planning System. ART-Plan offers the following visualization, contouring and manipulation tools to aid in the preparation of radiotherapy treatment: - Multi-modal visualization and rigid- and deformable registration of anatomical and functional images such as CT, MR, PET-CT, 4D-CT and CBCT - Display of fused and non-fused images to facilitate the comparison and delineation of image data by the user - Manual modification and semi-automatic generation of contours	functional images and display them with fused and non-fused displays to facilitate the comparison and delineation of image data by the user. The images created with rigid or elastic registration require verifications, potential modifications, and then the validation of a trained user with professional qualifications in anatomy and radiotherapy. With the Annotate module, users can edit manually and semi-automatically the contours for the regions of interest. It also allows to generate automatically, and based on medical practices, the contours for the organs at risk and healthy lymph nodes on CT images. The contours created automatically, semi-automatically or manually require verifications, potential modifications, and then the validation of a trained user with professional qualifications in anatomy and radiotherapy.	image visualization software must be used to review and, if necessary, edit results automatically generated by Contour ProtégéAI. Contour ProtégéAI is not intended to detect or contour lesions. **Indications for Use** Trained medical professionals use Contour ProtégéAI as a tool to assist in the automated processing of digital medical images of modalities CT and MR, as supported by ACR/NEMA DICOM 3.0. In addition, Contour ProtégéAI supports the following indications: • Creation of contours using machine-learning algorithms for applications including, but not limited to,	MIM 4.1 (SEASTAR) is a medical image and information management system that is intended to receive, transmit, store, retrieve, display, print and process digital medical images, as well as create, display and print reports from those images. The medical modalities of these medical imaging systems include, but are not limited to, CT, MRI, CR, DX, MG, US, SPECT, PET and XA as supported by ACR/NEMA DICOM 3.0. MIM 4.1 (SEASTAR) provides the user with the means to display, register and fuse medical images from multiple modalities. Additionally, it evaluates cardiac left ventricular function and perfusion, including left ventricular	treatment planning. **Indications for Use:** MRCAT Pelvis is indicated for radiotherapy treatment planning of soft tissue cancers in the pelvic region.	treatment planning. **Indications for use:** MRCAT is indicated for radiotherapy treatment planning for primary and metastatic brain tumor patients	preparation and response assessment of treatments such as, but not limited to those performed with radiation (for example, Brachytherapy, Particle Therapy, External Beam Radiation Therapy). It provides tools to efficiently view existing contours, create, edit, modify, copy contours of regions of the body, such as but not limited to, skin outline, targets and organs-at-risk. It also provides functionalities to create and modify simple treatment plans. Contours, images and treatment plans can subsequently be exported to a Treatment Planning System. The software combines following digital	deformable registration for the same modalities of images (CT, MR, PET) they allow automatic segmentation of organs-at-risk and lymph nodes on injected and non-injected CT images using deep learning algorithms they allow the import, manipulation, visualisation, generation and the export of DICOM images The intended for the proposed device has been adapted to provide a more specific description of the proposed device but does not represent a new intended use, except for the additional claims for the proposed device as compared to the primary predicate as: - it includes an improved version of the existing automatic segmentation tool as compared to the one of ART-Plan v1.6.1. - it allows automatic segmentation on more anatomies and organ-at-risk

for the regions of interest - Automatic generation of contours for organs at risk and healthy lymph nodes, based on medical practices, on medical images such as CT and MR images. - Generation of pseudo-CT for supported anatomies The device is intended to be used in a radiation therapy clinical setting, by trained professionals only. **Indications for Use** ART-Plan is indicated for cancer patients for whom radiation treatment has been planned. It is intended to be used by trained medical professionals including, but not limited to, radiologists, radiation oncologists, dosimetrists, and medical physicists. ART-Plan is a software application intended to display and visualize 3D multi-modal medical image data. The user may import, define, display, transform and store DICOM 3.0 compliant datasets (including regions of	The device is intended to be used in a clinical setting, by trained professionals only. **Indications for Use** ART-Plan is intended to be used by trained medical professionals including, but not limited to, radiologists, radiation oncologists, dosimetrists and physicists. ART-Plan is a software application intended to display and visualize 3D multi-modal medical image data. The user may process, render, review, store, display and distribute DICOM 3.0 compliant datasets within the system and/or across computer networks. Supported modalities include static and gated CT, PET, and MR. ART-Plan allows the user to register combinations of anatomical and functional images and display them with fused and non-fused displays to facilitate the comparison of image data by the user. PET images should not be	quantitative analysis, aiding adaptive therapy, transferring contours to radiation therapy treatment planning systems, and archiving contours for patient follow-up and management. • Segmenting normal structures across a variety of CT anatomical locations. • And segmenting normal structures of the prostate, seminal vesicles, and urethra within T2-weighted MR images. Appropriate image visualization software must be used to review and, if necessary, edit results automatically generated by Contour ProtégéAI.	end-diastolic volume, end-systolic volume, and ejection fraction. The Region of Interest (ROI) feature reduces the time necessary for the user to define objects in medical image volumes by providing an initial definition of object contours. The objects include, but are not limited to, tumors and normal tissues. MIM 4.1 (SEASTAR) provides tools to quickly create, transform, and modify contours for applications including, but not limited to, quantitative analysis, aiding adaptive therapy, transferring contours to radiation therapy treatment planning systems and archiving contours for patient follow-up and management. MIM 4.1 (SEASTAR) also			image processing and visualization tools: x Multi-modality viewing and contouring of anatomical, functional, and multi-parametric images such as but not limited to CT, PET, PET/CT, MRI, Linac Cone Beam CT (CBCT) images and dose distributions x Multiplanar reconstruction (MPR) thin/thick, minimum intensity projection (MIP), volume rendering technique (VRT) x Freehand and semi-automatic contouring of regions-of-interest on any orientation including oblique x Creation of contours on any type of images without prior assignment of a planning CT x Manual and semi-automatic	- it allows automatic segmentation on MR images which is not possible with ART-Plan v1.6.1 but covered by reference devices (MIM 4.1. and Contour ProtégéAI) - it can generate synthetic CT from MR images which is not possible with ART-Plan v1.6.1 but covered by reference devices (MRCATpelvis, MRCAT brain and Syngo.via RT Image Suite - it allows a cloud-based deployment which is not possible with ART-Plan v1.6.1 but covered by Contour ProtégéAI and Syngo.via RT Image Suite

interest structures). These images, contours and objects can subsequently be exported/distributed within the system, across computer networks and/or to radiation treatment planning systems. Supported modalities include CT, PET-CT, CBCT, 4D-CT and MR images. ART-Plan supports AI-based contouring on CT and MR images and offers semi-automatic and manual tools for segmentation. To help the user assess changes in image data and to obtain combined multi-modal image information, ART-Plan allows the registration of anatomical and functional images and display of fused and non-fused images to facilitate the comparison of patient image data by the user. With ART-Plan, users are also able to generate, visualize, evaluate and modify pseudo-CT from MRI images. .	registered directly but via the registration of the CT of the PET toward the target image. The result of the registration operation can assist the user in assessing changes in image data, either within or between examinations and aims to help the user obtain a better understanding of the combined information that would otherwise have to be visually compared disjointedly. ART-Plan provides a number of tools such as regions of interests, which are intended to be used for the assessment of regions of an image to support a clinical workflow. Examples of such workflows include, but are not limited to, the delineation of anatomical regions of interest on 3D-images of cancer patients for whom radiotherapy treatment has been planned. ART-Plan supports the loading and saving of DICOM RT objects and allows the user to define, import, display,		aids in the assessment of PET/SPECT brain scans. It provides automated quantitative and statistical analysis by automatically registering PET/SPECT brain scans to a standard template and comparing intensity values to a reference database or to other PET/SPECT scans on a voxel by voxel basis, within stereotactic surface projections or standardized regions of interest. **Indications for Use** MIM 4.1 (SEASTAR) software is used by trained medical professionals as a tool to aid in evaluation and information management of digital medical images. The medical image modalities include, but are not limited to, CT, MRI, CR, DX, MG,			registration using rigid and deformable registration x Supports the user in comparing, contouring, and adapting contours based on datasets acquired with different imaging modalities and at different time points x Supports the user in comparing images and contours of different patients x Supports multi-modality image fusion x Visualization and contouring of moving tumors and organs x Management of points of interest including but not limited to the isocenter x Management of simple treatment plans x Generation of a synthetic CT based on multiple	

| | | transform, store and export such objects including regions of interest structures to radiation therapy planning systems. ART-Plan allows the user to transform regions of interest associated with a particular imaging dataset to another, supporting AI-based contouring on CT images along with semi-automatic and manual tools for segmentation. | | US, SPECT, PET and XA as supported by ACR/NEMA DICOM 3.0. MIM 4.1 (SEASTAR) assists in the following indications: * Receive, transmit, store, retrieve, display, print, and process medical images and DICOM objects. * Create, display and print reports from medical images. * Registration, fusion display, and review of medical images for diagnosis, treatment evaluation, and treatment planning. * Evaluation of cardiac left ventricular function and perfusion, including left ventricular end-diastolic volume, end-systolic volume, and ejection fraction. * Localization and definition of objects such as | | | pre-define MR acquisitions | |

				tumors and normal tissues in medical images. * Creation, transformation, and modification of contours for applications including, but not limited to, quantitative analysis, aiding adaptive therapy, transferring contours to radiation therapy treatment planning systems, and archiving contours for patient follow-up and management. * Quantitative and statistical analysis of PET/SPECT brain scans by comparing to other registered PET/SPECT brain scans Lossy compressed mammographic images and digitized film screen images must not be reviewed for primary image interpretations. Images that are printed to film must be printed using a				

				FDA-approved printer for the diagnosis of digital mammography images. Mammographic images must be viewed on a display system that has been cleared by the FDA for the diagnosis of digital mammography images. The software is not to be used for mammography CAD.				

System Information Comparison

	System Information							
Property	*Proposed Device* **ART-Plan v1.10.0**	*Primary Predicate* **ART-Plan v1.6.1**	*Reference device* **Contour ProtégéAI**	*Reference device* **MIM 4.1**	*Reference device* **MRCAT Pelvis**	*Reference device* **MRCAT Brain**	*Reference device* **Syngo.via RT Image Suite**	**Comment**
Method of Use	Standalone software application accessed via a compliant browser (Chrome or Mozilla Firefox) on a personal computer, tablet or	Standalone software application accessed via a compliant browser (Chrome or Mozilla Firefox) on a personal computer, tablet or	Standalone software application	Standalone software package	Provided as a plug-in clinical application to Ingenia MR-RT. It is compatible with Ingenia 1.5T and 3.0T MR-RT, Ingenia Ambition 1.5T MR-RT and Ingenia Elition 3.0T MR-R. It runs parallel to image	Provided as a plug-in clinical application to Ingenia MR-RT. It is compatible with Ingenia 1.5T and 3.0T MR-RT, Ingenia Ambition 1.5T MR-RT and Ingenia Elition 3.0T MR-RT. It runs parallel to	syngo.via can be used as a standalone device or together with a variety of syngo.via-based software options, which are medical devices in their own right.	The proposed device and predicates (especially the primary predicate) have identical methods of use

	phone (In case of connection to the platform with a screen of a phone or a tablet, the user must choose the option for the desktop site of his communication device. The platform is optimally used with 17 inches and up screen. Facilitates display and visualization of data by user.	phone (In case of connection to the platform with a screen of a phone or a tablet, the user must choose the option for the desktop site of his communication device. The platform is optimally used with 17 inches and up screen. Facilitates display and visualization of data by user.			acquisition on the MR console, embedded post-processing generates MRCAT images using: • Automated segmentation and tissue classification • Automated assignment of CT-based density values	image acquisition on the MR console, embedded post-processing generates MRCAT images using: • Automated segmentation and tissue classification • Automated assignment of CT-based density values		
Computer Platform and Operating System	Full web platform Launch from Google Chrome or Mozilla Firefox Available on server-based application or Cloud-based deployment	Full web platform Launch from Google Chrome or Mozilla Firefox	Server-based application supporting Linux-based OS - and - Local deployment on Windows or Mac Cloud-based deployment	Windows 2000/XP	As the density information is generated directly on the MR console, the resulting data is available at the console for immediate review.	As the density information is generated directly on the MR console, the resulting data is available at the console for immediate review.	This solution is also available cloud-based, providing scalability with flexible use models and cloud deployment[1]	The proposed device and predicates are compatible with identical operating systems.
Data Visualization / Graphical Interface	Yes	Yes	Yes	Yes	Yes	Yes	Yes	The proposed device and all the predicates have a data visualisation and graphical interface
Synthetic CT	Generation of CT density	N/A	N/A	N/A	Generation of CT density image	Generation of CT density image	Generation of CT-	The proposed device and reference devices such as

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[1] Information obtained from their brochure: https://cdn0.scrvt.com/39b415fb07de4d9656c7b516d8e2d907/a4c5e63ae0880cd1/f2053f668eaa/shs-syngo-via-rt-image-suite-brochure-2020.pdf

	image series out of multiple MR-image series		CT and MR	Medical image modalities include, but are not limited to, CT, MRI, CR, DX, MG, US, SPECT, PET and XA as supported by ACR/NEMA DICOM 3.0.	series out of multiple MR-image series	series out of multiple MR-image series	density image series out of multiple MR-image series	MRCAT pelvis, MRCAT brain and Syngo.via RT Image Suite have the same feature
Supported Modalities	**Registration**: Static and gated CT, MR, PET (via the registration of the CT of said PET), 4D-CT and CBCT. **Segmentation**: CT (injected or not), MR images, DICOM RTSTRUCT	**Registration**: Static and gated CT, MR, PET (via the registration of the CT of said PET) **Segmentation**: CT (injected or not), DICOM RTSTRUCT	CT and MR	Medical image modalities include, but are not limited to, CT, MRI, CR, DX, MG, US, SPECT, PET and XA as supported by ACR/NEMA DICOM 3.0.	MR images	MR images	3D: CT, PET1, PET/CT1, MRI1, 4D-CT and Linac Cone Beam CT (CBCT) image support Support for time resolved CT and MR1 images (e.g. MR DCE, Perfusion CT)	The proposed device is compatible with the same modalities as the primary predicate on the registration feature, which are CT, MR and PET images in a DICOM format. However, the proposed device supports 2 additional modalities: - CBCT (covered by the reference device Syngo.via RT Image Suite) - 4D-CT (covered by the reference device Syngo.via RT Image Suite For both devices, supported images can be fixed (static) or moving (gated). The proposed device and the primary predicate are both compatible with CT images (injected or not), DICOM and RTSTRUCT on the segmentation feature. For MR images, the proposed device and some reference devices (such as MRCAT pelvis and MRCAT brain) are both compatible with MR images on the segmentation feature.

								Compared to reference devices, the proposed device claims less supported modalities
Data Export	Distribution of DICOM compliant Images into other DICOM compliant systems.	Distribution of DICOM compliant Images into other DICOM compliant systems.	As supported by ACR/NEMA DICOM 3.0.	The system has the ability to send data to DICOM-ready devices for image storage, retrieval and transmission.	MRCAT images can be exported in DICOM format enabling the use as primary images in the treatment planning systems	MRCAT images can be exported in DICOM format enabling the use as primary images in the treatment planning systems	DICOM, HL7 and IHE-RO standard compliance	The proposed device and predicates (especially the primary one) have identical data export capabilities with DICOM format.
Compatibility	Compatible with data from any DICOM compliant scanners for the applicable modalities.	Compatible with data from any DICOM compliant scanners for the applicable modalities.	supported by ACR/NEMA DICOM 3.0	The software can receive, transmit, store, retrieve, display, print, and process DICOM objects and medical image modalities including, but not limited to, CT, MRI, CR, DX, MG, US, SPECT, PET and XA as supported by ACR/NEMA DICOM 3.0.	MR console: Compatible with Ingenia 1.5T and 3.0T MR-RT, Ingenia Ambition 1.5T MR-RT and Ingenia Elition 3.0T MR-RT After export, compatible with any DICOM compliant scanners.	MR console: Compatible with Ingenia 1.5T and 3.0T MR-RT, Ingenia Ambition 1.5T MR-RT and Ingenia Elition 3.0T MR-RT After export, compatible with any DICOM compliant scanners.	Compatible with DICOM Automatic send to TPS configuration	The proposed device and predicates (especially the primary one) have identical compatibility (DICOM format)

TheraPanacea
Traditional 510(k)
ART-Plan

Technical Information Comparison

Property	Proposed Device ART-Plan v1.10.0	Primary Predicate ART-Plan v1.6.1	Reference device Contour ProtégéAI	Reference device MIM 4.1	Reference device MRCAT Pelvis	Reference device MRCAT Brain	Reference device Syngo.via RT Image Suite	Comment
				Technical Information				
Delineation Method	AI	AI	AI	Atlas	N/A	N/A	Deep learning autocontouring for organs at risk (incl. lymph nodes)[2]	The proposed device, primary predicate and most of the reference devices share an AI delineation method.
Image registration	Multi-modal and mono-modal. Rigid and deformable Automatic and manual initialization (landmarks, fusion box, alignment). Registration for the purposes of replanning/ recontouring and AI-based automatic contouring.	Multi-modal and mono-modal. Rigid and deformable Automatic and manual initialization (landmarks, fusion box, alignment). Registration for the purposes of replanning/ recontouring and AI-based automatic contouring.	N/A	Registration, fusion display, and review of medical images for diagnosis, treatment evaluation, and treatment planning.	N/A	N/A	Image Fusion Rigid and Deformable Registration with region-of interest based registration and multiple registrations per image pair Manual editing of registrations Save registrations and save deformed images as reformatted dataset[2] Contour warping and display of prior and new structure set Registration Quality Check with spyglass, deformation vector map,	Both the predicate device and ART-Plan offer mono-modal (CT-CT) and multi-modal (CT/MR, CT/PET) rigid and deformable registration. However, the proposed device supports 2 additional modalities: - CBCT (covered by the reference deviceSyngo.via RT Image Suite) - 4D-CT (covered by the reference deviceSyngo.via RT Image Suite Both devices offer an automatic solution for registration and semi-automatic registration by including manual initialization tools in addition to automatic initialization.

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[2] https://www.siemens-healthineers.com/radiotherapy/software-solutions/syngovia-rt-image-suite (last checked on Feb, 15th 2022)

							magnitude color map	Reference device such as Syngo.via RT Image Suite offers the same options as the proposed device: rigid and deformable registration.
Segmentation Features	Automatically delineates OARs and healthy lymph nodes Deep learning algorithm. Automatic segmentation includes the following localizations: * head and neck (on CT images) * thorax/breast (for male/female and on CT images) * abdomen (on CT images and MR images) * pelvis male(on CT images and MR images) * pelvis female (on CT images) * brain (on CT images and MR images)	Automatically delineates OARs and healthy lymph nodes (on any CT images) Deep learning algorithm. Automatic segmentation includes the following localizations: * head and neck * thorax/breast (for male/female) * abdomen * pelvis (for male only) * brain.	Creation of contours using machine-learning algorithms for applications including, but not limited to, quantitative analysis, aiding adaptive therapy, transferring contours to radiation therapy treatment planning systems, and archiving contours for patient follow-up and management. Segmenting anatomical structures across a variety of CT anatomical locations. And segmenting normal structures of the prostate, seminal vesicles, and urethra within T2-weighted MR images.	The software automatically generates contours using a deformable registration technique which registers pre-contoured patients to target patients. Registrations are either between a serial pair of intra-patient volumes or between a pre-existing atlas of contoured patients and a patient volume. This process facilitates contour creation or re-contouring for adaptive therapy.	N/A	N/A	Multimodality contouring Freehand 2D, 3D image-based Smart Freehand segmentation, s Contour on any arbitrary plane including oblique planes deep learning autocontouring for organs at risk (inclusive LNs) One-click adaptive contouring User configurable Organ Templates Multiple structure set support (1 per image series) Molecular imaging data such as PET, threshold-based and skin, gray value-based segmentation1 "CT-free" contouring: native PET or MR contouring	The proposed device and primary predicate are capable of automatically contouring the organ-at-risk (OAR) and healthy lymph nodes using AI (deep learning) algorithm. There is a difference in intended anatomies for CT images as the proposed device also includes pelvis female. For MR images, all anatomies included in the proposed device are also included in the primary predicate.

							Parallel contouring: contouring performed on any image is reflected on all other images Visualization of previously drawn structures on the current image series Contour copy and warping between image series[2]	
View Manipulation and Volume Rendering	Window and level, pan, zoom, cross-hairs, slice navigation. Maximum, average and minimum intensity projection (MIP, AVG, MinIP), color rendering, multi-planar reconstruction (MPR), fused views, gallery views.	Window and level, pan, zoom, cross-hairs, slice navigation. Maximum, average and minimum intensity projection (MIP, AVG, MinIP), color rendering, multi-planar reconstruction (MPR), fused views, gallery views.	Not stated	Not stated	N/A	N/A	Organ algebra (union, intersection, exclusion) Symmetric and asymmetric structure growth or contraction Smart 2D/3D Nudge, brush Pan, scale, rotate contour Geometrical and smart image-based contour interpolation Multi-modality Image Manipulation Multiplanar reconstruction (MPR) thin/thick, minimum intensity projection (MIP), volume	The proposed device has the same tools as the primary predicate.

							rendering technique (VRT)[2]	
Regions and Volumes of Interest (ROI)	AI Based autocontouring, Registration based contour projection (re-contouring), Manual ROI manipulation and transformation (margins, booleans operators, interpolation).	AI Based autocontouring, Registration based contour projection (re-contouring), Manual ROI manipulation and transformation (margins, booleans operators, interpolation).	AI Based contouring, tools to quickly create, transform, and modify contours.	Atlas based contouring, tools to quickly create, transform, and modify contours.	N/A	N/A	syngo.via RT Image Suite provides dedicated tools, which help the medical professional in contouring and evaluating volumes of interest. Freehand and semi-automatic contouring of regions-of-interest on any orientation including oblique[2]	Both the proposed device and the primary predicate allow AI automatic contouring and manual contouring
Region/volume of interest measurements and size measurements	Intensity, Hounsfield units and SUV measurements Size measurements include 2D and 3D measurements (number of slices, volume of a structure, static ruler)	Intensity, Hounsfield units and SUV measurements Size measurements include 2D and 3D measurements (number of slices, volume of a structure, static ruler)	N/A	Quantitative analysis tools.	N/A	N/A	N/A	The proposed device offers the same kind of region/volume of interest measurements and size measurements as the primary predicate

TheraPanacea
Traditional 510(k)
ART-Plan

Device Description:

The ART-Plan application is comprised of two key modules: SmartFuse and Annotate, allowing the user to display and visualize 3D multi-modal medical image data. The user may process, render, review, store, display and distribute DICOM 3.0 compliant datasets within the system and/or across computer networks. Supported modalities cover static and gated CT (computerized tomography including CBCT and 4D-CT), PET (positron emission tomography) and MR (magnetic resonance).

Compared to ART-Plan v1.6.1 (primary predicate), the following additional features have been added to ART-Plan v1.10.0:

- an improved version of the existing automatic segmentation tool
- automatic segmentation on more anatomies and organ-at-risk
- image registration on 4D-CT and CBCT images
- automatic segmentation on MR images
- generate synthetic CT from MR images
- a cloud-based deployment

The ART-Plan technical functionalities claimed by TheraPanacea are the following:

- Proposing automatic solutions to the user, such as an automatic delineation, automatic multimodal image fusion, etc. towards improving standardization of processes/ performance / reducing user tedious / time consuming involvement.

- Offering to the user a set of tools to assist semi-automatic delineation, semi-automatic registration towards modifying/editing manually automatically generated structures and adding/removing new/undesired structures or imposing user-provided correspondences constraints on the fusion of multimodal images.

- Presenting to the user a set of visualization methods of the delineated structures, and registration fusion maps.

- Saving the delineated structures / fusion results for use in the dosimetry process.

- Enabling rigid and deformable registration of patients images sets to combine information contained in different or same modalities.

- Allowing the users to generate, visualize, evaluate and modify pseudo-CT from MRI images.

ART-Plan offers deep-learning based automatic segmentation for the following localizations:
- head and neck (on CT images)
- thorax/breast (for male/female and on CT images)
- abdomen (on CT images and MR images)
- pelvis male(on CT images and MR images)
- pelvis female (on CT images)
- brain (on CT images and MR images)

ART-Plan offers deep-learning based synthetic CT-generation from MR images for the following localizations:
- pelvis male
- brain

Information about your training dataset:

- **Summary test statistics or other test results including acceptance criteria or other information supporting the appropriateness of the characterised performance**

Acceptance criteria for performance of ART-Plan modules were established using performance ranges extracted from benchmark devices and alternative technologies in the literature. For an auto segmentation model to be judged acceptable, every organ included in the model must pass at least one acceptance criterion with success across the different testings it has been submitted to. These criteria are as follows:

    A. The Dice Similarity Coefficient (DSC) is equal to or superior to the acceptance criteria set by the AAPM: DSC (mean)≥ 0.8.
    Or
    B. The Dice Similarity Coefficient (DSC) is equal to or superior to inter-expert variability: DSC (mean)≥ 0.54 or DSC (mean) ≥ mean (DSC inter-expert) + 5%
    Or
    C. The clinicians' s qualitative evaluation of the auto-segmentation is considered acceptable for clinical use without modifications (A) or with minor modifications / corrections (B) with a A+B % above or equal to 85% considering the following scale:
        A: the contour is acceptable for a clinical use without any modification
        B: the contour would be acceptable for clinical use after minor modifications/corrections
        C: the contour requires major modifications (e.g. it would be faster for the expert to manually delineate the structure)"

For the synthetic-CT generation tool, the acceptance criteria are as follows:

    A. A median 2%/2mm gamma passing criteria of ≥95%
    B. A median 3%/3mm gamma passing criteria of ≥99.0%
    C. A mean dose deviation (pseudo-CT compared to standard CT) of ≤2% in ≥88% of patients

- **Total number of individual patients images in the reported auto segmentation tools and independence of test data and training data**

Our training, validation and test cohorts are built from real-world retrospective data which were initially used for treatment of cancer patients. For the structures of a given anatomy for a given modality (MR or CT), two non-overlapping data sets were separated: the test patients (number selected based on thorough literature review and statistical power) and the train data. We make sure that those sets are non-overlapping and further split the train cases into train and validation sets and ensure enough train cases for the machine learning models to converge and achieve good performances of the validation set.

TheraPanacea
Traditional 510(k)
ART-Plan

	Sample Size	%
Training	299142	0.8
Validation	75018	0.2
Total	374160	1

- **Total number of cases and samples images in the reported auto segmentation results**

The total number of patients used for training (8736) is lower than the number of samples (374160). This is linked to the fact that one patient can be associated with more images (e.g. CT, MR) and that each image (anatomy) has the delineation of several structures (OARs and lymph nodes) which increases the number of samples used for training and validation.

- **Demographic distribution including gender, age and ethnicity**

All data used for training of the models have been pseudo-anonymised by the centers providing data before transfer. Around 80% of the data used for training contain information on gender and age of the patients. In terms of gender, around 44% and 56% of our data (that contains this information) are from female and male patients, respectively. In comparison, in 2020 according to the Global Cancer Observatory, 48% and 52% of the cancer patients were female and male, respectively.

In terms of age, our data follows the same trend observed and reported in the US (SEER NIH), UK (Cancer Research UK) and worldwide (Global Cancer Observatory) for cancer incidence according to age, with more than 95% of the data coming from patients between 20 and 85 years old. Our data has a slight overrepresentation (8% points) for the ages between 54 and 60 years old, at the cost of a slight underrepresentation of patients in the age range between 20-34 (1.5% points) and above 85 (6.5% points) years old. In addition, following the general global (incl US) trend, our data also depicts a steep rise in the incidence rate from in the age group of 55-64 years old, with a median age of 63 years old (as compared to 66 years old in the US).

Although this information is not exhaustive, this analysis shows that the demographic distribution in terms of age and gender of the data used for training and validation of the models are well aligned with the incidence cancer statistics found for instance in US, UK and globally. This comes from the fact that real clinical data provided by medical facilities without any selection criteria (i.e. no discrimination or selection has been applied to the cases retrieved), leading to the demographic distribution including gender and age across the data is representative of the distribution in the clinic and thus of the cancer patient population in general.

An exception is noted for following models that are gender-dependent:
- 100% of pelvis images for male pelvis model for automatic annotation are male patients
- 100% of pelvis images for female pelvis model for automatic annotation are female patients
- 100% of breast images for the breast automatic annotation are female patients
- 100 % of pelvis images for automatic synthetic-CT generation are male patients

No pseudo-anonymized data included any information on the ethnicity.

In addition, automatic delineation of the device demonstrated equivalent performances between non-US and US population.

- **On the "truthing" and data collection process**

The contouring guidelines followed to produce the contours were confirmed with the centers which provided the data. Our truthing process includes a mix of data created by different delineators (clinical experts) and assessment of intervariability, ground truth contours provided by the centers and validated by a second expert of the center, and qualitative evaluation and validation of the contours. This process ensures that the data used for training and testing can be considered representative of the delineation practice across centers and following international guidelines.

- **On clinical subgroups, confounders and equipment details**

In general, confounding factors affecting health status present in the dataset could be related to patient clinical variables such as age, gender, ethnicity, economical and educational levels. As shown in **"Demographic distribution including gender, age and ethnicity"**, our data is representative of the demographic cancer distribution in terms of gender and age. In addition, our models when appropriate (i.e. for gender independent anatomies) are shared across gender removing any further bias and augmenting substantially training cohorts.

Variables like ethnicity, economical and educational status that could be associated with obesity are further confounding factors that could impact global patient's anatomy and introduce bias in the performance of the obtained solution. To address this aspect, we have adopted a strategy that projects a patient's specific anatomy to common, multiple, different in size, full-body female and male patient templates, allowing a direct harmonization of data resulting in potential removal of bias of anatomical diversity across ethnic, economical and educational groups. Please note that this information (ethnic group, educational/economical level, etc.) is often not available in the pseudo-anonymised data and therefore performing statistical tests and increasing the number of operations allowing to separate correlations from causality is often unattainable.

Regarding variables associated with treatment therapeutic and treatment implementation strategies; we can imagine imaging devices and treatment devices being potential confounding factors as differences exist among CT and MR scanners manufacturers that could potentially introduce bias. We have addressed this concern through a statistical analysis of the different imaging vendors in EU & USA towards the creation of a data training, validation and testing cohort that globally appropriately represents the market share of the different vendors allowing generalization and removing hardware specific bias. In terms of treatment implementation, it should be noted that different guidelines exist and depending on the treatment device different therapeutic constraints and guidelines are applied. This is reflected in our database since different strategies and constraints are used depending on the choice of treatment (e.g external radiotherapy vs stereotactic treatment). Our solution, due to its concept of removing bias through projection to patient template anatomies as well as due to the component-based approach that is able to aggregate training data across imaging and treatment vendors, is able to address the maximum set of constraints. Therefore, we do not introduce any bias on the type of treatment that will be delivered (supporting any type of clinically conventionally adopted treatment from manufactures such as Varian, Elekta, Accuray, GE, Siemens, ViewRay & Zap

Surgical), providing direct means for customization of the constraints to be met at the clinical expert level and offering a representative coverage of all vendors in radiation oncology world-wide.

An exception is noted for following models that are vendor-, machine- or sequence-dependent:

- MR annotation tool for pelvis and abdominal regions were trained on data from a 0.35T MR machine provided by ViewRay
- synthetic-CT generation tool for pelvis was trained on data from a 0.35T MR machine provided by ViewRay
- synthetic-CT generation tool and annotation tool for MR pelvis was trained on data from 1.5T Philips (Elekta) for T2 sequences, and might not work on T1-weighted images

Technological Characteristics:

A comparative review of the ART-Plan with the predicate device found that the technology, mode of operation, and general principles for treatment with this device were substantially equivalent as the predicate device.

Non-Clinical Tests (Performance/Physical Data):

The ART-Plan was evaluated for its safety and effectiveness based on the following testing:

Test Name	Test Description/Results	Results
Usability Report (V1.10.0)	This document is intended to document the usability test results for the ART-Plan v1.10.0 for compliance with IEC 62366-1:2015+AMD1:2020 - Medical devices - Application of usability engineering to medical devices.	Passed
Usability file - ART-USR-09 (V1.10.0)	The ART-Plan was assessed with regards to usability for compliance with each section of IEC 62366	Passed
Usability - Testers qualification (V1.10.0)	This table shows that European medical physicists who have participated in the evaluation have at least an equivalent expertise level compared to a junior US medical physicist (MP), and responsibilities in the radiotherapy clinical workflow are equivalent	N/A
Literature Review and Performance Criteria Extraction Report for ART-Plan (V1.9.0 and V1.10.0)	A literature review is performed to establish acceptance criteria for performance of ART-Plan modules using performance ranges observed from benchmark devices and alternative technologies in the literature. All measures of performance that were established in this document were supported by clinical evidence. It was also demonstrated, from the clinical data, that ART-Plan has a clear	N/A

	clinical relevance in accordance with the clinical state of the art.	
ART-Plan performance testing - Overview (V1.6.1-V1.10.0)	The document summarises all performance tests that have been performed since the last FDA cleared version (1.6.1). It also shows which criteria have been met in each test for all modules of ART-Plan. It demonstrates that all modules of ART-Plan pass at least one performance acceptance criterion and hence are clinically acceptable for release.	Passed
Study Protocol and Report Annotate Performances Summary (V1.9.0)	The testing demonstrated that Annotate provides acceptable contours for the concerned structures on an image of a patient.	Passed
Abdo MRI auto-segmentation performances according to AAPM requirements (V1.8.0)	Mean DSC of each organ was compared with the tolerance threshold of 0.8. After comparing the contours of 3 different experts on the same patient the mean DSC was calculated, compared with the auto-segmentation and was observed to be in every case superior. It is concluded that the auto-segmentation algorithm provides clinical acceptable contours.	Passed
Testing protocol/report - Brain MRI autosegmentation performances according to AAPM requirements	In this test, some organs did not meet the acceptance criteria. However, the value of 0.80 is indicated by the AAPM as the "uncertainty of contouring of the structure" which in fact can be significantly below 0.80 depending on the organ. Thus, we also decided to evaluate in parallel the models with a qualitative evaluation of our predictions (see additional qualitative test below).	Passed
Qualitative validation of autosegmentation performances - Brain (V1.8.0)	All organs except left and right cochlea passed at least one of the acceptance criteria demonstrating that the Annotate module provides acceptable contours on MR brain structures. The MR brain model has been further improved, subjected to further testing, and, after providing acceptable contours for all structures (incl. the cochlea), released in v1.10.0. (see Study Protocol and Report- Autosegmentation performances against inter-expert variability - Brain MR (V1.10.0)).	
Qualitative validation of auto-segmentation performances - Gyneco (V1.8.0)	The testing demonstrates that Annotate provides acceptable contours for a specific list of gynecological structures on a Female pelvis CT image. Three testing methods are used: DICE calculation, Inter-expert DICE calculation and	Passed

	qualitative Indicator. All structures passed at least one of the acceptance criteria and were released.	
Pelvis MRI auto-segmentation tool performances according to AAPM requirements (V1.8.0)	The testing demonstrates that the auto-segmentation algorithm for Pelvis MRIs provides acceptable contours for the concerned structures on an image of a patient. All organs met at least one of the acceptance criteria and therefore were considered acceptable.	Passed
Qualitative & Quantitative validation of fusion performances (V1.9.0)	The study was developed to cover the major clinical use cases in which fusions are used in the radiotherapy workflow and split into as many sub-studies as clinical use cases of fusion in radiotherapy workflow. The results show that both types of fusion algorithms (Rigid & Deformable) in SmartFuse pass the performed tests, and provide valid results for further clinical use in radiotherapy.	Passed
Study Protocol and Report for qualitative validation of fusion performances for tCT_sCT_injected/PET modality (V1.9.0)	The study evaluated the quality of the rigid and the deformable fusion algorithms of the SmartFuse module for the following cases: - CT injected image fuse towards CT image - CT-PET image fuse towards CT image. Both types of fusion algorithms, rigid and deformable, provided clinically acceptable results for the desired clinical uses.	Passed
Study Protocol & Report for qualitative validation of ITV calculation performances for 4D_CT modality (V1.9.0)	The testing evaluated the quality of ITV calculation algorithm of the Annotate module in the case of 4D-CT examinations. Acceptable results were reached for the evaluation of contours propagation.	Passed
Study Protocol and Report for validation of fusion performances for tCT_sMR modality (V1.9.0)	This testing evaluated the performances of the SmartFuse module for the clinical case of fusion of an MRI towards a planning CT to aid in the delineation. Acceptable results were reached for this evaluation.	Passed
Study Protocol and Report for qualitative validation of fusion performances for tMR_sCT modality (V1.9.0)	This study evaluated the performances of the SmartFuse module for fusion of CTs towards planning MRIs for the purpose of electron density transfer. Acceptable results were reached for this evaluation.	Passed
Study Protocol and Report for qualitative & quantitative validation of fusion performances for tMR_sMR modality (V1.9.0)	This study evaluated the performances of the SmartFuse module on the clinical case of using fusion for MRI replannification. Favorable results to the established performance criteria for rigid and deformable registrations, and for all organs, were obtained.	Passed
Protocol for qualitative & quantitative validation of fusion performances for tCT_sCT_replanning modality (V1.9.0)	This study evaluated the quality of the rigid and the deformable fusion algorithms of the SmartFuse module for replanification of CT-based treatments. Acceptable results were reached for this evaluation.	Passed

Pilot study for sample size estimation - literature review (V1.9.0)	The literature review was performed to estimate the appropriate sample size of the testing data set towards demonstrating the performance of the image registration, segmentation and pseudo-CT generation solutions on the basis of the most recent and most relevant scientific literature.	N/A
Autoseg 2D regression test for integration in ART-Plan V1.9.0	The objective of the test was to demonstrate equivalence between the version (V1.9.0) and previous versions of Annotate (V.1.8 and v1.6.1). All organs passed at least one of the defined criteria, and hence were accepted for release in v1.9. Given that equivalence TheraPanacea considers all tests (especially the qualitative ones) performed on previous versions of the software to be still relevant.	Passed
Study Protocol & Report (SPR): External contour non-regression protocol for integration in ART-Plan V1.10.0	This test demonstrates equivalence between the version V.1.10 and V.1.9 of the external contours and show that the new added anatomies in the module Annotate provides clinically acceptable contours. The external contour for all anatomies passed the defined criteria, and hence were accepted for release in the v1.10.	Passed
Testing Protocol/Report - Autoseg CT, MR non-regression test for integration in ART-Plan V1.10.0	This test demonstrates equivalence between the version v.1.10 and v.1.9 of the auto-segmentation models for all structures and shows that the updated models provide clinically acceptable contours. All organs passed the defined criteria, and were hence accepted for release in the v1.10.	Passed
Study Protocol and Report Qualitative Validation of Annotate in ART-Plan V1.10.0 for Thorax	This test demonstrates that Annotate provides acceptable contours for structures of the thorax region: thoracic aorta and bronchial trees. This qualitative test was performed as an addition to Section 18.21 to ensure the contours are clinically acceptable.	Passed
Study Protocol and Report- Autosegmentation performances against inter-expert variability - Brain MR (V1.10.0)	This test demonstrates that the Annotate provides clinically acceptable (compared to inter-expert variability) for all MR-T1 Brain structures. Existing structures present in the previous version (v.1.8 - see Section 18.8) were also re-evaluated since a complete retraining of the model was done.	Passed
Study Protocol and Report Qualitative Validation of Annotate in ART-Plan V1.10.0 for Pelvis Truefisp model	This test demonstrates that the module Annotate provides acceptable contours for 9 organs evaluated on MR Truefisp images of patients. All organs have passed the acceptance criterion of reaching a percentage of at least 85% of A or B (qualitative evaluation) and hence can be released in v.1.10.0.	Passed
Study Protocol and Report Qualitative Validation of Annotate in ART-Plan V1.10.0 for H&N Lymph nodes	This test demonstrates that Annotate provides acceptable contours for following cervical lymph nodes levels: Ia, Ib right, VIIa left, VIIb right, II left, III right, V left, IVb right, IVb left. All cervical lymph nodes having reached a percentage of at least	Passed

	85% of A or B, the performance of auto segmentation is demonstrated, and hence all structures were included in V1.10.	
Study Protocol and Report Qualitative Validation of Annotate in ART-Plan V1.10.0	This test demonstrates that Annotate provides clinically acceptable contours, following qualitative measures, for the new version v.1.10. It serves as an additional evaluation to Section 18.21, and was done on a set of organs of all anatomies for both the CT and MR models. The benchmarking was done not only against the qualitative evaluation but also against the manual contours and a previously validated version of the models. All contours can be considered as acceptable as at least one criterion was met for each of the included structures.	Passed
Study Protocol and Report Annotate Performances Summary (V1.10.0)	The purpose of this document is to describe all the testing protocols and testing results for validating the performance of the Annotate module. Since all organs added in v.1.10.0 of Annotate have passed at least one test and met at least one acceptance criteria, all organs have been released.	Passed
Testing: pseudo-CT clinical performance and comparison to predicates (pelvis) (V1.10.0)	The evaluation demonstrated the non-inferiority of using Annotate's pseudo-CT for treatment planning in terms of dosimetric measures as compared to CT-based treatment planning. Our pseudo-CT for pelvis has shown to produce results that meet the acceptance criteria derived from clinical practice and literature review as well as to perform at least as good as two FDA cleared devices for pseudo-CT generation.	Passed
Testing: pseudo-CT clinical performance and comparison to predicates (brain) (V1.10.0)	The evaluation demonstrated the non-inferiority of using Annotate's pseudo-CT for treatment planning in terms of dosimetric measures as compared to CT-based treatment planning. Our pseudo-CT for pelvis has shown to produce results that meet the acceptance criteria derived from clinical practice and literature review as well as to perform at least as good as two FDA cleared devices for pseudo-CT generation.	Passed
Study Protocol & Report (SPR): Testing: Autosegmentation performances against predicates (V1.10.0)	This evaluation demonstrated the non-inferiority of using ART-Plan v1.10.0 for annotation of organs as compared to other devices which have been cleared for use in the US. In addition, ART-Plan v1.10.0 offers almost 3 times (2.72) more organs than MIM/ContourProtege AI, which represents an additional benefit to the users as compared to other devices.	Passed
Study Protocol & Report (SPR): Autosegmentation	In this test, Annotate demonstrated equivalent performances between non-US and US population	Passed

performances on Thorax US data (V1.10.0)	for the Thorax localisation. Considering that this is a worst case scenario of morphological deformation due to factors such as age, gender or weight in abdominal region, we claim that considering any localisation included in the intended use of ART-Plan, any autosegmentation result demonstrated on a non-US population can be generalized to a US population. Nonetheless, TheraPanacea has performed an additional evaluation on pediatric US-data covering all other localisations included in the intended use of the device.	
Clinical evaluation of automatic segmentation on Pediatric images (V1.10.0)	Considering the fact that all the structures have reached a percentage of 90% (>=85%) of A or B for the MR brain model, and that 11/15 structures passed with success for the CT model, Therapanacea claims that the performance of auto segmentation on said organs has been demonstrated for the studied population. These results highlight the high generalizability of the commercial tool, initially made for adults, to pediatric cases and its clinical implementation feasibility. Note that this study served to demonstrate that ART-Plan's Annotate, trained on European data, can be generalised to the US population given that it would be clinically acceptable even for pediatric cases where a more prominent change in size is expected than the one between two adults from different countries. This does not mean that TheraPanacea is claiming that ART-Plan should be used for pediatric patients.	Passed
System Verification and Validation Testing	The system verification and validation testing was performed to verify the software of the ART-Plan.	Passed

Software Verification and Validation Testing

Software verification and validation testing were conducted, and documentation was provided as recommended by FDA's Guidance for Industry and FDA Staff, "Guidance for the Content of Premarket Submissions for Software Contained in Medical Devices."

The software for this device was considered as a "major" level of concern, since a failure or latent design flaw could directly result in death or serious injury to the patient or a failure or provide diagnostic information that directly drives a decision regarding treatment or therapy, such that if misapplied it could result in serious injury or death.

Animal Studies

No animal studies were conducted as part of submission to prove substantial equivalence.

Clinical Studies

No clinical studies were conducted as part of submission to prove substantial equivalence.

Safety and Effectiveness/Conclusion:

Based on the information presented in these 510(k) premarket notifications the TheraPanacea ART-Plan is considered substantially equivalent. The TheraPanacea ART-Plan is as safe and effective as the currently marketed predicate devices.

Based on testing and comparison with the predicate devices, TheraPanacea ART-Plan indicated no adverse indications or results. It is our determination that the TheraPanacea ART-Plan performs within its design specifications and is substantially equivalent to the predicate device.