Varian Medical Systems Inc.
% Lynn Allman
Sr. Director Regulatory Affairs
Varian Medical Systems, Inc
3100 Hansen Way
PALO ALTO, CA 94304

April 30, 2024

Re: K232923
Trade/Device Name: Ethos Treatment Management 3.0, Ethos Treatment Planning 2.0
Regulation Number: 21 CFR 892.5050
Regulation Name: Medical Charged-Particle Radiation Therapy System
Regulatory Class: Class II
Product Code: IYE, MUJ
Dated: April 1, 2024
Received: September 20, 2023

Dear Lynn Allman:

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,

Lora D. Weidner, Ph.D.
Assistant Director
Radiation Therapy Team
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: 06/30/2023
See PRA Statement below.

Submission Number *(if known)*

K232923

Device Name

Ethos Treatment Management (3.0);
Ethos Treatment Planning (2.0)

Indications for Use *(Describe)*

Ethos Treatment Management is indicated for use in managing and monitoring radiation therapy treatment plans and sessions.

Ethos Treatment Planning is indicated for use in generating and modifying radiation therapy treatment plans.

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.

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510(k) Summary

I. SUBMITTER CONTACT DETAILS

Applicant Name	Varian Medical Systems, Inc.
Applicant Address	3100 Hansen Way Palo Alto, CA 94304
Applicant Contact Telephone	+1 (650) 424 5369 (phone) | +1 (650) 646 9200 (fax)
Applicant Contact	Dr. Lynn Allman Sr. Director, Regulatory Affairs
Applicant Contact Email	submissions.support@varian.com
Date	12 January 2024

II. DEVICE NAME

This is a bundled 510(k) for two devices: Ethos Treatment Management and Ethos Treatment Planning. The devices are submitted together to ensure that the shared scientific and regulatory considerations they raise are addressed within one review.

Device Trade name:	Ethos Treatment Management, version 3.0	Ethos Treatment Planning, version 2.0
Common name:	Treatment plan and image management application	Treatment planning system
Classification name:	Medical charged particle radiation therapy system (21 CFR 892.5050)	Medical charged particle radiation therapy system (21 CFR 892.5050)
Regulatory class:	Class II	Class II
Product code:	IYE	MUJ

III. LEGALLY MARKETED PREDICATE DEVICES

Predicate device:	Ethos Treatment Management, version 2.1 (K212294)	Ethos Treatment Planning, version 1.1 (K212294)

IV. DEVICE DESCRIPTION SUMMARY

Device Description:	Ethos Treatment Management is a software product designed to help radiation therapy medical professionals manage treatments for patients with malignant or benign diseases for whom radiation therapy is indicated. It allows the physician to create and communicate radiation treatment intent (RT intent) to the treatment planner, review and approve candidate plans, and monitor treatment progress. It is intended to be used with a treatment planning system to treat or alleviate disease in humans by streamlining the treatment management and monitoring processes.	Ethos Treatment Planning is a standalone software device designed to generate and modify radiation therapy treatment plans and manage treatment sessions. The device supports the traditional and adapted treatments, in which the scheduled plan is adapted to the patient's anatomy at the time of treatment.

V. INTENDED USE AND INDICATIONS FOR USE

Intended Use:	Ethos Treatment Management is used to manage and monitor radiation therapy treatment plans and sessions; it is intended to be used with a treatment planning system. *(Same as predicate)*	Ethos Treatment Planning is used to generate and modify radiation therapy treatment plans. *(Same as predicate)*
Indications for Use:	Ethos Treatment Management is indicated for use in managing and monitoring treatment plans and sessions. *(Same as predicate)*	Ethos Treatment Planning is indicated for use in generating and modifying radiation therapy treatment plans. *(Same as predicate)*

VI. TECHNOLOGICAL COMPARISON

Ethos Treatment Management:

There are identical technological characteristics and features that apply to the subject device and predicate. Both the subject device and the predicate device provide tools for qualified medical professionals to do initial planning, review and approve candidate plans, and monitor ongoing treatments for patients to be treated with radiation therapy. The significant differences between the subject device and predicate device are the following:

- High fidelity mode support
- AI segmentation deep learning algorithms added to contouring
- Hypersight images supported as planning images
- Handling of image only sessions
- Ethos – ARIA Coexistence in ARIA connected mode

These modifications do not raise different questions of safety and effectiveness. The verification and validation demonstrate that the device is as safe and effective as the predicate.

Ethos Treatment Planning:

Both the new device and the predicate device perform treatment planning, provide tools for qualified medical professionals to manage treatment sessions and adapt plans for patients to be treated with radiation therapy. A subset of features is different. The significant differences in design for Ethos Treatment Planning 2.0 when compared to the predicate are:

- Enhanced Intelligent Optimizer Engine (IOE)
- High Fidelity Mode on IOE
- New Beam Geometry Optimizer
- AI segmentation – additional anatomical site support
- Enhancement of target propagation
- Support HyperSight CBCT – direct CBCT dose calculation

These differences are all considered by Varian to be minor enhancements of the predicate. There are no changes in the principle of operation of the device. The verification and validation demonstrate that the device is as safe and effective as the predicate.

VII. NON-CLINICAL AND/OR CILINICAL TESTS SUMMARY & CONCLUSIONS

The following performance data were provided in support of the substantial equivalence determination.

Ethos Treatment Management 3.0 and Ethos Treatment Planning 2.0 has undergone formal design verification and design validation testing. Design verification and design validation testing demonstrates that Ethos Treatment Management 3.0 and Ethos Treatment Planning 2.0 performs as intended and meets its essential performance. The software for the subject device is considered to have a “major” level of concern, since a failure or latent flaw in the software could directly result in serious injury or death to the patient or operator.

Software Verification and Validation Testing

Software design verification and design validation testing was performed according to the FDA Quality System Regulation (21 CFR §820), ISO 13485 Quality Management System Standard, ISO 14971 Risk Management Standard, and IEC 62304 Software Life Cycle Process standard. Test results demonstrate conformance to applicable requirements specifications and assure hazard safeguards function properly. Software design verification and design validation testing was conducted, and documentation is 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” (June 2023).

No animal studies or clinical tests have been included in this submission.

AI Model Validation

The following are details on the validation charatseristics for the AI models:

Validation Characteristic	As applied in the Subject Device:
Characterization of Model Performance	Organs are detected on the patient image via artificial intelligence (AI) segmentation models. These models consist of convolutional neural networks, the weights of which are static. They are not adapted during the operation of the product. That means, the models do not continuously learn and thus do not alter their behavior over time based on user input.

	The AI models operate on image resolutions that are suitable for representation of the organs they were trained for. Patient images are re sampled before inference (running the detection network). After inference, the resulting label maps are sampled back onto the patient image grid. Contouring performance undergoes rigorous evaluation through verification and validation processes. The verification process aims to identify eligible models for subsequent validation. This initial stage relies on quantitative metrics such as the DICE similarity coefficient. The DICE coefficient serves as a comparison benchmark against references published in the literature, especially when introducing a model for a new organ. In cases of model replacement, DICE is computed to ensure non regression with respect to models already in production. The validation process emulates the usage of the auto contouring solution in clinical practice. Experts, including radiation oncologists, dosimetrists, and physicists from various healthcare facilities worldwide, evaluated the quality of the contours across test sets to assess the need and the type of contour adjustments, which consequently gives an estimate of the time saved on contouring tasks. Models were only considered eligible for production if they consistently produced contours that needed minor or no adjustments in at least 80% of the test cases.
Number of Patients and Samples in Dataset	For the training datasets, a variety of subjects and scans were used according to the body site of interest. The overall total number of training scans used was 4769, while the total for testing scans was 1045. These scans consisted of the following body sites with the respective patient count (*#, inclusive of training and testing subjects*): full body (179), head and neck (1173), thorax (600), abdomen (527), bowel (507), and pelvis (1192).
Demographic, clinical subgroups, and confounding details	The scans are obtained from different patient subgroups which are primarily comprised of those with treatment indications for cancers (assorted tumors, brain cancer, lung cancer, breast cancer, liver cancer, pancreatic cancer, stomach cancer, adrenal cancer, bladder cancer, prostate cancer, cervical cancer, vaginal cancer, uterus cancer, rectal cancer, anal cancer, and/or spinal cancer). Some scans came from post prostatectomy or post hysterectomy sourcing. Patient demographics from a large portion of the scans are anonymized, but the largest number and percentage proportionally of scans originated from patients in the United States. Other confounding details in the images used to train and test models would include contrasting agents, catheters, radioactive seeds, compression devices, external devices (tracheostomy tubes), breast implants, teeth implants, and/or radiotherapy masks.

Equipment and protocols used to collect images	The scans are comprised of CBCT (734 *training*, 398 *testing*) and CT (4035 *training*, 647 *testing*) image types; these were obtained on a variety of scanner manufacturers and models, including systems from GE Medical Systems (553 *total*), Phillips (1194), Siemens (274), Varian Medical Systems (1973), and others. The patient position for most of the scans (~90%) was head first supine (HFS).
Development of Ground Truth	Ground truth annotations were established by human anatomy experts as part of the algorithm development following RTOG and DAHANCA clinical guidelines. A single set of contours was produced for each training image. These clinical experts have significant clinical experience in segmentation of CT imaging for the different disease sites covered by the AI models. To ensure accuracy, contour definitions available in contouring guidelines are established prior to contouring tasks.
Data Independence for Training and Test Sets	The partitioning of training and test sets was done at the patient level, such that no scans from a patient could be used within both the training set and the test set.

VIII. CONCLUSIONS

The intended use and indications for use are the same as the predicate device. The overall verification and validation testing for Ethos Treatment Management and Ethos Treatment Planning demonstrates that the device requirements and risk control measures perform as intended at a level similar to the predicate. The subject device and the predicate device have the same intended use, and the significant differences do not result in a new intended use. Varian, therefore, believes that Ethos Treatment Management 3.0 and Ethos Treatment Planning 2.1 are substantially equivalent to their respective predicate devices.