June 26, 2020

iSchemaView, Inc.
% Mr. James Rosa
VP Quality and Regulatory
433 Park Point Drive, Suite 220
GOLDEN CO 80401

Re: K200760
Trade/Device Name: Rapid ASPECTS
Regulation Number: 21 CFR 892.2060
Regulation Name: Radiological computer-assisted diagnostic software for lesions suspicious of cancer
Regulatory Class: Class II
Product Code: POK
Dated: May 23, 2020
Received: May 27, 2020

Dear Mr. Rosa:

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,

Thalia T. Mills, Ph.D.
Director
Division of Radiological Health
OHT7: Office of In Vitro Diagnostics
and 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: 06/30/2020
See PRA Statement below.

510(k) Number *(if known)*
K200760

Device Name
Rapid ASPECTS

Rapid ASPECTS is a computer-aided diagnosis (CADx) software device used to assist the clinician in the assessment and characterization of brain tissue abnormalities using CT image data. The Software automatically registers images and segments and analyzes ASPECTS Regions of lnterest (ROIs). Rapid ASPECTS extracts image data for the ROI(s) to provide analysis and computer analytics based on morphological characteristics. The imaging features are then synthesized by an artificial intelligence algorithm into a single ASPECT (Alberta Stroke Program Early CT) Score. Rapid ASPECTS is indicated for evaluation of patients presenting for diagnostic imaging workup with known MCA or ICA occlusion, for evaluation of extent of disease. Extent of disease refers to the number of ASPECTS regions affected which is reflected in the total score. This device provides information that may be useful in the characterization of early ischemic brain tissue injury during image interpretation (within 6 hours). Rapid ASPECTS provides a comparative analysis to the ASPECTS standard of care radiologist assessment using the ASPECTS atlas definitions and atlas display including highlighted ROIs and numerical scoring.

Limitations:

1. Rapid ASPECTS is not intended for primary interpretation of CT images, it is used to assist physician evaluation.
2. Rapid ASPECTS has been validated in patients with known MCA or ICA Occlusion prior to ASPECT scoring.
3. Use of the Rapid ASPECTS Module in clinical settings other than early brain ischemia (within 6 hours) caused by known ICA or MCA occlusions has not been tested.
4. Rapid ASPECTS has been validated and is intended to be used on GE Lightspeed VCT Scanners.

Contraindications/Exclusions/Cautions:

- Patient Motion: excessive motion leading to artifacts that make the scan technically inadequate.
- Hemorrhagic Transformation, Hematoma
- Very thin or no Ventricles

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

iSchemaView, Inc.'s Rapid ASPECTS

This document contains the 510(k) summary for the iSchemaView Rapid ASPECTS. The content of this summary is based on the requirements of 21 CFR Section 807.92(c).

Applicant Name and Address:

Name:	iSchemaView, Inc.
Address:	433 Park Point Drive Ste. 220 Golden, CO 80401
Official Contact:	Jim Rosa Phone: (303) 704-3374 Email: rosa@ischemaview.com

Summary Preparation Date: May 23, 2020

Device Name and Classification:

Trade Name:	Rapid ASPECTS
Common Name:	CADx
Classification:	II
Product Code:	POK
Regulation No:	21 C.F.R. §892.2060
Classification Panel:	Radiology Devices

Predicate Devices:

The iSchemaView Rapid is claimed to be substantially equivalent to the following legally marketed predicate device:

QuantX (DEN170022)

Device Description:

Rapid ASPECTS Module

Rapid ASPECTS provides an automatic ASPECT score based on the case input file for the physician. The score includes which ASPECT regions are identified based on regional imaging features derived from non-contrast computed tomography (NCCT) brain image data. The results are generated based on the Alberta Stroke Program Early CT Score (ASPECTS) guidelines and provided to the clinician for review and verification. At the discretion of the clinician, the scores may be adjusted based on other clinical factors the clinician may integrate though the Rapid Platform User Interface.

The ASPECTS software module processing pipeline performs four major tasks:

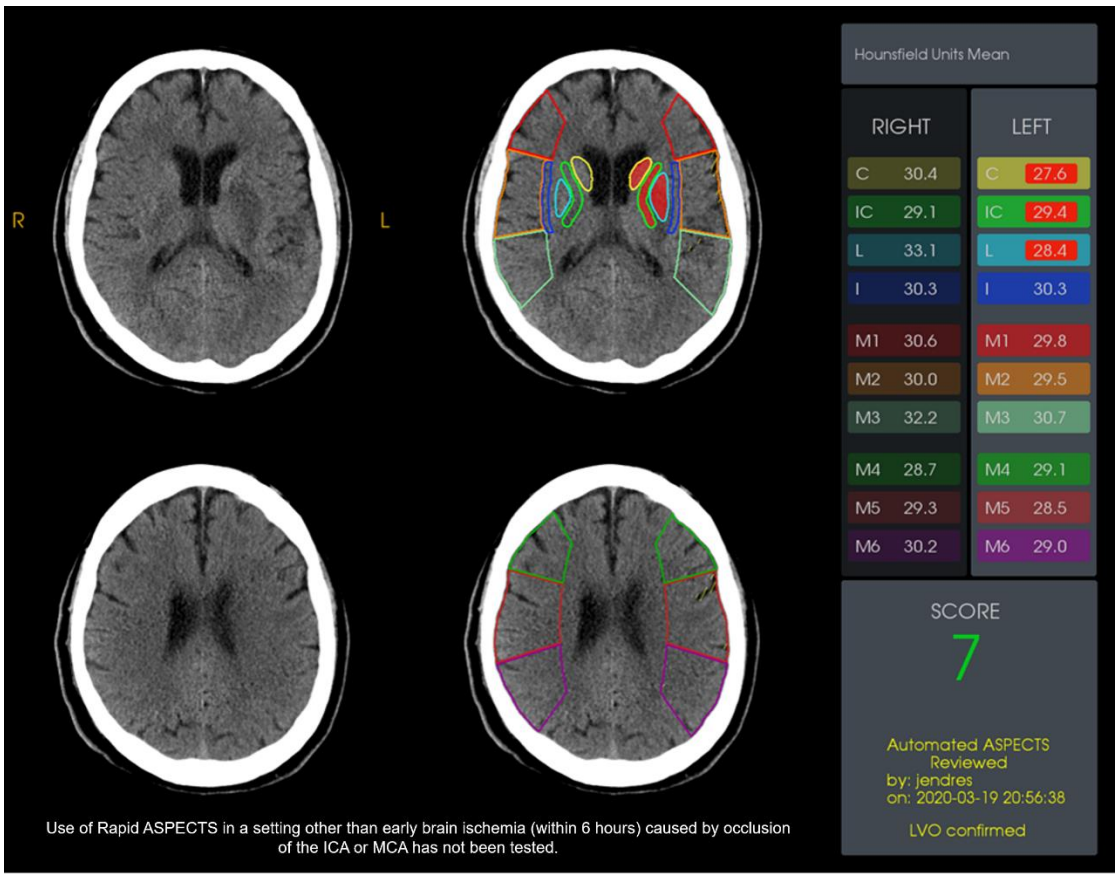
- Orientation and spatial normalization of the input imaging data (rigid registration/alignment with anatomical template);

- Delineation of pre-defined regions of interest on the normalized input data and computing numerical values characterizing underlying voxel values within those regions;
- Identification and highlighting previous/old stroke areas along with areas of early ischemic change; and
- Labeling of these delineated regions and providing a summary score reflecting the number of regions with early ischemic change as per ASPECTS guidelines.

Subsequently, the system notifies the physician of the availability of the ASPECT score which then requires the confirmation by the physician that a Large Vessel Occlusion (LVO) is detected. The ASPECTS information is then available for the physician to review and edit prior to pushing the data to a PACS or Workstation. The final summary score together with the regions selected and underlying voxel values are then sent to the Picture Archiving and Communication System (PACS) to become a part of the permanent patient medical record.

Clinical Characteristics

The images generated by Rapid ASPECTS provide additional diagnostic information, which is derived from the temporal/diffusion/density features of the native CT images. The following figure provides a general layout of the ASPECTS display image as provided from Rapid ASPECTS.



Indications for Use:

Rapid ASPECTS is a computer-aided diagnosis (CADx) software device used to assist the clinician in the assessment and characterization of brain tissue abnormalities using CT image data. The Software automatically registers images and segments and analyzes ASPECTS Regions of lnterest (ROIs). Rapid ASPECTS extracts image data for the ROI(s) to provide analysis and computer analytics based on morphological characteristics. The imaging features are then synthesized by an artificial intelligence algorithm into a single ASPECT (Alberta Stroke Program Early CT) Score.

Rapid ASPECTS is indicated for evaluation of patients presenting for diagnostic imaging workup with known MCA or ICA occlusion, for evaluation of extent of disease. Extent of disease refers to the number of ASPECTS regions affected which is reflected in the total score.

This device provides information that may be useful in the characterization of early ischemic brain tissue injury during image interpretation (within 6 hours). Rapid ASPECTS provides a comparative analysis to the ASPECTS standard of care radiologist assessment using the ASPECTS atlas definitions and atlas display including highlighted ROIs and numerical scoring.

Limitations:

1. Rapid ASPECTS is not intended for primary interpretation of CT images, it is used to assist physician evaluation.
2. Rapid ASPECTS has been validated in patients with known MCA or ICA Occlusion prior to ASPECT scoring.
3. Use of the Rapid ASPECTS Module in clinical settings other than early brain ischemia (within 6 hours) caused by known ICA or MCA occlusions has not been tested.
4. Rapid ASPECTS has been validated and is intended to be used on GE Lightspeed VCT Scanners.

Contraindications/Exclusions/Cautions:

- Patient Motion: excessive motion leading to artifacts that make the scan technically inadequate.
- Hemorrhagic Transformation, Hematoma
- Very thin or no Ventricles

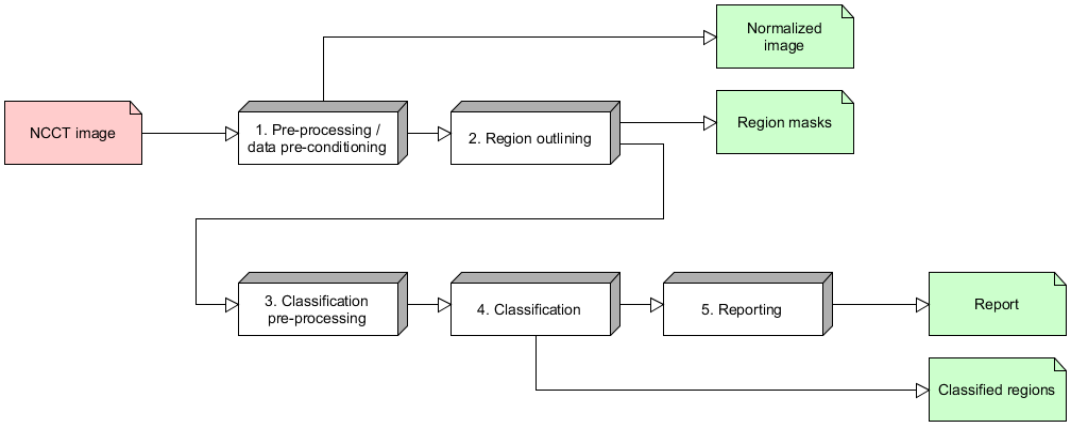
Technological Characteristics:

Rapid ASPECTS is a machine learning implementation using the processing pipeline below. Rapid ASPECTS provides an automatic ASPECT score based on the case input file for the physician. The score includes which ASPECT regions are identified based on regional imaging features derived from non-contrast computed tomography (NCCT) brain image data based on the random forest machine learning technique. The results are generated based on the Alberta Stroke Program Early CT Score (ASPECTS) guidelines and provided to the clinician for review and verification. At the discretion of the clinician, the scores may be adjusted based on the clinician's judgment as well as other factors the clinician may integrate though the Rapid Platform User Interface.

The red box denotes input data (e.g. patient imaging data) which is processing through the PACS and Rapid platform, the white boxes denote the Rapid ASPECTS architecture which generates analysis data for output results (Green Boxes) for display to the user

through the Rapid platform UI. The Rapid ASPECTS software module processing pipeline performs four major tasks:

- Orientation and spatial normalization of the input imaging data (rigid registration/alignment with anatomical template);
- Delineation of pre-defined regions of interest on the normalized input data and computing numerical values characterizing underlying voxel values within those regions;
- Identification and highlighting previous/old stroke areas along with areas of early ischemic change; and
- Labeling of these delineated regions and providing a summary score reflecting the number of regions with early ischemic change as per ASPECTS guidelines.



Rapid ASPECTS Processing Pipeline Architecture

Performance Standards:

Rapid has been developed in conformance with the following standards, as applicable:

ISO 14971:2019	Application of Risk Management to Medical Devices
IEC 62304:2015	Medical device software – Software lifecycle processes
IEC 62366:2015	Application of Usability Engineering to Medical Devices
NEMA PS 3.1 - 3.20	Digital Imaging and Communications in Medicine (DICOM)

Performance Data:

Rapid complies with DICOM (Digital Imaging and Communications in Medicine) - Developed by the American College of Radiology and the National Electrical Manufacturers Association. NEMA PS 3.1 - 3.20.

Additionally, iSchemaView conducted extensive performance validation testing and software verification and validation testing of the Rapid ASPECTS module both as standalone software and as integrated within the Rapid Platform. This performance validation testing demonstrated that the Rapid ASPECTS module provides accurate representation of key processing parameters under a range of clinically relevant parameters and perturbations associated with the intended use of the software. Software performance, validation and verification testing demonstrated that the Rapid ASPECTS module met all design requirements and specifications.

The reader study design was a concurrent read, cross-over study design with 50 cases with each of 10 regions scored independently. Data truthing was performed by three experts. Eight readers were used to represent the intended use population.

Performance was independently tested against expert neuroradiologist readers and indicated that a wide range of readers (neurologists, radiologists, emergency medicine, neurocritical care specialists) benefited from the Rapid ASPECTS and significantly increased their agreement with an expert consensus read when considering all ASPECTS regions in all patients evaluated ($P<0.0001$). With Rapid ASPECTS readers agreed, on average, with almost ½ a region 0.425 (95% CI 0.11 – 0.74) more per scan than without Rapid ASPECTS. Use of Rapid ASPECTS led to non-neuroradiologists to improve their level of agreement from 73.6% to 79.8% which is comparable to the agreement achieved by expert neuroradiologist readers with each other.

Prescriptive Statement:

Caution: Federal law restricts this device to sale by or on the order of a physician.

Safety & Effectiveness:

Rapid ASPECTS has been designed, verified and validated in compliance with 21 CFR, Part 820.30 requirements. The device has been designed to meet the requirements associated with EN ISO 14971:2019 (risk management). The Rapid ASPECTS performance has been validated using digital phantoms, retrospective data from case data and through the use of Reader comparison analysis.

Substantial Equivalence:

QuantX (DEN170022) under regulation 21 C.F.R. §892.2060 CADx is the predicate device for Rapid ASPECTS. While the disease/clinical use is different, the generic definition of CADx provides substantial equivalence between the two devices. The QuantX and Rapid ASPECTS assist the radiologists (clinicians) in the assessment and characterization of morphological features of their respective focus areas using imaging data. The software in both, registers, segments and analyzes regions of interest (ROI) to provide computer analytics. The identified/extracted features are then synthesized by artificial intelligence algorithms into clinical reference scores. Both devices provide localization information: the QuantX based on a database of abnormalities with known ground truth; Rapid ASPECTS based on the ASPECTS Atlas regions. The features are compared in the following table, as well as the Risk Benefit Analysis in the next paragraph is comparative to the predicate:

Substantial Equivalence Table		
Comparison Feature	QuantX (DEN170022)	Rapid ASPECTS
Indications for Use	QuantX is a computer-aided diagnosis (CADx) software device used to assist radiologists in the assessment and characterization of breast abnormalities using MR image data. The software automatically registers images and segments and analyzes user-selected regions of interest (ROI). QuantX extracts image data from the ROI to provide volumetric analysis and computer analytics based on morphological and enhancement characteristics. These imaging (or radiomic) features are then synthesized by an artificial intelligence algorithm into a single value, the QI score, which is analyzed relative to a database of reference abnormalities with known ground truth. QuantX is indicated for evaluation of patients presenting for high-risk screening, diagnostic imaging workup, or evaluation of extent of known disease. Extent of known disease refers to both the assessment of the boundary of a particular abnormality as well as the assessment of the total disease burden in a particular patient. In cases where multiple abnormalities are present, QuantX can be used to assess each abnormality independently. This device provides information that may be useful in the characterization of breast abnormalities during image interpretation. For the QI score and component radiomic features, the QuantX device provides comparative analysis to lesions	Rapid ASPECTS is a computer-aided diagnosis (CADx) software device used to assist the clinician in the assessment and characterization of brain tissue abnormalities using CT image data. The Software automatically registers images and segments and analyzes ASPECTS Regions of Interest (ROIs). Rapid ASPECTS extracts image data for the ROI(s) to provide analysis and computer analytics based on morphological characteristics. The imaging features are then synthesized by an artificial intelligence algorithm into a single ASPECT (Alberta Stroke Program Early CT) Score. Rapid ASPECTS is indicated for evaluation of patients presenting for diagnostic imaging workup, or evaluation of extent of disease. Extent of disease refers to the number of ASPECTS regions affected which is reflected in the total score. This device provides information that may be useful in the characterization of early ischemic brain tissue injury during image interpretation. Rapid ASPECTS provides a comparative analysis to the ASPECTS standard of care radiologist assessment using the ASPECTS atlas definitions and atlas display including highlighted ROIs and numerical scoring. Limitations: 1. Rapid ASPECTS is not intended for primary interpretation of CT images. It is used to assist physician evaluation. 2. Rapid ASPECTS has been validated in patients with known MCA or ICA occlusion prior to ASPECT scoring.

Substantial Equivalence Table		
Comparison Feature	QuantX (DEN170022)	Rapid ASPECTS
	with known outcomes using an image atlas and histogram display format. QuantX may also be used as an image viewer of multi-modality digital images, including ultrasound and mammography. The software also includes tools that allow users to measure and document images, and output in a structured report. Limitations: QuantX is not intended for primary interpretation of digital mammography images.	3. Use of the Rapid ASPECTS Module in clinical settings other than early brain ischemia (within 6 hours) caused by known ICA or MCA occlusions has not been tested. 4. Rapid ASPECTS has been validated and is intended to be used on GE Lightspeed VCT Scanners. Contraindications/Exclusions/Cautions: • Patient Motion: excessive motion leading to artifacts that make the scan technically inadequate. • Hemorrhagic Transformation, Hematoma • Very thin or no Ventricles
Clinical Application/Anatomical Region	Cancer Lesion Detection/Breast	Stroke/Head
Standard of Care Representation	QI Scoring	ASPECT Scoring
Primary Imaging Modalities	MR	CT
Technical Implementation	ML/AI/Neural Network	ML/AI/Random Forest
Image Overlay	ROI box	ASPECTS Atlas ROIs, highlighted by algorithms.
Primary User(s)	Radiologist	Neuroradiologist/Clinician
Alteration of original image data base	No	No
Alters Standard of Care Workflow	In parallel to	In parallel to

Risk Benefit Analysis:

Risk Benefit Summary	
Summary of Benefits:	This device provides a systematic, automated analysis of NCCT scans of the head to provide a standardized, automated ASPECT score for Stroke workup. The clinical reader study, which included 2 expert neuroradiologists and 6 non-expert typical readers demonstrated a statistically significant improvement in the accuracy of the 8 readers' scores when scoring was performed in conjunction with the Rapid ASPECTS output. In a subgroup analysis, the benefit of the software was most substantial among the non-neuroradiologist readers which typically evaluate CT scans in community hospitals and primary stroke centers. These non-expert readers also evaluate CT scans in comprehensive centers, particularly in the acute setting, when expert neuroradiologists are not immediately available. The software allows the non-expert physician to perform at the expert-like level. Use of the system did not appear to have any significant impact (either positive or negative) on the scores of the 2 expert neuroradiologists who were included in the test reader group. Overall this system should provide a more consistent and timely benefit of standardized reads regardless of physician and center specialty.
Summary of the Risks	There are minimal potential risks associated with the use of the device.
	Incorrect scoring which may result in false positive results and result to incorrect patient management with possible adverse effects such as, unnecessary additional medical imaging and/or unnecessary additional diagnostic workup.
	Incorrect scoring which may result in false negative results may lead to complications, including incorrect diagnosis and delay in disease management.
	The device could be misused to analyze images from an unintended patient population or on images acquired with incompatible imaging hardware or incompatible image acquisition parameters, leading to inappropriate diagnostic information being displayed to the user.
	Device failure could lead to the absence of results, delay of results or incorrect results, which could likewise lead to inaccurate patient assessment.
	However, based on the performance data and the application of mitigating measures (general controls and special controls established for this device type), use of

Risk Benefit Summary	
	the device is unlikely to decrease diagnostic performance of the user and possible misuse of the device does not present additional risks compared with misuse of other types of radiological image processing devices.
Summary of other Factors	The study was enriched to cover the range of ASPECT scores; and, the readers in practice may not experience a significant improvement in determining ASPECTS.
Conclusions: Do the probable benefits outweigh the probable risks.	Yes. The probable benefits outweigh the probable risks, given the combination of required general controls and the special controls established for this device. The Special Controls will sufficiently assist in managing risks associated with incorrect brain tissue characterization determining ASPECT scoring, application of the device results to the wrong patient population, analysis of incompatible images, and/or device failure by ensuring proper performance and use of the device By providing a systematic, automated analysis of NCCT scans of the head to provide a standardized, automated ASPECT score for Stroke workup. The Rapid ASPECTS analytics calculates morphological characteristics of brain tissue using the historical training data and providing results which the attending physician may evaluate and modify based on other presenting conditions of the patient. In addition to the Rapid ASPECTS clinical module, other clinical information is easily accessible within the Rapid System framework such as CTA and CTP to inform the clinical decision-making process. The clinical reader study demonstrates a statistically significant improvement of ASPECTS reads among a diverse sample of 8 typical readers representing multiple specialties, years of practice, and practice settings. By using a gating condition of LVO determination to guide ASPECTS use, many of the risks of stroke mimics confounding the scoring will be averted. Overall this system should provide a more consistent and timely benefit of standardized reads regardless of physician and center specialty. Therefore, given the available information concerning the benefits, risks, and supporting data; the probable benefits outweigh the probable risks, given the combination of required general controls and special controls established for this device.

Conclusion:

The Rapid ASPECTS and the predicate device are intended to aid in the assessment of specific disease states using standard of care scoring using machine learning/artificial intelligence algorithms. The devices use ROI based assessments. The Rapid ASPECTS ROIs are based on an ASPECTS defined atlas; the Quantx ROI is selected by the user. Both devices are SaMD's with similar algorithm development approaches using variants of artificial intelligence implementations. Both devices analyze imaging modalities to highlight morphological and feature differences. While the clinical focus of the two devices are different, the approaches undertaken generically fit within the CADx designation.

The company proposes the Rapid ASPECTS is substantially equivalent to the QuantX predicate.