510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY

I Background Information:

A 510(k) Number

K232833

B Applicant

Indica Labs, Inc.

C Proprietary and Established Names

HALO AP Dx

D Regulatory Information

Product Code(s)	Classification	Regulation Section	Panel
QKQ	Class II	21 CFR 864.3700 - Whole Slide Imaging System	PA - Pathology

II Submission/Device Overview:

A Purpose for Submission:

New device

B Type of Test:

Software only device

III Intended Use/Indications for Use:

A Intended Use(s):

See Indications for Use below.

B Indication(s) for Use:

For In Vitro Diagnostic Use

HALO AP Dx is a software only device intended as an aid to the pathologist to review, interpret and manage digital images of scanned surgical pathology slides prepared from formalin-fixed paraffin embedded (FFPE) tissue for the purposes of pathology primary diagnosis. HALO AP Dx is not intended for use with frozen section, cytology, or non-FFPE hematopathology specimens.

It is the responsibility of a qualified pathologist to employ appropriate procedures and safeguards to assure the quality of the images obtained and, where necessary, use conventional light microscopy review when making a diagnostic decision. HALO AP Dx is intended for use with the Hamamatsu NanoZoomer S360MD Slide scanner and the JVC Kenwood JD-C240BN01A display.

C Special Conditions for Use Statement(s):

Rx - For Prescription Use Only

IV Device/System Characteristics:

A Device Description:

HALO AP Dx, version 2.1 is a browser-based software-only device intended to aid pathology professionals in viewing, manipulating, management, and interpretation of digital pathology whole slide images (WSI) of glass slides obtained from the Hamamatsu Photonics K.K. NanoZoomer S360MD scanner and viewed on the JVC Kenwood JD-C240BN01A display.

HALO AP Dx is operated as follows:

1. Image acquisition is performed using the predicate device, NanoZoomer S360MD Slide scanner according to its Instructions for Use. The operator performs quality control of the digital slides per the instructions of the NanoZoomer and lab specifications to determine if re-scans are necessary.
2. Once image acquisition is complete, the unaltered image is saved in an external image storage location. HALO AP Dx ingests the image and a copy of image metadata is stored in the subject device's database to improve viewing response times.
3. Scanned images are reviewed by scanning personnel such as histotechnicians to confirm image quality and initiate any re-scans before making it available to the pathologist.
4. The reading pathologist selects a patient case from a selected worklist within HALO AP Dx whereby the subject device fetches the associated images from external image storage.
5. The reading pathologist uses the subject device to view the images and can perform the following actions, as needed:
    a. Zoom and pan the image.
    b. Measure distances and areas in the image.
    c. Annotate images.
    d. View multiple images side by side in a synchronized fashion.
6. The above steps are repeated as necessary.

After viewing all images belonging to a particular case (patient), the pathologist will make a diagnosis which is documented in another system, such as a Laboratory Information System (LIS).

The interoperable components of HALO AP Dx and other system specifications are provided in tables 1 – 4 below.

Table 1. Interoperable Components for Use with HALO AP Dx

Components	Manufacturer	Model
Scanner	Hamamatsu	NanoZoomer S360MD Slide scanner
Display	JVC	JD-C240BN01A

Table 2. Client System Requirements

Workstation Component	Specifications
Processor	Intel Core i7 CPU
Memory	16 GB or more
Network connectivity	100 Mbps (1 Gbps recommended) connection
Keyboard/ Mouse / Trackpad	Standard Keyboard and Mouse Input Devices
Operating system	Windows 10
Supported browsers	Google Chrome version 116 and above Microsoft Edge version 116 and above
Antivirus software	The following anti-virus software has been validated for use: - Microsoft Windows Defender - Trend Micro - Webroot

Table 3. Server System Requirements

Server	Operating System	Memory	Processor
Component Server, Processing Node Server, File Monitor Server	Windows Server 2022 Only x64 (64 bit) operating systems are supported	16 GB or more	8 cores or more
NGINX Reverse Proxy	Ubuntu 22.04 Only x64 (64 bit) operating systems are supported	2 GB or more	2 cores or more
MySQL Server	Windows Server 2022 *or* Ubuntu 22.04 Only x64 (64 bit) operating systems are supported	16 GB or more	4 cores or more

Table 4. Server Configurations

Component	Specifications
Network connectivity	1 Gbps (10 Gbps recommended) LAN connection between services
Antivirus software	The following anti-virus software has been validated for use with Windows server: - Microsoft Windows Defender - Trend Micro - Webroot

B Instrument Description Information:

1. Instrument Name:
   HALO AP Dx

2. Specimen Identification:
   HALO AP Dx uses digital pathology images obtained from the Hamamatsu S360 MD scanner of Hematoxylin and Eosin (H&E) stained glass slides. The reading pathologist selects a case (patient) from a worklist (within the device or external to the device) whereby the subject device fetches the associated images from the external image storage. The scanned images are identified based on the previously assigned specimen identifier such as the laboratory specimen accession number.

3. Specimen Sampling and Handling:
   Specimen sampling and handling are performed upstream and independent of the use of the subject device. Specimen sampling includes biopsy or resection specimens which are processed using histology techniques. The FFPE tissue section is Hematoxylin and Eosin (H&E) stained. Digital images are then obtained from these glass slides using the Hamamatsu S360 MD scanner.

4. Calibration:
   Not applicable

5. Quality Control:
   The scanning technician should perform quality control of all glass slides following the instructions. Upon scanning, quality control should be performed on all digital slide images following procedures defined by the scanner manufacturer prior to import into HALO AP Dx.

   The pathologist should review all images to ensure that all expected slides have been imported by viewing the thumbnails and labels, and manually verifying the tissue specimen, block, and staining information is present. Additional details of the quality control procedures are provided in the device User's Guide and the Implementation Guide.

V Substantial Equivalence Information:

A Predicate Device Name(s):

NanoZoomer S360MD Slide scanner system

B Predicate 510(k) Number(s):

K213883

C Comparison with Predicate(s):

Device & Predicate Device(s):	K232833	K213883
Device Trade Name	HALO AP Dx	Hamamatsu NanoZoomer S360MD Slide scanner system
General Device Characteristic Similarities		
Intended Use/Indications For Use	HALO AP Dx is a software only device intended as an aid to the pathologist to review, interpret and manage digital images of scanned surgical pathology slides prepared from formalin-fixed paraffin embedded (FFPE) tissue. HALO AP Dx is not intended for use with frozen section, cytology, or non-FFPE hematopathology specimens. It is the responsibility of a qualified pathologist to employ appropriate procedures and safeguards to assure the quality of the images obtained and, where necessary, use conventional light microscopy review when making a diagnostic decision. HALO AP Dx is intended for use with the Hamamatsu NanoZoomer S360MD Slide scanner and the JVC Kenwood JD-C240BN01A display.	The NanoZoomer S360MD Slide scanner system ("NanoZoomer System") is an automated digital slide creation, viewing, and management system. The NanoZoomer System is intended for in vitro diagnostic use as an aid to the pathologist to review and interpret digital images of surgical pathology slides prepared from formalin-fixed paraffin embedded ("FFPE") tissue. The NanoZoomer System is not intended for use with frozen section, cytology, or non-FFPE hematopathology specimens. The NanoZoomer System comprises the NanoZoomer S360MD Slide scanner, the NZViewMD Software and the JVC Kenwood JD-C240BN01A display. The NanoZoomer System is for creation and viewing of digital images of scanned glass slides that would otherwise be appropriate for manual visualization by conventional light microscopy. It is the responsibility of a qualified pathologist to employ appropriate

Device & Predicate Device(s):	K232833	K213883
		procedures and safeguards to assure the validity of the interpretation of images obtained using NanoZoomer System.
Specimen Type	Same	Surgical pathology slides prepared from FFPE tissue
Diagnostic Image File Format	Same	Hamamatsu NDPI File
Image Storage	Same	User-supplied network attached storage
General Device Characteristic Differences		
Image Manipulation and Review Functions	Functions for continuous panning and zooming, annotations, image adjustments, distance/area measurements, organize workload and view patient data, export images, and display of diagnostic status of images.	Functions for continuous panning and zooming, annotations, distance/area measurements, track visited areas, export images, discrete Z-axis displacement, and display of diagnostic status of images.
Type of Software Application	Internet browser-based application	PC-based installed application
End User's Interface	HALO AP Dx	NZViewMD

VI Standards/Guidance Documents Referenced:

1. Guidance for Industry "Technical Performance Assessment of Digital Pathology Whole Slide Imaging Devices", April 20, 2016.
2. Guidance for Industry "Applying Human Factors and Usability Engineering to Medical Devices", February 3, 2016.
3. IEC 62304 Edition 1.1 2015-06 CONSOLIDATED VERSION, 13-79. Medical device software – Software life cycle processes.
4. ISO 14971 Third Edition 2019-12, 5-125, Medical devices – Applications of risk management to medical devices.
5. IEC 62366-1 Edition 1.1 2020-06 CONSOLIDATED VERSION, 5-129, Application of usability engineering to medical devices.
6. AAMI TIR 45:2012, 13-36, Guidance on the use of AGILE practices in the development of medical device software.
7. Standards Details / Supplemental Documentation per ISO/IEC 17050-2.

VII Performance Characteristics (if/when applicable):

A Analytical Performance:

1. Precision/Reproducibility:

   Not applicable

2. Linearity:

   Not applicable

3. Analytical Specificity/Interference:

   Not applicable

4. Accuracy (Instrument):

   Not applicable

5. Carry-Over:

   Not applicable

B Other Supportive Instrument Performance Characteristics Data:

Technical performance testing was conducted with HALO AP Dx. The subject device was compared to the predicate device's image review manipulation software (IRMS, as defined in FDA guidance document, "Guidance for Industry – Technical Performance Assessment of Digital Pathology Whole Slide Imaging Devices," dated April 20, 2016) using the quantitative pixel-wise comparison method. The basis for the comparison was the CIEDE2000 color difference equation, ΔE.

1. **Bench Testing - Pixelwise comparison test**

   Pixel-wise comparison testing to demonstrate identical image reproduction was conducted to compare WSIs reproduced by HALO AP Dx and Nanozoomer NZViewMD. The devices were tested as operating with the intended components, including the scanner (Hamamatsu NanoZoomer S360MD Slide scanner), image management system (Nanozoomer NZViewMD, HALO AP Dx with Google Chrome, or HALO AP Dx with Microsoft Edge), and display (JVC Kenwood JD-C240BN01A).

   The device was tested with multiple slides across multiple regions of interest (ROI) at multiple magnification levels. A total of 35 H&E-stained, FFPE glass slides of normal and tumor tissues from various human anatomical organs were used in the testing. The glass slides were scanned on a Hamamatsu NanoZoomer S360MD Slide scanner system to obtain 35 WSIs. For each of the 35 WSIs, 3 ROIs were selected by qualified personnel to represent various features in the tissue samples. Each ROI was captured at 3 magnification levels (10x, 20x, 40x).

The screenshots were captured from the intended display and cropped to generate bitmap images (.bmp) that were ready for pixelwise comparison. Three sets of images were collected: (1) NZViewMD, (2) HALO AP Dx using Google Chrome, and (3) HALO AP Dx using Microsoft Edge. Each image set included 315 images that covered all combinations of 35 slides, 3 ROIs, and 3 magnification levels. The testing data, including the overview images of the 35 glass slides with annotations of the ROIs, registration/cropping information, and captured images, were provided in the FDA specific format.

Image set #1 above was used as the reference to compare image set #2 (or #3) to determine whether all the 315 image-pairs were identical. Two images are considered identical if the 95th percentile of the pixelwise differences, computed using the International Commission on Illumination (CIE) color difference metric CIEDE2000 (ΔE_{00}), is less than 3 ΔE_{00}. Testing results showed that the pixelwise differences across all 630 image-pairs were less than 3 ΔE_{00}. The mean 95th percentile ΔE_{00} value was 1.52 with the lowest value reported as 0.82 and the highest reported as 2.75. Testing results demonstrated that WSIs reproduced by HALO AP Dx are identical to images reproduced by the predicate device.

2. **Turnaround Time**
   Turnaround times for image loading, panning and zooming were tested when using Google Chrome and Microsoft Edge browsers over different magnifications levels and over multiple fields of view (FOVs). Additionally, concurrent, multi-user load testing of the HALO AP Dx Image Server was performed to show that the subject device is responsive under constant utilization over a long period of time. Test results showed these to be adequate for the intended use of the subject device.

3. **Measurements – area and distance**
   Measurement accuracy testing was performed to demonstrate that HALO AP Dx represents length and area measurements accurately across multiple magnification levels. An image of a calibration slide with known object sizes was used to verify the measurement accuracy. A total of 32 annotations were created – 4 annotations (2 horizontal and 2 vertical) at 4 magnification levels in 2 browsers. The intended and reported metrics were recorded for each annotation. The differences between intended and reported measurements were calculated. Test results showed that the subject device performed accurate measurements of length and area across multiple magnification settings with respect to its intended use.

4. **Human Factors (Usability) Testing**
   Usability testing was conducted per FDA's Guidance on Applying Human Factors and Usability Engineering to Medical Devices (2016). A summative human factors test, designed around critical user tasks and use scenarios using multiple representative users (pathologists and histotechnicians), was conducted. All tasks associated with reviewing and reporting results for cases including confirmation that all slides belonging to specific cases are reviewed before reporting results were included in the study. The HALO AP Dx device has been found to be safe and effective for intended users, users and use environments**.**

VIII Proposed Labeling:

The labeling supports the finding of substantial equivalence for this device.

IX Conclusion:

The submitted information in this premarket notification is complete and supports a substantial equivalence decision.