NICOLAB

Instructions for Use

StrokeViewer

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Table of Contents

1. Introduction

Welcome to the StrokeViewer Instructions for Use. Before using StrokeViewer, read the Instructions for Use, especially the Section "2. Safety".

1.1. About these Instructions for Use

These Instructions for Use are intended to assist you in the safe and effective use of StrokeViewer.

The product can be identified via the information provided in the DICOM summary report or the command line interface (CLI; in case of manual deployment). This information can be used to identify for which software tool the Instructions for Use are intended (please consult the installation and configuration manual (NIC-230079) for more information).
The full labeling information of the device is presented in Section "1.2. Label of StrokeViewer". The DICOM summary report will contain the following information:

- Name of the device
- Manufacturer name
- Contact information
- Unique Device Identifier (UDI; including the UDI-DI and UDI-PI)
- URL to the webpage where the Instructions For Use can be accessed.

Before using the product, you must read these Instructions for Use, noting and strictly observing all **WARNING** and **CAUTION** notices. Important safety information is provided in the following manners:

	**WARNING**
	A warning alerts you to a potential serious outcome, adverse event, or safety hazard. Failure to observe a warning may result in death or serious injury to the patient.

	**CAUTION**
	A caution alerts you when special care is necessary for the safe and effective use of the device. Failure to observe a caution may result in moderate injury to the operator or patient, or damage to the equipment, and presents remote risk of more serious injury or environmental pollution.

NOTE	*A note highlights unusual points to assist you when using the device.*

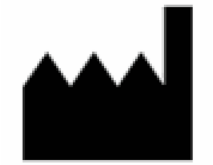
1.2. Label of StrokeViewer

The information provided in this Section gives an overview of the information needed to identify and correctly use the device. Please make sure you read and fully understand this Section. For explanation on the symbols used, please consult the Section "9. Symbols Glossary".

Product	StrokeViewer
Major system version	4
	UDI-DI: 8720299502345
	Initial release: 29-Apr-2025
Intended Purpose	StrokeViewer is an image processing software application that analyzes CT scans and MR perfusion scans of the brain to indicate areas of the brain of suspected stroke patients to indicate areas of the brain with suspected anterior circulation large vessel occlusion (LVO) or hemorrhagic stroke. Additionally, StrokeViewer performs calculations to quantify collateral circulation, brain perfusion, hemorrhagic stroke volume, and ASPECTS. StrokeViewer provides this information to the user to include it as additional data for diagnosis of stroke in suspected stroke patients for the adult population, and to determine treatment. There is no change to the standard of care assessment of suspected stroke patients where the healthcare professional assesses the medical images. StrokeViewer only provides additional imaging data and numerical data that may be taken into consideration by a healthcare professional. StrokeViewer is not intended to be used as a standalone diagnostic tool, and StrokeViewer output should always be interpreted in the context of clinical information about the patient rather than in isolation. The StrokeViewer output is provided as a DICOM report/series.
	Please consult the Instructions For Use for important cautionary information and instructions for use.

MD

Manufacturer and Contact



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No special handling and/or storage conditions apply.

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1.3. Electronic Instructions for Use

These Instructions for Use are available to view in PDF file format. The Instructions for Use can be opened by copying the URL from the DICOM report (or CLI; in case of manual deployment) into the address bar of your browser. After that, an internet page appears that provides you information on minimum requirements to be able to access the Instructions for Use. On this page you will have access to the current version of the Instructions for Use.

NOTE	*Downloaded versions of the Instructions for Use may be outdated, please use the URL provided in the label to have access to the latest version of the Instructions for Use.*

NOTE	*Earlier versions of the Instructions for Use and translations are available via the same URL. Printed versions of this Instructions for Use can be made available on request. Please contact the manufacturer to request printed Instructions for Use.*

NOTE	*Please ensure that you are using a compatible web browser, such as Google Chrome, Microsoft Edge, Mozilla Firefox, Apple Safari or any other browser that supports reading PDF documents, in order to access and view the electronic Instructions for Use.*

1.4. Training

Users of StrokeViewer must have received adequate training on its safe and effective use before using StrokeViewer as described in this Instructions for Use. Users should ensure that they receive adequate training in accordance with local laws and/or regulations. As a minimum level of training, users should read and understand these Instructions for Use.

NOTE	*Do not use the product in clinical practice until you have met the following conditions:* • *You have read, understood and know all the safety information contained in the Section "2. Safety".* • *You have received adequate training in the safe and effective use of Strokeviewer's output. If you are unsure of your ability to use the output in a safe and effective manner, do not use it.*

	• *You have received adequate training on retrieving information from StrokeViewer (e.g., event logs, termination of analysis, Unique Device Identifier (UDI) retrieval).*

For more information about the application training, please contact Nicolab (see Section "1.5. Contacting the Manufacturer").

1.5. Contacting the Manufacturer

You can get in touch with the manufacturer via different contacting channels, e.g., e-mail, telephone, or post:

NICo-Lab B.V.
Address: Paasheuvelweg 25
1105 BP Amsterdam
The Netherlands (NL)
E-mail: support@nicolab.com
Telephone: +31 20 244 0852 (worldwide), 1800 642 652 (AU)

2. Safety

All Nicolab products are designed to meet stringent safety standards. In order to protect patient safety, all medical device software should be installed, used and maintained properly. In order to use the product safe and effectively, it is necessary to understand and follow all the **WARNINGS** and **CAUTIONS** provided in these Instructions for Use. Only authorized and qualified personnel may use this device. In addition to the generic safety warnings/cautions presented in this Section, algorithm specific warnings/cautions are explained in the algorithm specific sections of this Instructions for Use.

	**WARNING**
	The results obtained should only be used to support clinical decision-making made by a physician.

	**WARNING**
	Strong motion or metal artifacts might lead to incorrect results.

	**CAUTION**
	Because StrokeViewer is a medical device, it is imperative that you fully understand the information provided in these instructions for use before you start using the product.

	**CAUTION**
	StrokeViewer does not include a DICOM viewer. Please make sure to use a DICOM viewer that is compatible with StrokeViewer. In case an incompatible DICOM viewer is used, results can be missing or incorrectly displayed. When using a DICOM image viewer for visualization of the imaging data and StrokeViewer results, please consult the instructions for use of the DICOM viewer.

	**CAUTION**
	In case of StrokeViewer malfunctions or processing is delayed, it is imperative that you continue the usual clinical workflow. StrokeViewer is intended to be used in parallel to the usual clinical workflow and should not delay clinical decision-making.

	**CAUTION**
	Please make sure you have access to processing information when using StrokeViewer. The processing information will provide you with the notification of whether the processing is done, failed or prematurely terminated.

	**CAUTION**
	Make sure that image requirements as defined in the Annex (see Section "11. Annex") are met when providing imaging to StrokeViewer. When these requirements are not met a message might be presented to the user.

	**CAUTION**
	Please refrain from running StrokeViewer while an update is in progress. Running StrokeViewer during an update can interrupt the analysis and potentially cause the update process to become corrupted.

NOTE	*StrokeViewer should only be used on "baseline" imaging, meaning scanning should be performed before the start of thrombectomy.*

NOTE	*Features will be available for use when enabled for your hospital. This implies that not all algorithm results might be available for you as only a subset of the*

	algorithms might be enabled for your hospital. Please contact your system administrator for more information on which algorithms are enabled.

NOTE	*Paper printouts with StrokeViewer output should not be used for diagnosis unless the used Postscript printer has specifically received clearance for this purpose.*

2.1. Information Security

Access to the StrokeViewer application is arranged via your system administrator. Please contact your system administrator for access to the StrokeViewer application. The application can be accessed via your regular authentication workflow and you will then have access to the application as an authenticated user. Additional Information Security documentation can be provided upon request, please contact the Manufacturer (see Section "1.5. Contacting the Manufacturer").

	**CAUTION**
	Unauthorized access to the system may lead to the system becoming non-operational and the loss of patient data. Please contact the manufacturer for information about minimum system requirements (NIC-230048).

2.2. Reporting of a serious incident

In the case a serious incident occurs in relation to StrokeViewer, it should be reported to the manufacturer and the competent authority of the country where you are located.

A serious incident can be defined as any incident that directly or indirectly led, might have led or might lead to any of the following:

- the death of a patient, user or other person,
- the temporary or permanent serious deterioration of a patient's, user's or other person's state of health,
- a serious public health threat.

If a serious incident happens, please contact the Nicolab office (see Section "1.5. Contacting the Manufacturer") without undue delay. Nicolab might contact you for additional information.

3. Intended Purpose

The general intended purpose of StrokeViewer is described as part of the label (please see Section "1.2. Label of StrokeViewer" for the description).

3.1. Intended User

The intended users of StrokeViewer are defined as trained healthcare professionals involved in the diagnosis and care of stroke patients at hospitals and other medical centers where stroke patients are administered. They include, but are not limited to, physicians such as neurologists and radiologists.

3.2. Patient Target Population

The device is intended to be used in adult patients suspected of stroke.

3.3. Indications

StrokeViewer provides support in the diagnosis of suspected stroke patients.

3.4. Contraindications

No contraindications are known for this device.

4. Device description

4.1. Features and Workflow

StrokeViewer consists of five features: Hemorrhage, Alberta Stroke Program Early CT Score (ASPECTS), anterior circulation large vessel occlusion (LVO), Collaterals, and Perfusion. For every feature, the DICOM series that should be used as input series is specified in Figure 1. The features, and functions are further explained in Section "6. Features".

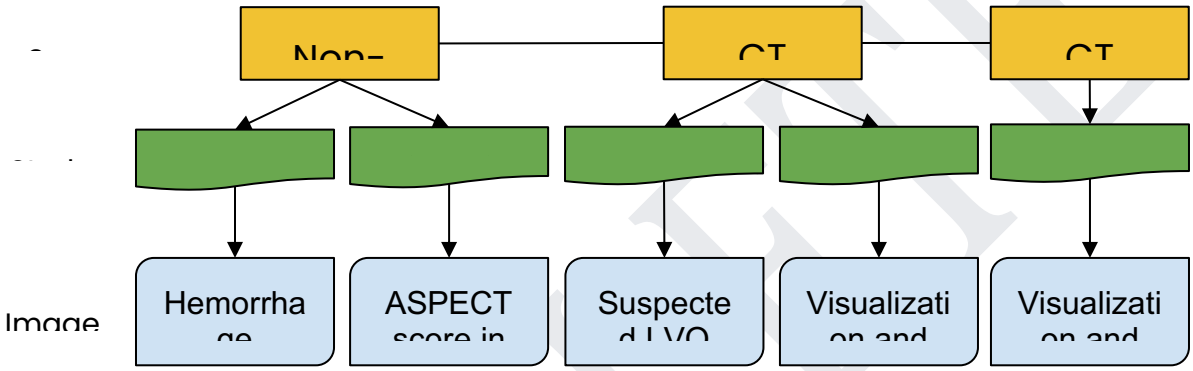

Figure 1. Detailed description of the input data for the StrokeViewer features and output functions.

4.2. Operating Principle

Strokeviewer should be used as suggested in Section "3. Intended Purpose". In order to meet this purpose, StrokeViewer has the following operating principles:

- StrokeViewer entails multiple medical imaging analysis algorithms. There is a separate algorithm for each of the features: Hemorrhage, ASPECTS, LVO, Collaterals, and Perfusion.
- The algorithms are trained and adapted prior to the product release. The algorithms are fixed during their operational lifetime.
- Image analysis is started by indicating the image series to be analyzed and the type of analysis (e.g., which algorithm) to StrokeViewer.
- Image analysis results are made available in a DICOM summary report and / or DICOM series.
- StrokeViewer is distributed to the customer using a docker container, which allows for an installation in multiple environments.

4.3. Minimum Requirements and Compatibility

In order to execute and use StrokeViewer in a safe and effective manner, minimum requirements are set. The input imaging data should adhere to the DICOM standard. StrokeViewer's output is provided in a DICOM format (DICOM series and annotation overlays) and to be able to view these results a compatible DICOM viewer is required (see **NOTE** for the requirements). In order to have a timely

analysis provided by StrokeViewer a stable and fast internet connection is required (see **NOTE** for the requirements). To be able to use the command line interface, please consult the installation and configuration manual (NIC-230079; as provided by the Manufacturer) for the minimum requirements. StrokeViewer is not supplied with any accessories.

NOTE	*A DICOM viewer is required to meet the following requirements to be compatible with StrokeViewer.* • *DICOM viewer conforms to DICOM standard;* • *DICOM viewer supports CSPS file format;* • *DICOM viewer supports secondary capture file format.*

NOTE	*To be able to have timely analysis, StrokeViewer requires a stable internet connection with a minimum upload speed of at least 20 MB/s. This only applies in case the StrokeViewer is deployed in a remote/cloud environment.*

4.4. Getting started

1. **System requirements**
   The requirements to run StrokeViewer are provided with the onboarding of the hospital. Please contact the manufacturer for more information (see Section "1.5. Contacting the Manufacturer").
2. **Installation**
   StrokeViewer requires installation prior to use. In case of manual deployment, please consult the installation and configuration manual (NIC-230079), as provided during the installation, regarding instructions on how to install and configure the medical device. This manual also includes instructions on maintenance, and detailed description of operating of the device.
3. **Configuring the software**
   StrokeViewer can be deployed to automatically or manually trigger the analysis. For both automatic and manual deployment, the device requires a one-time configuration by a system administrator. Instructions for setup and configuration for the IT team are provided with the onboarding of the hospital. Please contact the manufacturer for more information.
4. **User access level**
   StrokeViewer is protected against unauthorized access. IT networks characteristics and IT security measures to protect against unauthorized access are provided in system requirements (NIC-230048; please consult your system administrator for more information).
5. **User interface**
   In case of manual deployment, the user will be provided with a command line interface (CLI). In case of automatic deployment, the user will be provided with an interface to trigger StrokeViewer analysis. The results computed by StrokeViewer can be viewed by a compatible

DICOM viewer. To view requirements on compatible DICOM viewers, please consult the Section “4.3 Minimum Requirements and Compatibility”.

5. Operating the application

5.1. Input Data

Input data for StrokeViewer are head CT scans (NCCT, CTA, CTP) and/or head MR Perfusion scans from suspected stroke patients. These CT/MRI scans should be saved according to the DICOM standard, supported and recommended parameters are presented in Annex (see Section "11. Annex"). For more information regarding the required properties of the DICOM files please consult the DICOM Conformance Statement (NIC-230037) which is available on request via the manufacturer (see Section "1.5. Contacting the Manufacturer").

5.2. Accessing the Application

In case of manual deployment, StrokeViewer can be accessed via a command line interface (CLI). For more information about the CLI, please consult the installation and configuration manual (NIC-230079), as provided during installation. In case of automatic deployment, the user will be provided with an interface to trigger StrokeViewer analysis. For both deployments, the access to the StrokeViewer application is arranged via your system administrator. Please contact your system administrator for access to the StrokeViewer application. StrokeViewer can then be accessed via your regular authentication workflow and you will have access to the application as an authenticated user.

5.3. Starting the Analyses

In case of an automatic StrokeViewer deployment, the images are automatically sent to StrokeViewer and StrokeViewer output is automatically generated. In case of a manual deployment, analyses are triggered by the CLI. This includes specification of the input, output, and algorithm. Please consult the installation and configuration manual (NIC-230079) for the commands that need to be executed as provided during installation.

5.4. Output Data

Results of the analysis are generated and stored at the pre-specified location as configured. Results StrokeViewer can be saved in the following formats, depending on the feature that is executed and whether analysis provides any results:

- DICOM Color Softcopy Presentation State (CSPS) series
- DICOM secondary capture series
- DICOM summary reports

DICOM CSPS series are defined as color overlays which references a DICOM series. The overlays are toggleable in your compatible DICOM viewer. In case the analysis does not provide any results, no CSPS series is created. For example, when StrokeViewer Hemorrhage does not detect any hemorrhage, no CSPS series is created.

DICOM secondary capture series are defined as the color overlays embedded into the series, creating a new DICOM series with both the original DICOM images and the embedded overlay. This secondary capture is not toggleable. In case the analysis does not provide any results, in contrast to the CSPS series, a secondary capture series is created. Thus, for the StrokeViewer Hemorrhage example, regardless of whether or not a hemorrhage is detected, a secondary capture series is created.

DICOM summary reports are created as highlights from the result series with additional clinical/relevant information (patient, image, and StrokeViewer output). DICOM summary reports are always created when StrokeViewer is executed. When multiple StrokeViewer features are executed for the same study, the DICOM summary reports of the features are combined into one DICOM summary report. An example DICOM summary report for StrokeViewer LVO is presented in Figure 2.

NOTE	*In case of an error during the analysis, a message that no results will be available might be presented to the user.*

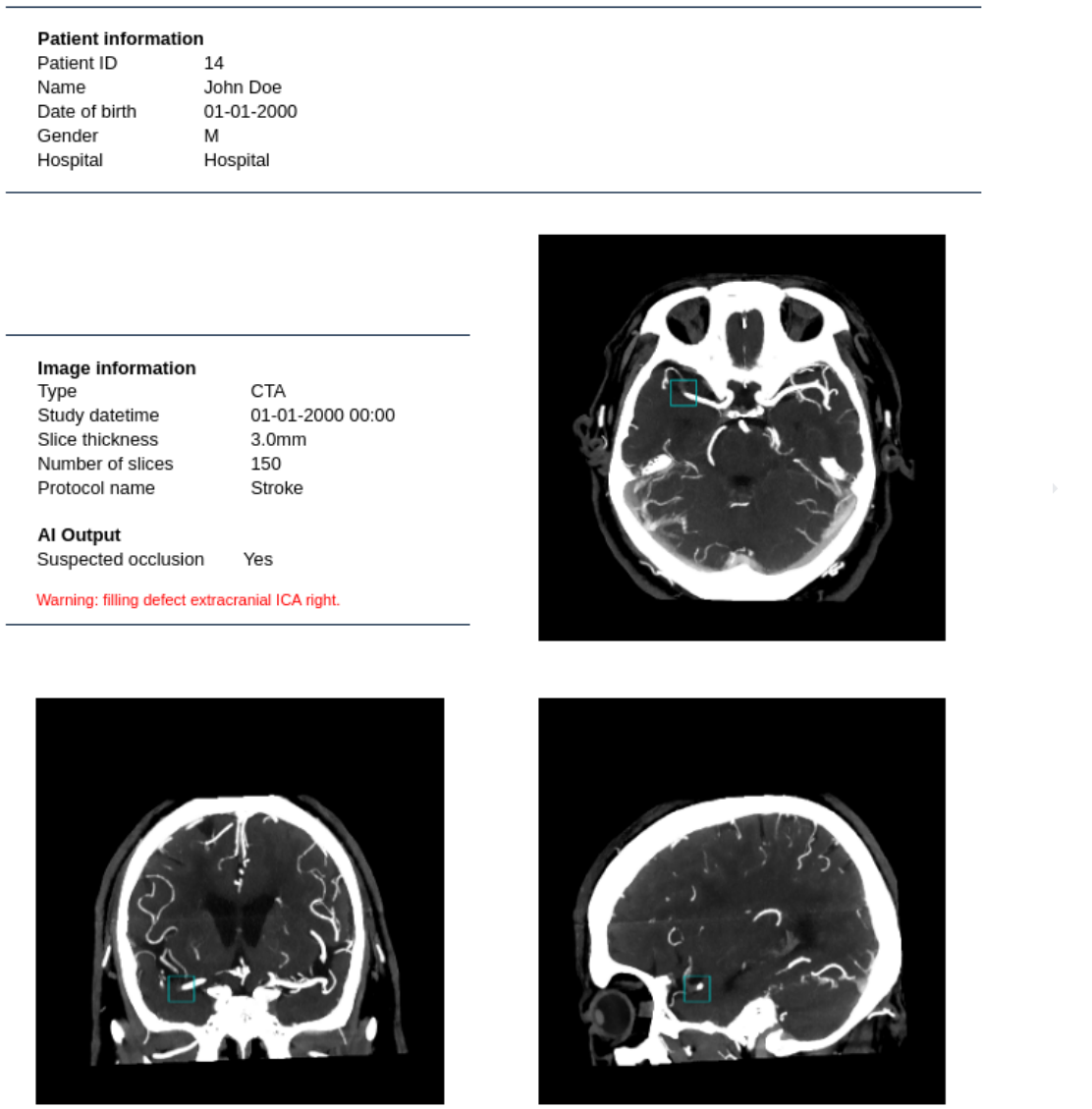

Figure 2. Example report for StrokeViewer LVO showing highlights of the bounding box suggesting a potential occlusion, clinical information and StrokeViewer output.

5.4.1. Error Messages

Error messages may be presented to the user for diverse reasons, as explained in the notes and cautions throughout these instructions for use. In rare cases (for example when the DICOM series is not acquired axially, StrokeViewer will not process these images), there will be no output from StrokeViewer, nor will there be any error message. For manual deployment, you should access the StrokeViewer event logs for detailed information on the error (please consult the installation and configuration manual; NIC-230079).

NOTE	*In case of manual deployment, you need access to the StokeViewer event logs to retrieve information on termination of the analysis of StrokeViewer due to completion or failure of the analysis.*

5.5. Maintenance and Device Disposal

The device is subjected to updates/releases, which will be coordinated and communicated by the Nicolab team. In case of manual deployment, the installation and configuration manual (NIC-230079) contains information on how these updates can be deployed. The user is advised to update StrokeViewer as soon as the new version is made available. Servicing of StrokeViewer will be performed when needed. For information on deinstallation of the software, please refer to the installation and configuration manual (NIC-230079). In case of automatic deployment, updates/releases will be performed by the Nicolab team. Please contact Nicolab when you experience any problems (see Section "1.5. Contact the Manufacturer"). Since StrokeViewer is software, physical device installation and calibration are not applicable.

6. Features

6.1. StrokeViewer Hemorrhage

6.1.1. Description

StrokeViewer Hemorrhage is intended for detection, segmentation and volumetric assessment of the findings suggestive of hemorrhagic stroke on NCCT scans. StrokeViewer Hemorrhage requires head NCCT scans as input. The result is presented as an overlay on the NCCT scan highlighting the areas that were classified as suspected hemorrhage.

6.1.2. Safety and Performance

StrokeViewer Hemorrhage has a sensitivity of 92% (95%-confidence interval: 88%-95%) and a specificity of 100% (95%-confidence interval: 98%-100%) for cases of ≥ 1 mL[1].

	**WARNING**
	StrokeViewer Hemorrhage may highlight other conditions that are also characterized by the presence of coagulated blood and therefore are also presented in NCCT scans as hyperdense areas compared to brain parenchyma.

	**WARNING**
	StrokeViewer Hemorrhage was not validated on patients with traumatic brain injury and venous hemorrhagic stroke.

6.1.3. Analysis Output

The output of the hemorrhage detection and segmentation analysis is shown to the user in different DICOM outputs described below.

CSPS series (with toggleable binary hemorrhage prediction contour mask)

The binary contour is a mask that represents the area predicted to be a hemorrhage in the NCCT (see Figure 3 (Left)). The binary contour mask can be toggled on and off in a compatible DICOM viewer. This output is automatically generated and presented together with the original scan in a CSPS DICOM series named "**01: SV Hemorrhage AI**". This output is not created when no hemorrhage is detected.

Secondary capture (with pixel-wise hemorrhage prediction map)

The pixel-wise prediction is a color map that represents the likelihood that each pixel is part of a hemorrhage (see Figure 3 (Right)). It is by default on and cannot be toggled off in a compatible

[1] Based on internal validation data.

DICOM viewer. This output is automatically generated and presented with the original scan in a secondary capture DICOM series named "**01: SV Hemorrhage AI RGB**".

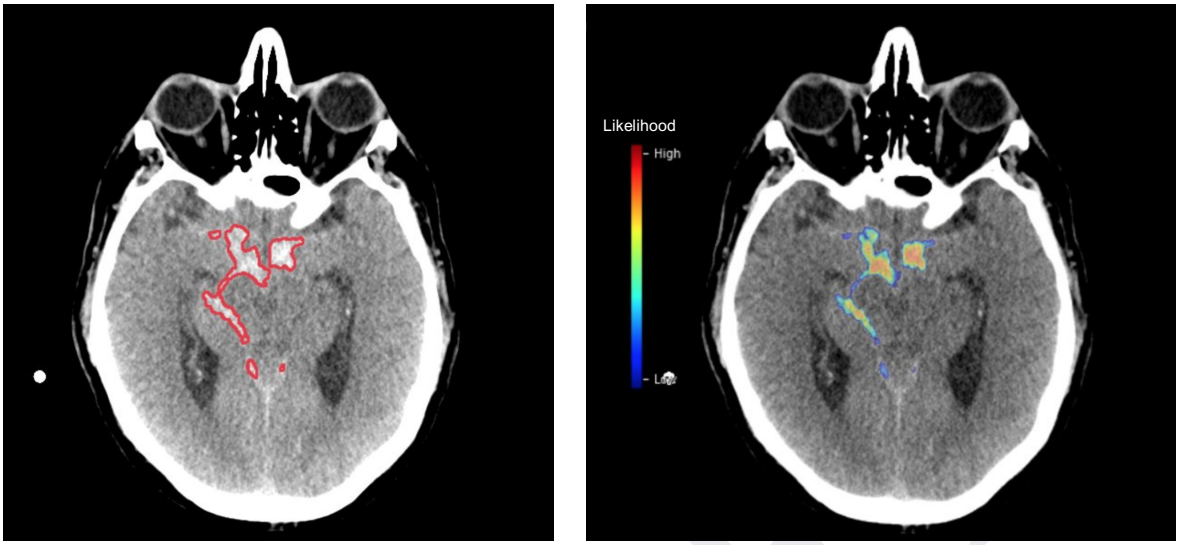

Figure 3. (Left) Example of StrokeViewer Hemorrhage output as a binary contour mask on the NCCT scan. (Right) Example of StrokeViewer Hemorrhage output as a color map displaying the likelihood of hemorrhage per pixel on the NCCT scan.

Summary report

The summary report is a DICOM object that includes, on top of patient and image information, the following summary of the analyses:

- Suspected hemorrhage: Yes / No;
- Hemorrhage likelihood color maps are given as preview images. The three image slices are 15 mm apart, with the middle image containing the largest hemorrhage likelihood map;
- The volume of all the segmented hemorrhages in mL (if any).

This output is automatically generated and presented as part of the DICOM series named "**StrokeViewer Reports**".

6.2. StrokeViewer ASPECTS

6.2.1. Description

StrokeViewer ASPECTS is intended to determine the ASPECTS score in NCCT scans of patients with suspected acute ischemic stroke. StrokeViewer ASPECTS requires head NCCT scans as input. The output is an overlay of ASPECTS regions on the original NCCT scan, and a comparison of Hounsfield Units (HU) distribution per region with the contralateral hemisphere. Regions that are deemed ischemic are highlighted in red/yellow color (see Figure 4). They are then used to calculate the total ASPECTS score, which is displayed numerically to the user.

6.2.2. Safety and Performance

StrokeViewer ASPECTS has a sensitivity of 99.9% and a specificity of 97.8% of total ASPECT score. In addition, StrokeViewer ASPECTS shows accurate results with a good agreement (ICC) with human readers of 0.63-0.73.

	**WARNING**
	StrokeViewer ASPECTS has not been tested on patients with non-LVO stroke in the middle cerebral artery (MCA) territory and posterior circulation stroke (LVO and non-LVO).

	**WARNING**
	The StrokeViewer ASPECTS result may be influenced by the presence of hemorrhage, (extensive) hydrocephalus, strong motion or metal artifacts, old infarcts (> 24 hours) and the presence of intravasal contrast from recent contrast injection.

	**CAUTION**
	You should check M-region hypodensities, white-gray matter differentiation and for loss of insular ribbon sign.

6.2.3. Analysis Output

The output of the ASPECTS analysis is shown to the user in different DICOM outputs described below.

Secondary capture (with ASPECTS clinical information)

The ASPECTS algorithm output shown to the user includes the following information (see Figure 4):

- Box plots showing the distribution of HU values per ASPECTS region (Caudate (C), Lentiform (L), Insular cortex (I), Internal Capsule (IC), M1-M6 regions) for the right (in red color) and left hemisphere (in blue color). The upper and lower boundaries of the box indicate the interquartile range of the HU values in that region, the thick horizontal bar within the box indicates the median HU value, the whiskers indicate the maximum/minimum HU value below/above 0.5 times the inter quartile range.
- A table at the right side with mean HU value per ASPECTS region for right (R) and left (L) hemispheres. Regions with lower mean HU compared to the contralateral hemisphere are shown in yellow (potentially affected region) and red (affected region). The thresholds are based on the mean HU difference between the left and right region. If that difference is larger than the threshold of 1.8 for C, L, I, IC or 2.05 for M1-6, the region is labeled as affected (red), but if the difference between both sides is within 0.3 of the threshold then it is potentially affected (yellow).
- MNI-registered NCCT scan without and with an overlay showing the border of the ASPECTS regions and highlighting those that are (potentially) affected.
- Computed ASPECTS and information about affected regions and affected side.

This output is automatically generated and presented in a secondary capture DICOM series named "**02: SV ASPECTS RGB**".

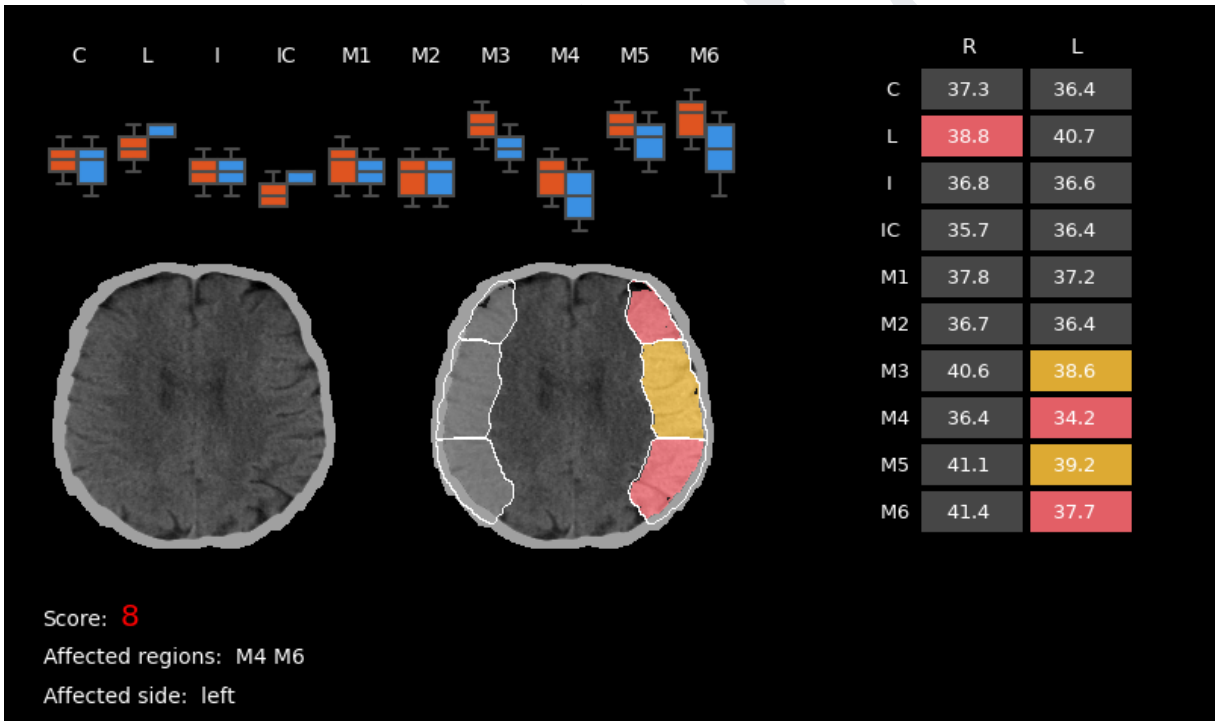

Figure 4. Example of StrokeViewer ASPECTS output. Regions in yellow indicate potentially affected (their HU difference approaches the predefined threshold to be considered affected) while those in red have a HU difference above the threshold and are considered affected.

Summary report

The summary report is a DICOM object that includes, on top of patient and image information, the following summary of the analyses:

- ASPECTS score: 0-10;

- Affected regions: C / L / I / IC / M1 / M2 / M3 / M4 / M5 / M6;
- Affected side: Right / Left / n/a.

This output is automatically generated and presented as part of the DICOM series named "**StrokeViewer Reports**".

6.3. StrokeViewer LVO

6.3.1. Description

StrokeViewer LVO is intended for evaluation of the brain vasculature of suspected acute ischemic stroke patients. StrokeViewer LVO detects large vessel occlusions (LVO) by identifying a sudden drop of contrast in an otherwise normally enhancing blood vessel, indicating that blood flow to the vessel is obstructed. StrokeViewer LVO requires head CTA scans as input. The output is a bounding box projected on the original CTA highlighting the location of a suspected intracranial LVO of the anterior cerebral circulation (internal carotid artery (ICA), M1 segment, or M2 segment).

6.3.2. Safety and Performance

Internal validation

In internal validation, StrokeViewer LVO showed a sensitivity of 91% (95%-confidence interval: 87%-95%) and specificity of 86% (95%-confidence interval: 81%-90%). Within the different segments, the sensitivity was 98% (95%-confidence interval: 90%-100%), 99% (95%-confidence interval: 95%-100%), and 64% (95%-confidence interval: 48%-78%) for ICA, M1 and M2, respectively.

Aggregated clinical evidence

Aggregating clinical evidence including both internal validation studies and external publications, StrokeViewer LVO has a sensitivity of 84% (weighted mean[2], range: 74-93%) and a specificity of 84% (weighted mean[1], range: 79-90%) including ICA, M1 and M2. Sensitivity for M2 occlusions is 55% (weighted mean[1], range: 44-66%).

	**WARNING**
	StrokeViewer LVO is not designed for the detection of LVOs outside of intracranial ICA, M1 and M2 segments of the MCA (e.g., StrokeViewer LVO should not be used for occlusions in anterior cerebral artery, M3-M4, posterior cerebral circulation or the extracranial internal carotid arteries).

	**WARNING**
	StrokeViewer LVO has a lower performance in the detection of LVOs in the M2 segment of the MCA. Therefore, manual checking is always recommended.

[2] Weighted means are used when performance measures of different studies/publications are combined. For the overall weighted mean, a total of 3944 patients were included from 6 studies. For the M2 specific weighted mean, a total of 2997 patients were included from 4 studies.

⚠	**CAUTION**
	In case of multiple occlusions, only the occlusion with the highest likelihood as determined by StrokeViewer will be highlighted. Therefore, manual checking for multiple occlusions is always recommended.

⚠	**CAUTION**
	If a sudden drop in contrast is identified in the extracranial ICA, a message might be presented to the user to notify the detection of a filling defect.

6.3.3. Analysis Output

The output of the LVO analysis is shown to the user in different DICOM outputs described below.

NOTE	*To facilitate the visual inspection of the CTA scans, the image series with the occlusion detection results is automatically aligned to the MNI (Montreal Neurological Institute) space.*

NOTE	*Depending on the hospital settings, an automatically generated message might be shown if the CTA acquisition phase or the image noise levels are not deemed suitable for visualization and detection of LVO.*

CSPS series (with registered scan and toggleable bounding box overlay)

The MNI-registered original CTA scan is presented with a bounding box overlay showing the detected LVO location. This bounding box can be toggled on and off in a compatible DICOM viewer. This output is automatically generated and presented in a CSPS DICOM series named "**01: SV Occlusion AI**". This output is not created when no LVO is detected.

Secondary capture (with registered scan and fixed bounding box overlay)

The MNI-registered original CTA scan is also presented with a fixed non-toggleable bounding box overlay showing the detected LVO location (if any). This output is automatically generated and presented in a secondary capture DICOM series named "**01: SV Occlusion AI RGB**" (see Figure 5).

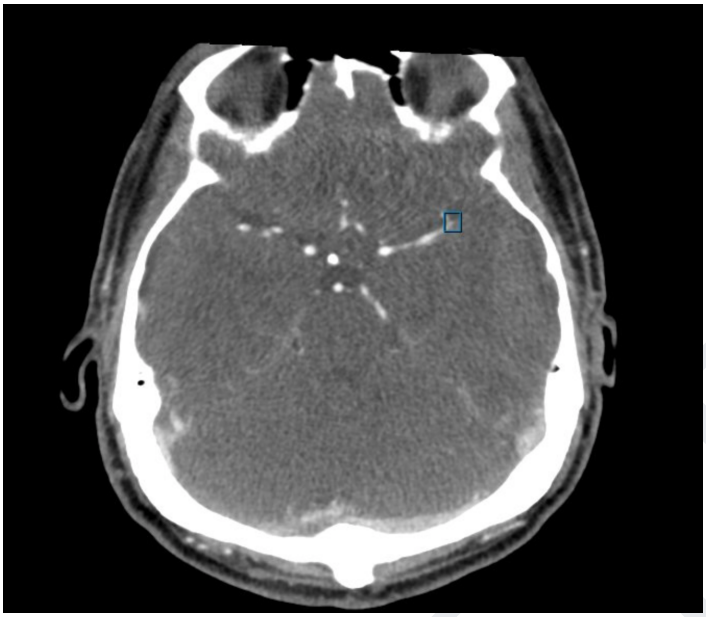

Figure 5. Example of StrokeViewer LVO output. Detected LVO location is highlighted with a blue bounding box on the CTA scan.

Summary report

The summary report is a DICOM object that includes, on top of patient and image information, the following summary of the analyses:

- Suspected occlusion (LVO): yes/no;
- Three MIP images of the CTA scan in the three plane with the LVO overlay (if any)
- In case a sudden drop in contrast is detected in the extracranial ICA, the following message is included in the report (in red): Warning: filling defect extracranial right/left.

This output is automatically generated and presented as part of the DICOM series named "**StrokeViewer Reports**".

6.4. StrokeViewer Collaterals

6.4.1. Description

StrokeViewer Collaterals provides visualization and quantification of collateral flow of the middle cerebral artery (MCA) territory. StrokeViewer Collaterals requires head CTA scans as input. The algorithm segments contrast-enhanced vessels in the middle cerebral artery region and computes the number of segmented voxels downstream of the suspected occlusion (detected with StrokeViewer LVO feature). Quantitative collateral score is provided as a percentage (0-100%) compared to the unaffected contralateral hemisphere and as a categorical number (range, 0-3, with 0 indicating poor and 3 indicating excellent collaterals).

6.4.2. Safety and Performance

StrokeViewer Collaterals showed a strong correlation with the conventional and extended Tan-score (Spearman correlation of 0.70-0.78 for providing percentages). In addition, for a quantitative collateral score category (providing categories), the device showed a good agreement with human readers, with a quadratic kappa of 0.61.

	**WARNING**
	StrokeViewer Collaterals was clinically validated only on cases with confirmed middle cerebral artery LVO.

	**CAUTION**
	Collateral filling may not be adequately visualized in an early arterial or late venous acquisition phase. Make sure to evaluate the acquisition phase of the CTA scan before you consider the results of the quantitative collateral assessment. In case the image acquisition phase is not correct, a message might be presented to the user.

	**CAUTION**
	The calculation of collateral score is dependent on positively predicted LVO. Therefore, the utility may be impacted in case of false negative findings. The M2 occlusion detection performance may be impacted by the more distal occlusion locations.

6.4.3. Analysis Output

The output of the Collaterals analysis is shown to the user in different DICOM outputs as described below.

NOTE	*In absence of suspected occlusion, entire MCA territories of both brain hemispheres are highlighted in green.*

NOTE	*When there are more vessels highlighted in the affected side compared to the non-affected side, the collateral score is clamped at 100%.*

CSPS series (with registered scan and toggleable vessel overlay)

The MNI-registered CTA scan is presented with an overlay that highlights collateral flow of the affected hemisphere in red, whereas collateral flow of the unaffected hemisphere is highlighted in green. The bounding box of the automatically detected LVO (if any) is also included, alongside the collateral score (0-100%) and the automatically detected CTA acquisition phase (Early arterial / Peak arterial / Equilibrium / Peak venous / Late venous). The vessel overlay can be toggled on and off. This output is automatically generated and presented in a CSPS DICOM series named "**01: SV Collateral AI**".

Secondary capture (with registered scan and fixed vessel overlay)

The MNI-registered original CTA scan is also presented with a fixed non-toggleable vessel overlay showing the collateral flow in the affected (red) and unaffected (green) hemisphere (see Figure 6). The overlay cannot be toggled on and off. Information about the CTA acquisition phase is also included. This output is automatically generated and presented in a secondary capture DICOM series named "**01: SV Collateral AI RGB**".

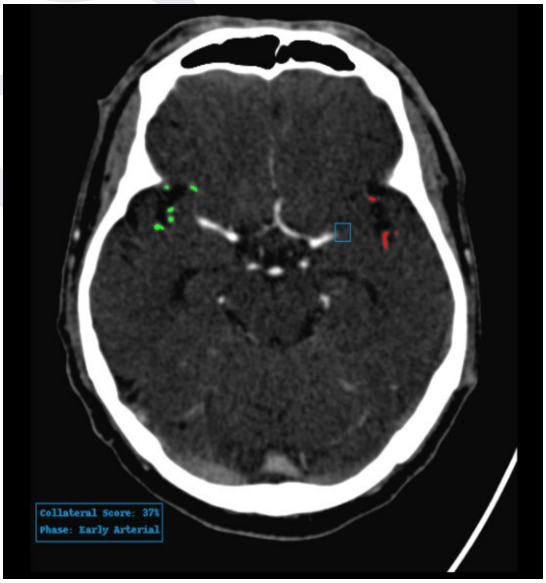

Figure 6. Example of StrokeViewer Collaterals output as an overlay in the CTA scan (one slice presented in this example). Collateral flow of the affected hemisphere is presented in red, and

collateral flow of the unaffected hemisphere is presented in green. Detected LVO is highlighted with a blue bounding box.

Summary report

The summary report is a DICOM object that includes, on top of patient and image information, the following summary of the analyses:

- Suspected occlusion (as detected by the LVO feature): Yes / No;
- Collateral score percentage (qCS, %): 0-100%;
- qCS category: 0-3;
- Affected side: Right / Left / Neither;
- Contrast phase: Early arterial / Peak arterial / Equilibrium / Peak venous / Late venous;
- Three MIP images (in the axial plane) that best represent the collateral flow segmentation in the affected side near the occlusion (see Figure 7).

This output is automatically generated and presented as part of the DICOM series named "**StrokeViewer Reports**".

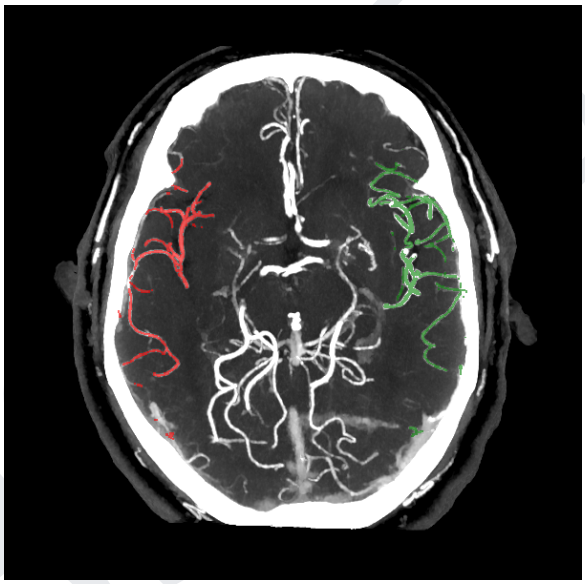

Figure 7. Example of StrokeViewer Collaterals output MIP image included in the summary report. Collateral flow of the affected hemisphere is presented in red, and collateral flow of the unaffected hemisphere is presented in green as an overlay in the CTA scan (one slice presented in this example).

6.5. StrokeViewer Perfusion

6.5.1. Description

StrokeViewer Perfusion provides analysis capabilities for functional and dynamic imaging datasets acquired with computed tomography perfusion (CTP) or magnetic resonance (MR) perfusion. StrokeViewer Perfusion is used for visualization and analysis of perfusion scans, being able to assess tissue blood flow from changes in contrast over time. The device outputs parametric maps related to tissue blood flow (Cerebral Blood Flow (CBF), Cerebral Blood Volume (CBV), and Time to Maximum Contrast (Tmax), Mean Transit Time (MTT)), besides automatically identifying areas of hypoperfusion and low blood-flow (potential infarct core).

6.5.2. Safety and Performance

StrokeViewer Perfusion has an intraclass correlation coefficient with a benchmarking product in the range of 0.85 to 0.92 for hypoperfused volumes.

	**WARNING**
	If the number of imaging slices is not considered sufficient to cover the full MCA territory, the calculated volumes might be underestimated, and a message might be presented to the user for cautious interpretation.

	**CAUTION**
	StrokeViewer Perfusion is a tool to support patient management in acute ischemic stroke. Decisions must never be made based on the Perfusion results alone. The product should only be used by trained users familiar with the current guidelines and the perfusion measurement technique. It is the user's responsibility to carefully take into account all available patient information.

	**CAUTION**
	When patient motion or suboptimal bolus quality is identified, a message might be presented to the user recommending to carefully assess the quality control output image series.

6.5.3. Analysis Output

The output of the Perfusion analysis is shown to the user in different DICOM outputs described below. All the outputs are automatically generated and presented in separate secondary capture DICOM series.

SV Perfusion Lesion Map and SV Perfusion Lesion Map Mosaic

The "**SV Perfusion Lesion Map"** output series includes:

- Reference NCCT or Perfusion baseline images;
- Segmented CBF < 30% (red) and mismatch volume (yellow) overlaid on the reference images;
- Perfusion maps in color for:
    - Tmax (values ranging between 0 and 10s);
    - MTT (values range between 0 and 15 s);
    - CBF (0-150%);
    - CBV (0-150%);
- Automatically computed volumes:
    - Extended Tmax volume in mL, defined as the volume with Tmax > 6s;
    - Reduced flow volume in mL, defined as the volume with CBF < 30%;
    - Mismatch volume in mL, defined as the difference between Tmax > 6s and CBF < 30%;
- Mismatch ratio, defined as extended Tmax volume (Tmax > 6s) divided by the reduced flow volume (CBF < 30%);
- A horizontal graphical bar presenting the relative proportions of core (red) and penumbra (yellow).

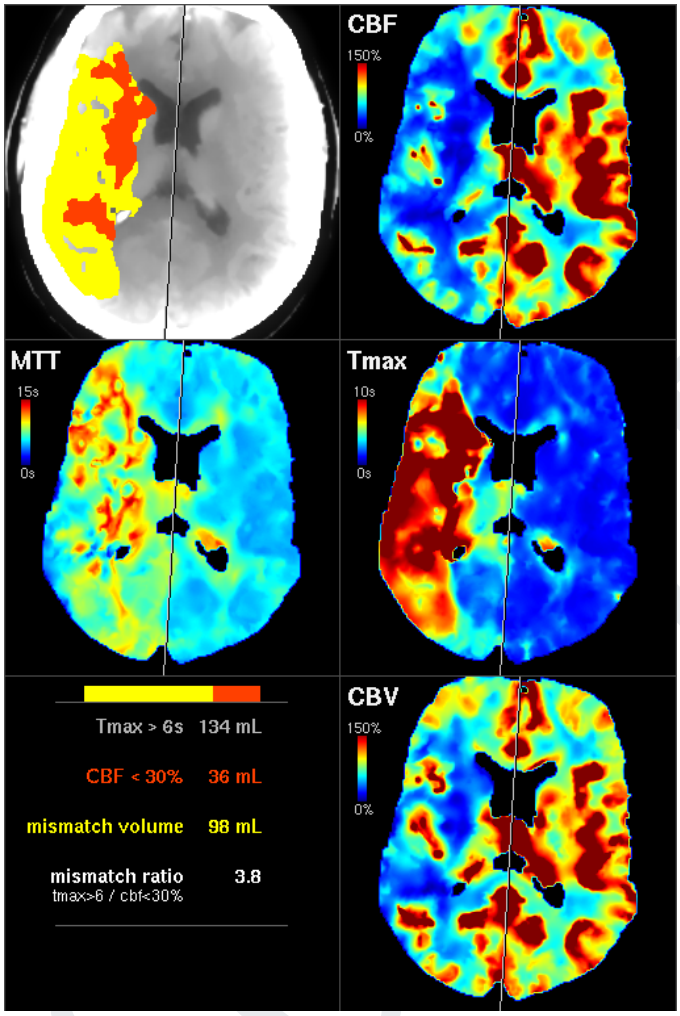

*Figure 8. Example of the output series **SV Perfusion Lesion Map**, including different perfusion maps and segmented volumes of core (red) and penumbra (yellow).*

Images and maps are arranged in a stack of slices, such that the user can scroll through the full brain volume (see Figure 8 and details in Figure 9). The "**SV Perfusion Lesion Map Mosaic**" output series includes all the different stacks of slices of the Perfusion maps and reference images with overlays projected onto a single mosaic image (see Figure 10).

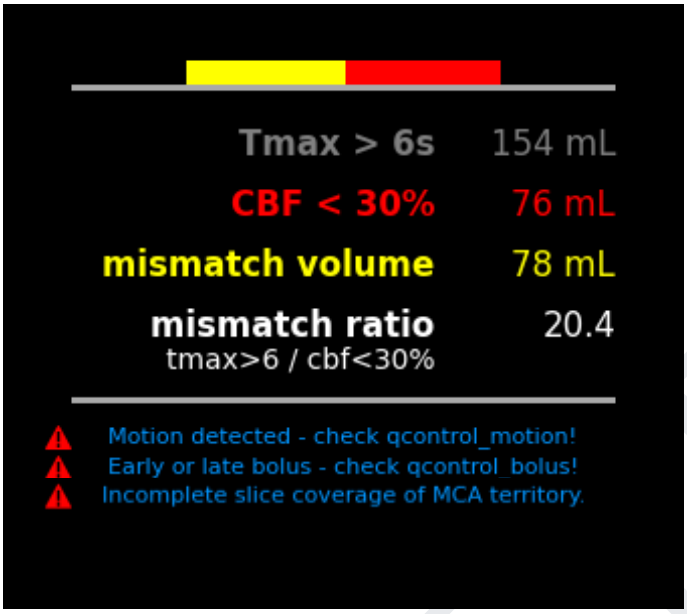

*Figure 9. Example detailed view of automatically computed volumes and ratio of the output series **SV Perfusion Lesion Map** and potential warnings for motion, early or late bolus, and incomplete slice coverage of the MCA territory.*

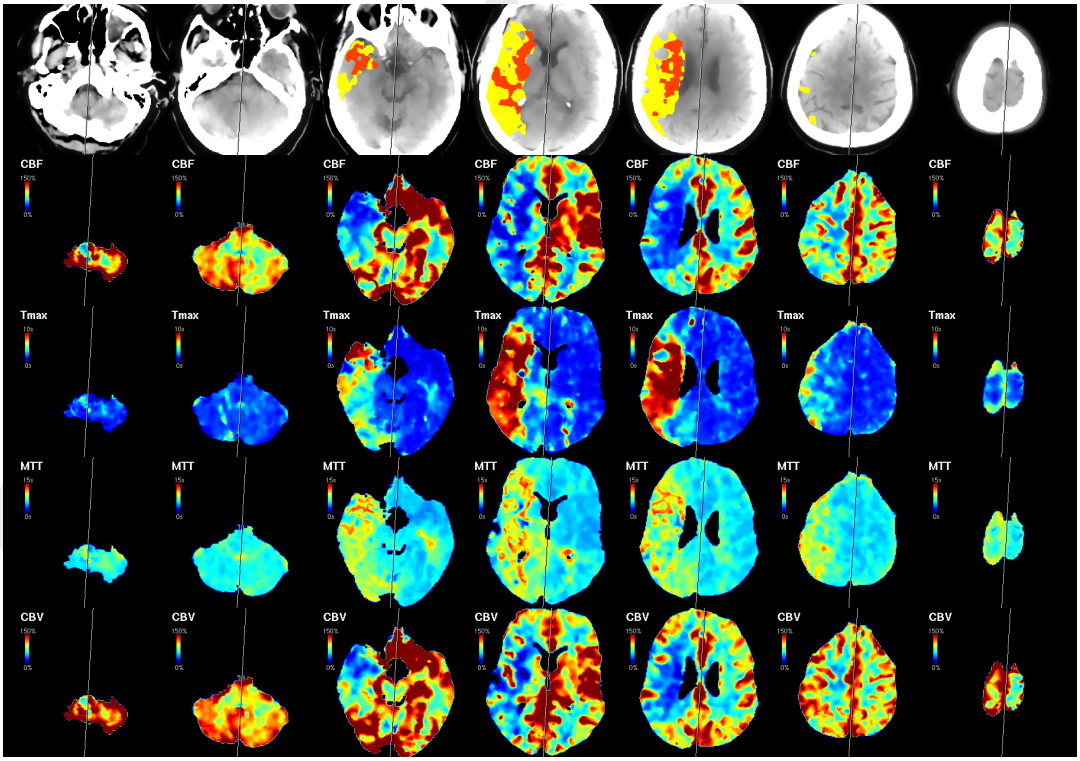

*Figure 10. Example of the **SV Perfusion Lesion Map Mosaic** including stacks of slices of the Perfusion maps and reference images.*

NOTE	*When using MR as an input, the user is presented with a message indicating that even though the input was MR and high core visibility is expected, the core was automatically computed using cerebral blood flow.*

SV Perfusion Quality Control Motion and SV Perfusion Quality Control Bolus

To ensure correct interpretation of the output, two series are created providing information about quality control of the acquisition images.

StrokeViewer Perfusion automatically corrects for patient motion on the input images. The "**SV Perfusion Quality Control Motion"** series output (see Figure 11 (Left)) includes the original and motion-corrected temporal series of images, which can be scrolled/browsed using a DICOM image viewer so that the user can assess the effectiveness of the motion correction. Correlation of each image volume with the first image volume over time is plotted for uncorrected (red line), and motion-corrected (blue line) images to give a quantitative measure for motion. The vertical white line indicates the current time point in the stack of images.

The "**SV Perfusion Quality Control Bolus"** series output (see Figure 11 (Right)) includes the following information:

- Contrast agent bolus details (including a message whether each value is within pre-configured optimal limits):
  - Temporal sampling of the perfusion time series;
  - Relative peak position of the bolus on the time axis of the AIF;
  - Average peak height of the bolus (Hounsfield units for CT, relative units for MR);
  - Lowest correlation in time series, serving as an index for maximal patient motion;
- Normalized curves showing contrast intensity over time clustered into "all vessels" (white curve), "veins" (blue curve) and "arteries" (red curve). The Arterial Input function (AIF, yellow curve) is chosen from the arterial pool by the features early arrival time, narrow shape and high signal-to-noise ratio.
- The same patient motion correlation information as indicated in the paragraph above.

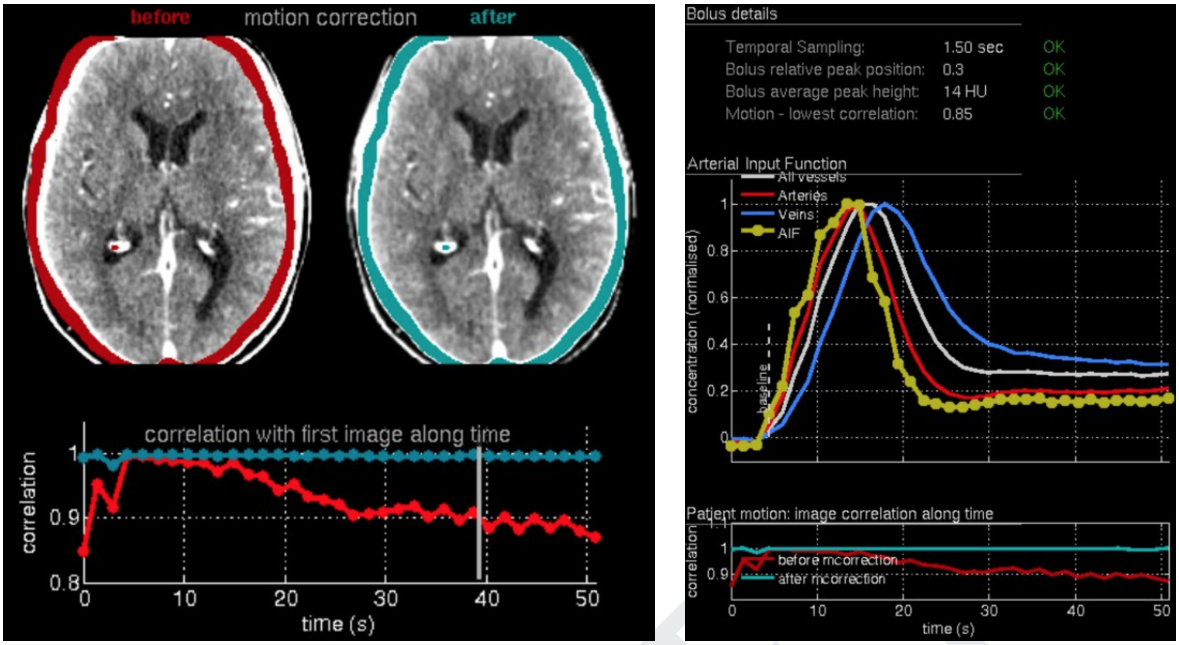

Figure 11. Example of the output of StrokeViewer Perfusion quality control information about patient motion during acquisition (Left) and bolus details (Right).

SV Perfusion RGB Tmax, SV Perfusion RGB CBV, and SV Perfusion RGB CBF

The color perfusion maps for Tmax (values ranging between 0 and 10s), CBV (0-150%), and CBF (0-150%) are also presented in independent output DICOM series respectively in "**SV Perfusion RGB Tmax"**, "**SV Perfusion RGB CBV"**, "**SV Perfusion RGB CBF"**. The perfusion maps are arranged in a stack of slices, such that the user can scroll through the full brain volume.

Summary report

The summary report is a DICOM object that includes, on top of patient and image information, the following summary of the analyses:

- CBF < 30% in mL;
- Mismatch volume in mL;
- Mismatch ratio

This output is automatically generated and presented as part of the DICOM series named **"StrokeViewer Reports".**

6.5.4. Suggested workflow

We suggest the following workflow when interpreting the results:

1. Open the main result image "**SV Perfusion Lesion Map";**
2. When there are warning signs about bolus quality or patient motion, check "**SV Perfusion Quality Control Motion"** and/or "**SV Perfusion Quality Control Bolus;**
3. Check the perfusion maps **"SV Perfusion RGB Tmax", "SV Perfusion RGB CBV"** and **"SV Perfusion RGB CBF"**. Assess hypoperfusion, core lesion, image quality and whether the full MCA territory is covered.
4. Check automated segmentations of core and penumbra in "**SV Perfusion Lesion Map"**, and assess possible overestimations based on the information from the Perfusion maps.

5. Check the original NCCT or MR image in "**SV Perfusion Lesion Map"**, and assess possible underestimations in core segmentation.
6. Assess the accuracy of the automated computed volumes for core and penumbra in relation to the interpretations in previous steps.

7. Clinical benefit of StrokeViewer

The clinical benefit of StrokeViewer is defined as: StrokeViewer assists in assessment of patients with suspected stroke by detecting findings suggestive of anterior circulation LVO stroke and increase EVT rates.

7.1. Clinical benefit StrokeViewer Hemorrhage

StrokeViewer Hemorrhage assists in assessment of patients with suspected stroke by detecting findings suggestive of hemorrhagic stroke on NCCT imaging, with high sensitivity and specificity.

7.2. Clinical benefit StrokeViewer ASPECTS

StrokeViewer ASPECTS assists in the assessment of ASPECTS on baseline NCCT imaging in patients suspected of acute stroke, with high sensitivity and specificity.

7.3. Clinical benefit StrokeViewer LVO

StrokeViewer LVO aids intended users in assessment of findings suggestive of anterior circulation LVO stroke.

7.4. Clinical benefit StrokeViewer Collaterals

StrokeViewer Collaterals improves consistency and interobserver agreement in assessment of collateral score on baseline CTA imaging in patients suspected of stroke.

7.5. Clinical benefit StrokeViewer Perfusion

StrokeViewer Perfusion analyzes computed-tomography perfusion (CTP) and MR perfusion imaging by calculating parameters related to tissue blood flow and tissue blood volume, which is not possible without dedicated post-processing software.

8. Acronyms, Abbreviations and Definitions

The following acronyms, abbreviations and definitions are used throughout this Instructions for Use.

AI	Artificial Intelligence
AIF	Arterial Input Function
ASPECTS	Alberta Stroke Program Early CT Score
Caution	A caution alerts you when special care is necessary for the safe and effective use of the device. Failure to observe a caution may result in moderate injury to the operator or patient, or damage to the equipment, and presents remote risk of more serious injury or environmental pollution
CBF	Cerebral Blood Flow
CBV	Cerebral Blood Volume
CSPS	Color Softcopy Presentation State, which can be explained as the manner of saving the StrokeViewer results as a DICOM annotation overlay on the original DICOM series, in this case in color.
CT	Computed Tomography
CTA	CT Angiography
CTP	CT Perfusion
DICOM	Digital Imaging and Communications in Medicine
Filling defect	Indicates a sudden drop of contrast in an otherwise normally enhancing blood vessel
HU	Hounsfield Unit
ICA	Internal Carotid Artery
IFU	Instructions for Use
Incident	Any malfunction or deterioration in the characteristics or performance of the device made available on the market, including use-error due to ergonomic

	features, as well as any inadequacy in the information supplied by the manufacturer and any undesirable side-effect
LVO	Large Vessel Occlusion
MCA	Middle Cerebral Artery
MIP	Maximum Intensity Projection
MNI	Montreal Neurological Institute
MR	Magnetic Resonance
M1	The M1 is the most proximal segment of the middle cerebral artery (MCA), before bifurcation of the artery
M2	The M2 segments originate from the M1 segment. The M2 segments start as soon as branching of the M1 occurs (generally after bifurcation or trifurcation)
NCCT	Non-contrast CT
Note	A note highlights unusual points to assist you when using the device
Serious incident	Any incident that directly or indirectly led, might have led or might lead to any of the following: (A) the death of a patient, user or other person (B) the temporary or permanent serious deterioration of a patient's, user's or other person's state of health, (C) a serious public health threat
Tmax	Time to maximum contrast
UDI, UDI-DI and UDI-PI	The UDI (Unique Device Identifier) of StrokeViewer consists of a combination of the UDI-DI (Device Identifier) and the UDI-PI (Production Identifier). The UDI-PI for StrokeViewer resembles the software version of the device, consisting of X.Y.Z.
Warning	A warning alerts you to a potential serious outcome, adverse event, or safety hazard. Failure to observe a warning may result in death or serious injury to the operator or patient

9. Symbol Glossary

Information of the left column (symbols) of the table below (Table 1) can be used for understanding the symbols used throughout these Instructions for Use.

Symbol	Reference	Explanation
	n/a	Indicates a warning and alerts the user to a potential serious outcome, adverse event, or safety hazard. Failure to observe a warning may result in death or serious injury to the operator or patient
	EN ISO 15223-1 5.4.4	Indicates that caution is necessary when operating the device or control close to where the symbol is placed, or that the current situation needs operator awareness or operator action in order to avoid undesirable consequences
	EN ISO 15223-1 5.4.3	Indicates the need for the user to consult the instructions for use
	• Medical Device Regulation (EU) 2017/745 Annex I Chapter III 23.2 (c) • EN ISO 15223-1 5.1.1 • EN ISO 20417:2021 6.1.2	Indicates the medical device manufacturer (name & address) NICo-Lab B.V. Paasheuvelweg 25 1105 BP Amsterdam The Netherlands (NL)
	EN ISO 15223-1 5.1.3	Indicates the date when the medical device was manufactured Date of initial software release
	Medical Device Regulation (EU) 2017/745 Annex V and Medical Device Regulation (EU) 2017/745 Article 20	CE marking, accompanied by reference to the Notified Body that issued the EC certificate
	Medical Devices Regulations 2002	UKCA marking, accompanied by reference to the Approved body that issued the UKCA certificate
	EN ISO 15223-1 5.7.7	Indicates the product is a medical device

UDI	• Medical Device Regulation (EU) 2017/745 Article 27 • EN ISO 15223-1 5.7.10	Indicates a carrier that contains unique device identifier information UDI (consisting of both the UDI-DI and UDI-PI) can be found on the label on the device (CLI and DICOM summary report). UDI-DI will be part of the label within the IFU
	EN ISO 15223-1 5.7.8	Indicates that the original medical device information has undergone a translation which supplements or replaces the original information This symbol will be accompanied with the address of the entity responsible for the translation
UKRP	Medical Devices Regulations 2002	Indicates the name and address of the UK Responsible Person Psephos Ltd. Sussex Innovation Centre Science Park Square Brighton BN1 9SB (UK)
CH REP	Swiss Medical Devices Ordinance	Indicates the name and address of the Swiss Authorized Representative Jan Möstel Robert-Seidel-Hof 70 8048 Zürich (CH)

Table 1. Symbols glossary

10. Revision history

Instructions for Use are identified by a unique document number (as shown in the footer of this Instructions for Use: NIC-220193). The revision number can be identified behind the document number; -rr-F (e.g., 01-F identifies the first approved version of the document).

Version	Date	Change description
01-F - 06-F	24-Mar-2023 - 20-Aug-2024	Creation and internal updates of the Instructions for Use of StrokeViewer under the Medical Device Regulation 2017/745 (EU MDR) and Medical Device Regulation 2002 No. 618 (UK MDR).
07-F	25-Apr-2025	First version available for customer release of StrokeViewer 4

11. Annex

The information provided in Table 2 presents the supported and recommended imaging parameters.

Parameter	Supported range	Recommended setting	Used as input for StrokeViewer algorithm
(single phase) CT Angiography (CTA) / Multiphase CTA / Enhanced CTA Acquired volumes of low-dose CTs acquired pre- and during injection of a contrast bolus. This series is often called CTA (CT-Angiography)			StrokeViewer LVO, StrokeViewer Collaterals
Orientation	AXIAL	AXIAL	
Slice spacing	spacing should be equal or less than slice thickness	spacing should be equal or less than slice thickness	
Matrix size	512 x 512	512 x 512	
Slice thickness	≤ 2 mm	1 mm	
Kernels	Soft tissue	Soft tissue	
CT perfusion (VPCT) / Enhanced CTP Repeatedly acquired volumes of low-dose CTs acquired during injection of a contrast bolus. This series is often called VPCT (Volume-Perfusion-CT).			StrokeViewer Perfusion
Orientation	AXIAL	AXIAL	
Slice spacing	spacing should be equal or less than slice thickness	spacing should be equal or less than slice thickness	
Number of timepoints:	10 - 100	40	
Temporal sampling	0.5 to 5 sec	1.5 sec	
Matrix size	512 x 512	512 x 512	
Slice thickness	0.5 - 15 mm	5 mm	
Number of slices per timestamp	any	20 - 30	
Kernels	Soft tissue	Soft tissue	
Non-contrast CT (NCCT) / Enhanced NCCT Native image without contrast injection with a reconstruction kernel optimized for brain tissue.			StrokeViewer Hemorrhage, StrokeViewer ASPECTS
Orientation	AXIAL	AXIAL	

Slice spacing	spacing should be equal or less than slice thickness	spacing should be equal or less than slice thickness	
Matrix size	512 x 512	512 x 512	
Slice thickness	0.625 mm - 5 mm (StrokeViewer ASPECTS) 2.5 - 5 mm (StrokeViewer Hemorrhage)	1 - 2 mm (StrokeViewer ASPECTS) 5 mm (StrokeViewer Hemorrhage)	
Number of slices	any	20 - 30	
Kernels	Soft tissue	Soft tissue	
MR perfusion (MR-PWI, DSC-contrast) Repeatedly acquired volumes of echo-planar imaging acquired during injection of a contrast bolus. This measurement technique is often referred to as "DSC-Perfusion" (Dynamic-susceptibility-contrast perfusion).			StrokeViewer Perfusion
Orientation	AXIAL	AXIAL	
Slice spacing	spacing should be equal or less than slice thickness	spacing should be equal or less than slice thickness	
Number of timepoints:	10 - 100	40	
Temporal sampling (TR)	0.5 to 5 sec	1.5 sec	
Echo Time	10 - 100 ms	40 ms	
Matrix size	up to 256 x 256	96	
Slice thickness	1 - 15 mm	5 mm	
Number of slices	any	20 - 30	

Table 2. An overview of the supported and recommended image acquisition parameters that are recommended for the StrokeViewer features.