clouds of care

INSTRUCTIONS FOR USE		
Document Title	Document Description	Version No.
TMP730-32-PROD01-002	**Instructions for Use for Persyst ESI powered by Epilog – Clinical User ROW**	**6**

General IFU information	
IFU Version	6
Date of IFU issue	July 2025
Latest IFU issue	April 2026
IFU purpose	This "Instructions for Use" contains information on how to use Persyst ESI powered by Epilog service as a clinical user and applies to Rest of World (ROW) users.
Support contact	support@persyst.com

Table of contents

1 Important device information

1.1 Device description

Commercial product name	Persyst ESI powered by Epilog
Model	v3
Intended purpose	The device is intended for use by a qualified operator on both adult and pediatric epilepsy patients at least 3 years of age for the visualization of epileptic activity based on an EEG recording and an MR image (electrical source imaging). The device results are intended to aid a clinician in guiding next treatment steps and/or in classifying epilepsy of the patient.
Indications	Epilepsy (including refractory epilepsy)
Patient target group	• Adults • Pediatric patients at least 3 years of age
Intended user	• The "clinical user": neurologist, EEG technician, or neurophysiologist • The "analytical user": direct user of the device, internally at Clouds of Care (not in scope of this user manual)
UDI-DI	5430000733038
Manufacturer	Clouds of Care NV Kliniekstraat 27a, 9050 Ghent, Belgium SRN: BE-MF-000003302
Distributor	Persyst Development LLC 420 Stevens Avenue Suite 210, Solana Beach, CA 92075 United States

Rx only

CE 1639 MD

The product is a class IIa medical device in accordance with Regulation (EU) 2017/745. Notified body is SGS Belgium NV (NB 1639).

The product is a Class II medical device cleared by FDA with 510(k) number K252565, for prescription use only.

1.2 Safety information

Contraindications	• Skull defects or skull parts missing • Artefacts in imaging due to intracranial electrodes

	• Substantial intracranial lesion impacting brain structure (such as hemispherectomy, big malformations of brain structures, tumors, etc.)
Limitations	• The EEG recording must have at least 18 electrodes with spatial coverage in line with the 10-20 electrode placement system.
Precautions	• The results can never be the sole basis for diagnosis and/or treatment decisions. • The results should be considered in conjunction with other clinical and paraclinical investigations, including but not limited to clinical neurological examination, seizure semeiology, EEG, imaging (including but not limited to MRI) and neuropsychological evaluation. • The final diagnosis or treatment conclusion can only be made by a physician who is adequately trained and licensed. • The accuracy of the analyses is directly related to the quality of the input signals and images (EEG, annotations, MRI). The results must therefore always be interpreted taking into account the original input's quality. • The results only evisualize results without any interpretation of the signal. It is up to the clinical user to assess the displayed cluster activity as artefact, physiological, or genuine spike activity.
User training and/or qualifications	The clinical user must be a trained healthcare professional: neurologist, EEG technician, or neurophysiologist.

Any serious incident that has occurred in relation to the device shall be reported to Clouds of Care and to the authority having jurisdiction in the locale (in Europe: competent authority of the member state) where the user and/or patient is established.

1.3 Performance characteristics

1.3.1 Device performance

- Persyst ESI powered by Epilog aids in determining the lateralization and localization of the detected interictal epileptiform discharges.
- Persyst ESI powered by Epilog aids in planning the treatment of epilepsy (including aiding in invasive EEG electrode positioning, patient treatment management, patient triaging and planning further surgical procedures).
- Persyst ESI powered by Epilog is an automated ESI-as-a-service tool that empowers doctors to easily interpret ESI results (within the presurgical workflow of refractory epilepsy patients), saving valuable time and reducing the need for extensive training.

1.3.2 Clinical benefits

- Increased accuracy of epileptogenic focus localization compared to visual EEG assessment. Higher chance of becoming seizure-free if resection area contains area of ESI results.
- Persyst ESI powered by Epilog positively influences patient management in the presurgical evaluation.
- Persyst ESI powered by Epilog saves time for clinicians and reduces the need for extensive training.

1.3.3 Service

The expected turnaround time between uploading appropriate input data and receiving the results is 2 business days, excluding Belgium and USA holidays.

2 Compatibility

2.1 Other devices or software

Persyst EEG Review and Analysis software can be used for pre-processing the EEG in terms of automated spike detection, as well as user selections and annotations.

The device has been ensured to be compatible with Persyst EEG Review and Analysis Software with a fully automated integration. The software is able to be used for:

- Persyst ESI app: data management system for communication with the Persyst ESI powered by Epilog service (upload of input data, download of results).
- MRI viewer to review the volumetric result files and export to DICOM format.

Please refer to the user guide of Persyst software for detailed instructions.

2.2 Input data

- MRI data
  - File format: any file format that can be read by the Persyst software.
  - Image type T1, T2, or Flair.
  - The whole head of the patient must be fully captured in axial, sagittal and coronal planes. The MR image should include the foramen magnum, the vertex, the left and right pre-auricular points, the nasion, and the inion.
  - MRI artifacts shall be minimized to ensure adequate image quality for tissue segmentation for ESI.

- EEG data
  - File format: any file format accepted by Persyst software.
  - Before submission to Persyst ESI powered by Epilog, the uploaded EEG can have three different statuses:
    - As a raw recording without any user annotations or selections, and without being pre-processed by the user in the Persyst software.
    - With annotations; these can be either selected (up to 16 selected clusters allowed) from the automated spikes detected when processing the recording in the Persyst software, or manually annotated in the Persyst software. Note that if the recording has not been fully processed in the Persyst software during the whole duration of the recording and spikes have been selected by the user, the automated results will only cover the length of the recording that has been pre-processed by the Persyst software.
    - Without any user annotations or spike selections, but pre-processed by the Persyst software.

- Supported EEG setups:
  - Standard 10-20, 10-10 or 10-5 arrays. The EEG record must have at least 18 electrodes with standard channel labels. The channel names of received recording must be unique. Names differing only by letter case, i.e., upper or lower case, are considered duplicates and not accepted.
- EGI-128, EGI-256 set-ups.
- ECG channel, if present.
- Recording duration of up to 15 days. Please note that if the number of spikes occurring during the recording time is too high (more then 100k), the histogram will show no spikes near then end of the recording because we will remove execess spikes. This will not compromise the reliability of the results.
- Users should exclude any EEG channels that were not connected to the patient during data acquisition from the recording.
- Users may upload EEG records whether they have been processed by Persyst or not.
  - If the record is processed by Persyst, users can use Spike Review to assess spikes and select subsets of spikes. Note that if the recording is only partially processed by Persyst and spikes have also been selected by the user, the automated results will only cover the length of the recording that was processed by Persyst.
- Users may also add manually annotated spikes to the record, whether it is processed or not by Persyst.

3 Report interpretation guideline

3.1 Report structure

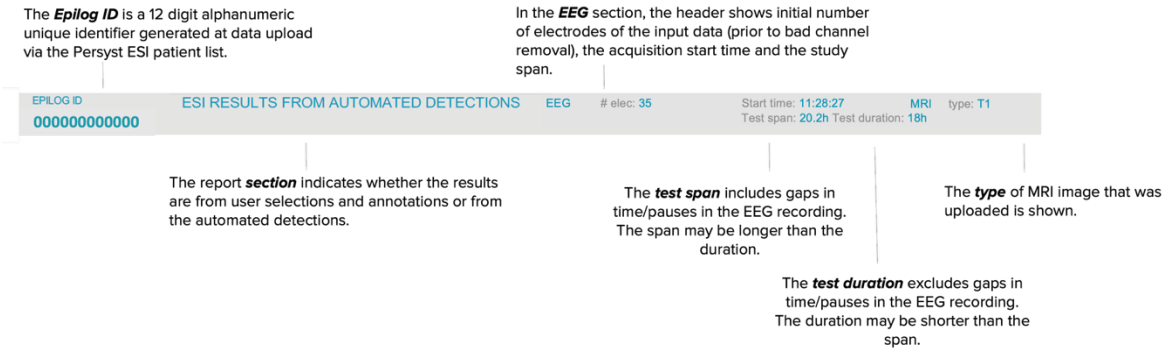
The report is structured as follows:

1. Title page with identification of the report and the analysis.
2. Results of the electrical source imaging analysis, divided into **two sections** (see sections *Clusters overview* and *Cluster results*):
   a) The results for the **user** selected and/or annotated spikes, for **all clusters** (with a maximum of 16 clusters).
   b) The results for the **automated** method (with a maximum of 4 clusters).
   Both sections are provided with a summary page of the clusters found in that section, followed by the details of each cluster, including the localization results at three time points: onset, half-rising and peak of the spike waveform.
3. Details of the head model generated to run the ESI analyses. See section *Head model.*
4. Technical details about the analysis. See section *End of the report.*

The details of each section are described within this document.

3.2 Header elements

Each page of the report will have a header with the elements specified below:

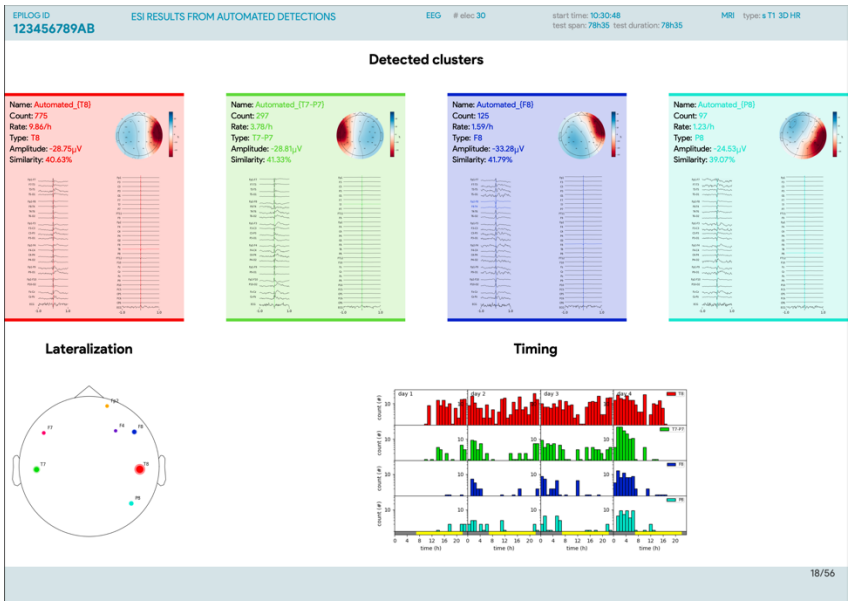


Please note that the number of electrodes of the header refers to the total number of electrodes in the record before bad electrodes are removed during processing.

On the footer of each page, patient identifying information such as name and date of birth are automatically added back by the Persyst ESI application

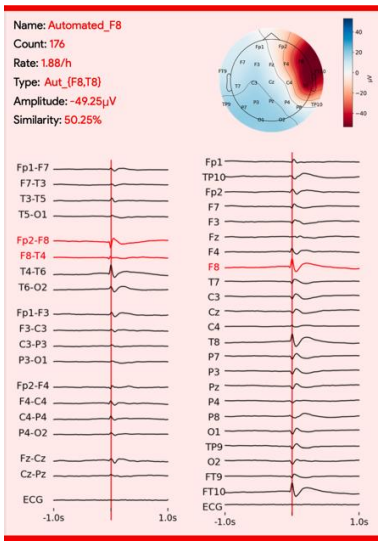
3.3 Clusters overview

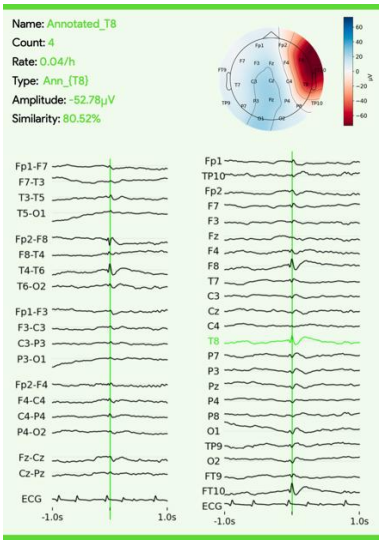
The start of each report section is an overview of the spike clusters, the lateralization of these clusters, and at what time during the recording the spikes occurred. Each cluster is **color-coded**, and this same color is used throughout the report for the results of that cluster. Note that the same color schemes are used for the user selection and annotations, and automated report sections.

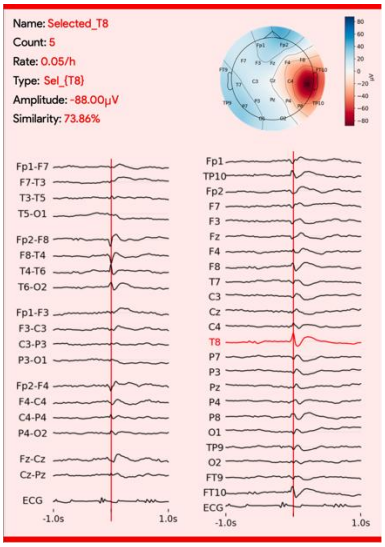


- The clusters reported on according to the section of the report. **User selections and annotations**
  - In this section, all user spike selections and manual spike annotations are reported on (with a maximum of 16 clusters), regardless of the total amount of individual spikes in a cluster. For sufficient signal-to-noise ratio, marking a minimum of 15 spikes is recommended.
  - Spikes are clustered according to the name of the user-marked channel.
  - Note that where the user marked the spike is the presumed peak. However, if there is a larger negativity within 20 ms before or after the user-marked peak, the timestamp of the peak will be automatically shifted to the larger negativity.
- **Automated detections**
  - From all automated detections, the 4 clusters with the highest number of spike detections after preprocessing are reported.
  - Each spike cluster must have a minimum of 15 individual spikes for it to be reported. For high-density EEG data, the threshold is reduced to 4 individual spikes.
  - The spikes are clustered based on their topography at the peak.

Note that when a record is uploaded that has been processed by Persyst, a de-identified, concatenated record containing the spike detections is uploaded where further post-processing is performed for artifact removal. During this step, some of the Persyst-detected spikes may be removed. Therefore, the number of spike clusters and spike detections seen in Persyst prior to upload may be different than those in the final ESI report.



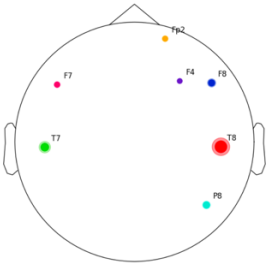




The cluster summary includes:

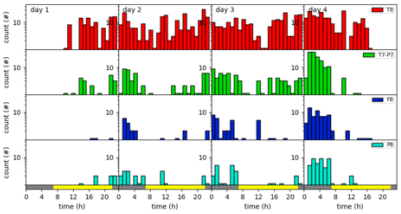
- Cluster **Name**, which is constructed as the type (Automated / Annotated / Selected) and the channel the spike was maximally detected on or named as. When two Automated clusters have a similarity of 90% or higher, they are merged into a single cluster. The merged cluster is named according to the cluster that had the most spike candidates prior to the merge.
- **Count** is the total number of individual spikes within the cluster
- Spike **Rate** expressed in number of spikes per hour of the recording duration.
- Cluster **Type**, indicating whether the cluster is generated from Automated, Annotated or Selected spikes (Aut / Ann / Sel). When Automated clusters are merged, the original clusters are reported here.
- The **Amplitude** of the average waveform at the peak, in microvolts.
- The **Similarity** is a measure of how similar each individual spike is to the average, calculated as the Pearson correlation between waveforms.
-

- A **topographic plot** depicting the scalp voltage topography of the average waveform at the maximum (peak).
- The **average waveform** of all the individual spike candidates within the cluster with 1.0 s before and 1.0 s after the maximum (peak) in both bipolar and referential montages. Averaging aligned to the maximum (peak) is performed to increase the signal-to-noise ratio of the data.



The spike **lateralization diagram** shows the scalp electrodes spike clusters were detected on. All detected spike clusters are shown with their color code.

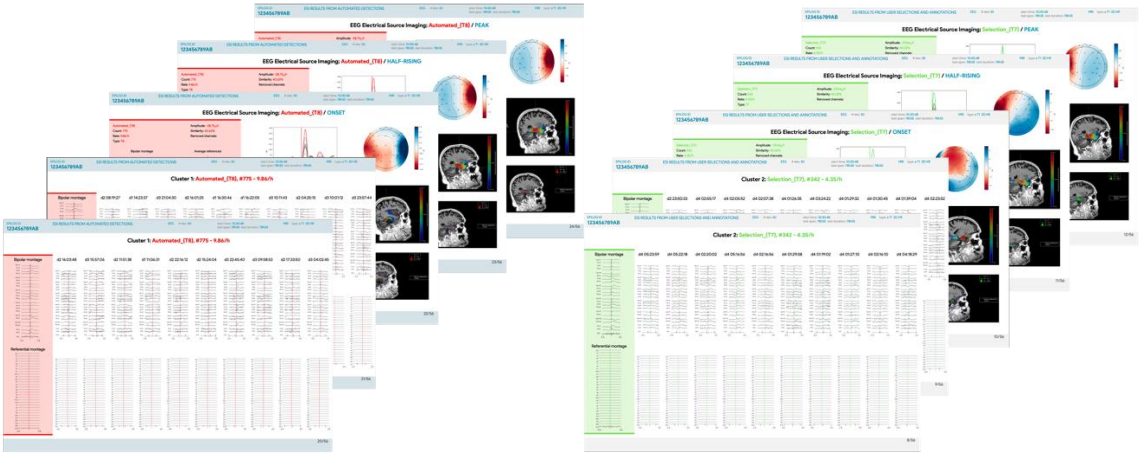
The size of the disc correlates to the number of detections in that cluster.



The spike **timing histogram** shows when individual spikes were detected throughout the EEG recording, where the y-axis, expressed in log scale, represents the number of individual detections after post processing, where outlier spikes, e.g., spikes with artifacts) and spikes exceeding the predefined spike-count threshold are removed. The x-axis indicates time. All detected clusters are shown.

The bottom bar shows a visual indication of day (yellow) and night (grey) times.

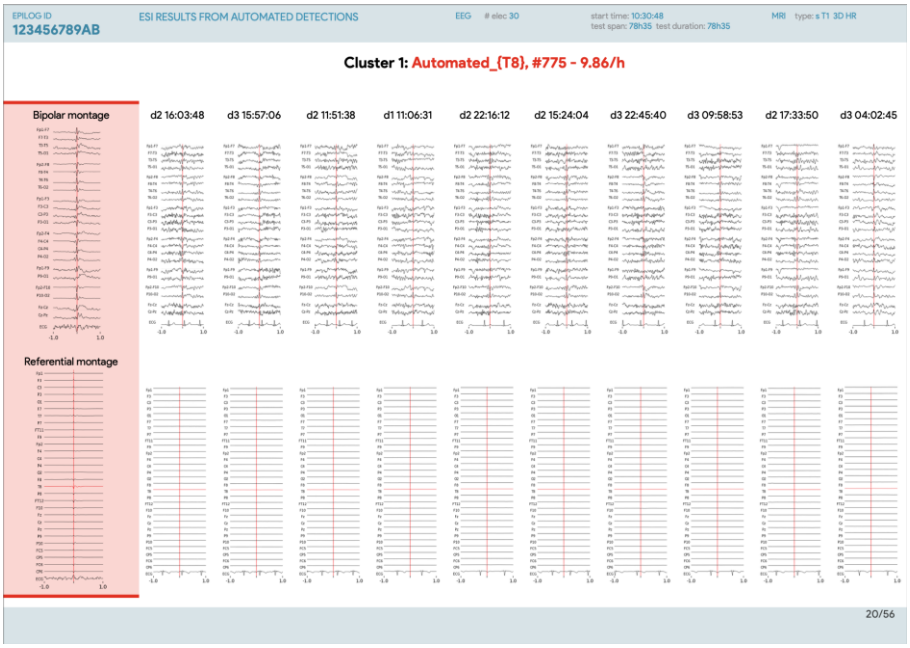
3.4 Cluster results



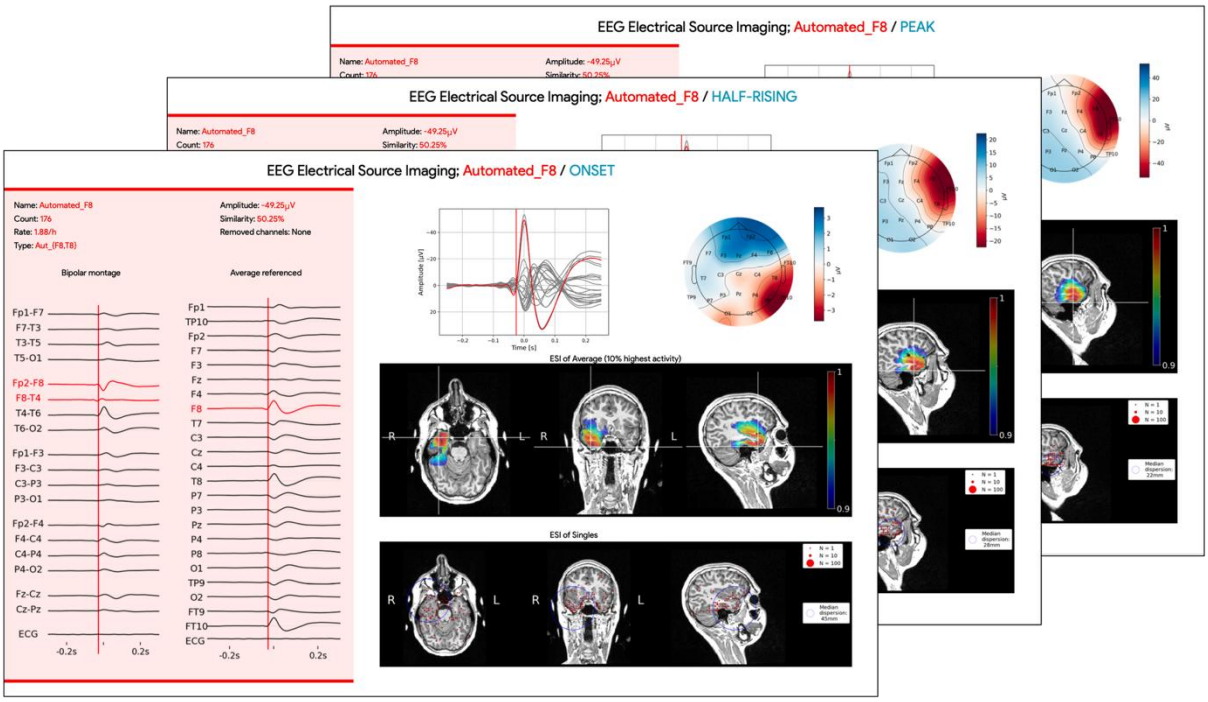
3.4.1 Detected spikes per cluster

After the clusters overview, the details for each cluster are reported in the order they appear in the overview. The first two pages in each details section show **20 individual spike examples** from that cluster, shown in **bipolar** and **referential** montages (or less if the cluster is based on fewer spikes).

The 20 individual spikes shown are those with the highest **similarity** to the average. The time point of when each spike occurred in the original EEG record is above each figure.

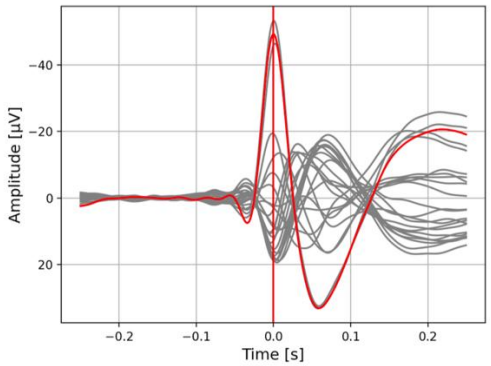


3.4.2 EEG Source Imaging per cluster



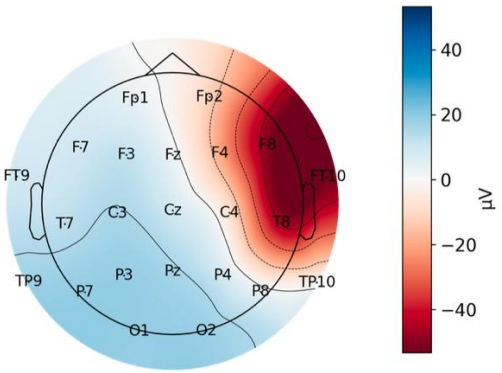
The next three pages show the ESI calculations at the **onset**, **half-rising** and **peak** of the cluster. The time point of the **onset** is calculated as having **10% of the amplitude measured at the peak of the spike** on the leading electrode**.** Similarly, the time point of **the half-rising** is calculated as having **50% of the amplitude measured at the peak of the spike.**

The ESI results are shown alongside the scalp EEG data including the average spike waveform in bipolar and referential montages on the left and a butterfly plot and topographic scalp voltage map on the top of the page.

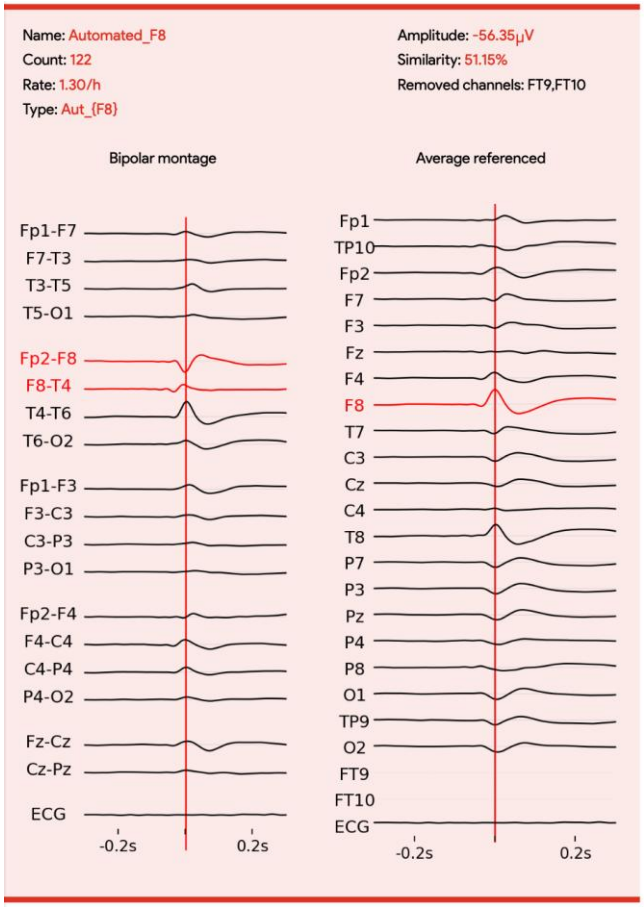


The **butterfly plot** shows an overlay of all the EEG channels in a referential montage. The channel with the maximum peak activity is depicted in the color of the cluster.

The vertical line shows the time point along the EEG waveform for which the ESI results are shown. In this example, the onset is shown.



The topographic scalp **voltage map** for the same time point is shown; either the onset, half-rising or peak.



The same summary information as in the clusters overview is repeated, along with a list of bad channels that were removed, if any. Removed channels are not included in the ESI calculations for that cluster.

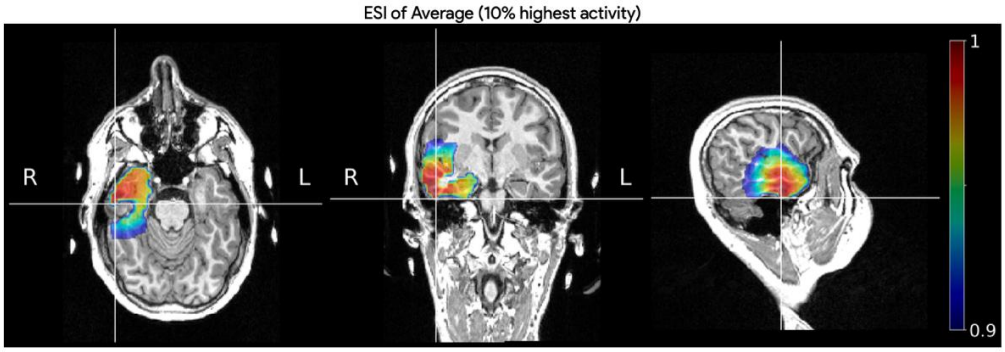
When a bad channel has been removed from a cluster:

- it is listed at the top, along with the number of removed channels (# = x [removed channels])
- the channel is displayed as a flat line in gray watermark
- the channel is not displayed in the voltage map

Common reasons for channel removal are:

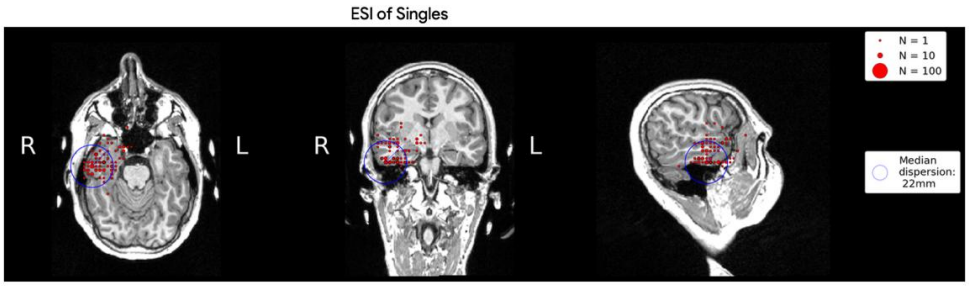
- The channel contains high-frequency muscle artifact.
- The channel exceeds the impedance threshold and shows environmental noise.
- The channel is an outlier in the voltage map of the average spike.
- The amplitude of the channel is an outlier compared to the other channels.

There are two sets of images for the ESI results on each of the three pages with ESI results (onset, half-rising and peak). Each set of images includes the **axial** (left), **coronal** (middle) and **sagittal** (right) slices at the 3D anatomical location of the maximum calculated current at the specified time point. The ESI results of the Average Spike Waveform appear under the Butterfly Plot with the ESI results of the Individual (Single) Spikes appearing after.



ESI results for the Average Spike Waveform are obtained by using the patient-specific or atlas based head model with the sLORETA algorithm to calculate the cortical areas contributing the most to the EEG patterns measured at the scalp at the specified time point.

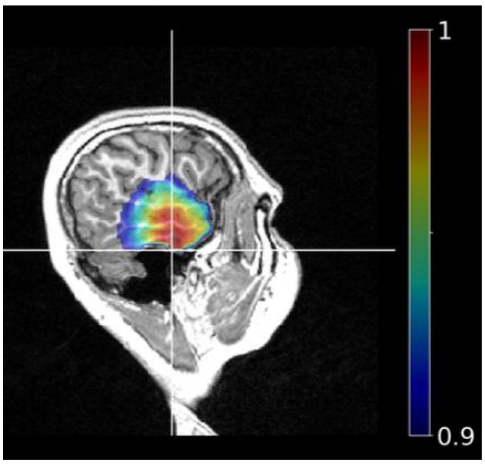
The ESI results of the **Average Spike Waveform** are shown as a distributed spectrum of colors where red represents a high level of relative current and blue represents a lower level of relative current. Results are thresholded to show only the top 10% of the calculated current at that time point within the whole gray matter volume.

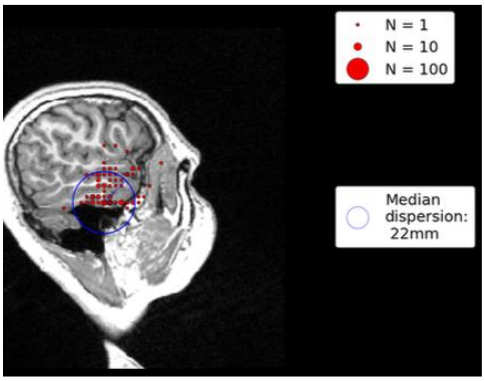


The ESI results for the **Individual (Single) Spikes** are obtained by taking the 100 single spikes in the cluster with the highest similarity to the average and first calculating the ESI results for each spike using the patient-specific or atlas-based head model with the sLORETA algorithm.

Next, the voxel (3D point) with the **maximum** calculated current from the distributed ESI result is identified. A red dot is then placed on the MRI slices for each voxel; 100 dots represent the maxima for 100 spikes. The size of a dot correlates to the number of single spikes whose maximum localized to that location. In this way, the ESI results of the average can be visually correlated to the ESI results of the single spikes.

Note that the axial (left), coronal (middle) and sagittal (right) slices that are shown are taken at the ESI location of the averaged spike. The individual dots are then orthogonally projected onto these 3 slices. Because of this projection, only some of the dots are located in the visualized slices, and some dots may appear to fall outside of the brain.

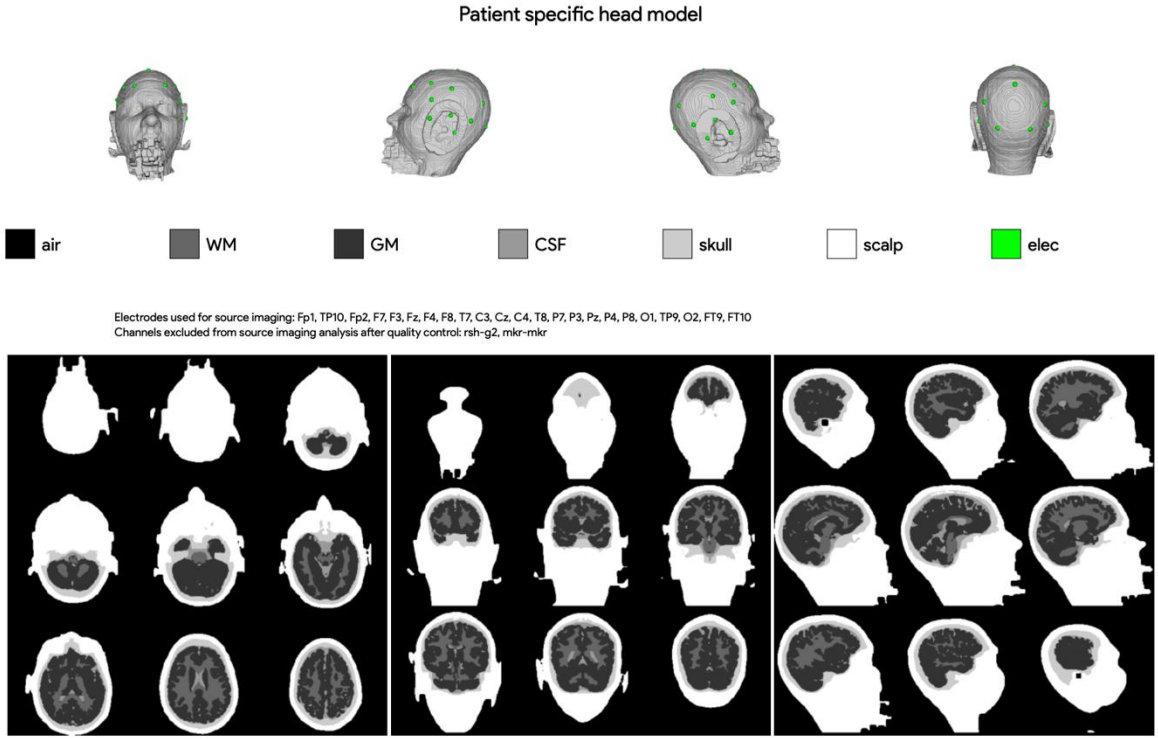




For the ESI results of the Individual (single) Spikes, the **Median Dispersion value** is shown.

Dispersion is calculated as the average distance in source space of the Individual (single) Spikes results from the Average Spike Waveform results. Dispersion is shown as sphere which is over the center location of the Average Spike Waveform's maximum ESI result at the indicated time point. The radius of the sphere is the Dispersion measure, expressed in mm. The sphere contains 50% of the Individual (single) Spike results within it.

3.5 Head model



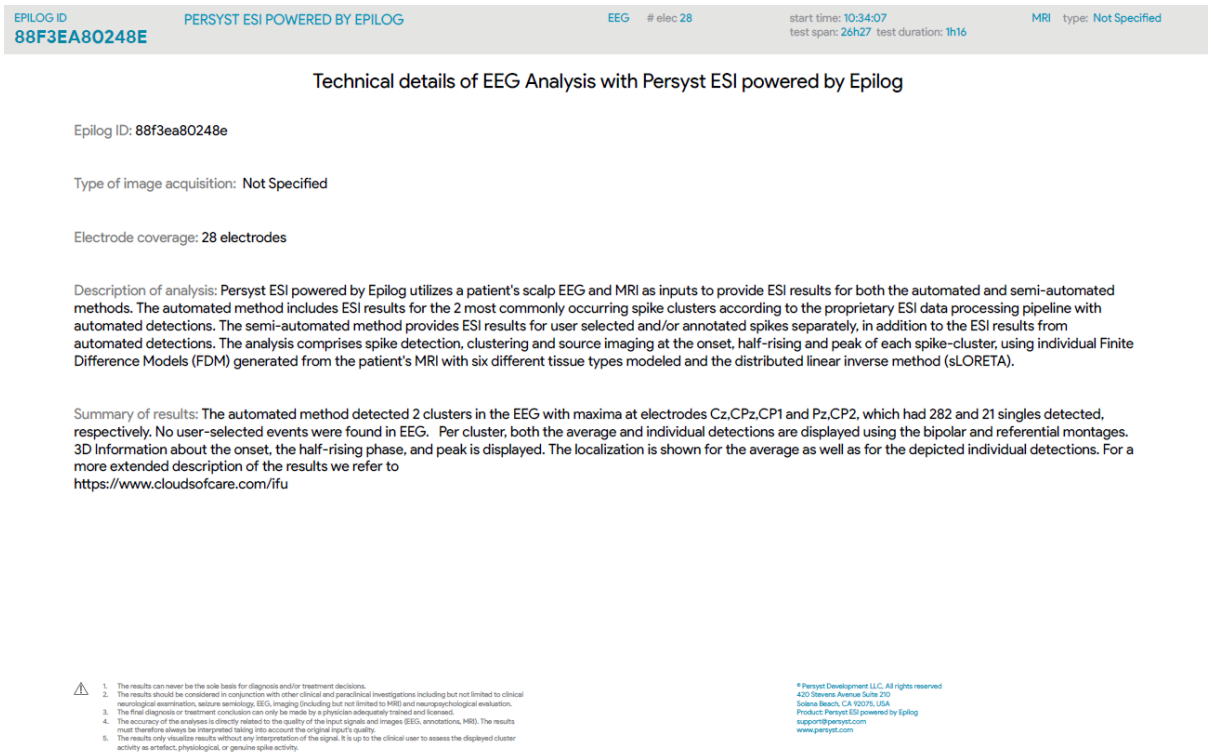
Information about the patient-specific or atlas based **head model** used to perform the ESI calculations is summarized here. All models calculated are **Finite Difference Models** (FDM).

- The 3-dimensional rendering of the head of the patient shows where the **electrodes** (green dots) were positioned for the ESI calculations.
- The legend shows the color codes for the **six different tissue types** that are used to construct the head model.
- The axial, coronal and sagittal slice views allow for visual assessment of the tissue segmentation.

All electrodes from the original recording are represented here, including the bad channels not included in the source imaging calculations.

3.6 End of the report

The final page of the report includes a general description of the analysis performed, along with a summary of the results that are presented in the report.



EPILOG ID 88F3EA80248E PERSYST ESI POWERED BY EPILOG EEG # elec 28 start time: 10:34:07 test span: 26h27 test duration: 1h16 MRI type: Not Specified

Technical details of EEG Analysis with Persyst ESI powered by Epilog

Epilog ID: 88f3ea80248e

Type of image acquisition: Not Specified

Electrode coverage: 28 electrodes

Description of analysis: Persyst ESI powered by Epilog utilizes a patient's scalp EEG and MRI as inputs to provide ESI results for both the automated and semi-automated methods. The automated method includes ESI results for the 2 most commonly occurring spike clusters according to the proprietary ESI data processing pipeline with automated detections. The semi-automated method provides ESI results for user selected and/or annotated spikes separately, in addition to the ESI results from automated detections. The analysis comprises spike detection, clustering and source imaging at the onset, half-rising and peak of each spike-cluster, using individual Finite Difference Models (FDM) generated from the patient's MRI with six different tissue types modeled and the distributed linear inverse method (sLORETA).

Summary of results: The automated method detected 2 clusters in the EEG with maxima at electrodes Cz,CPz,CP1 and Pz,CP2, which had 282 and 21 singles detected, respectively. No user-selected events were found in EEG. Per cluster, both the average and individual detections are displayed using the bipolar and referential montages. 3D Information about the onset, the half-rising phase, and peak is displayed. The localization is shown for the average as well as for the depicted individual detections. For a more extended description of the results we refer to https://www.cloudsofcare.com/ifu

⚠
1. The results can never be the sole basis for diagnosis and/or treatment decisions.
2. The results should be considered in conjunction with other clinical and paraclinical investigations including but not limited to clinical neurological examination, seizure semiology, EEG, imaging (including but not limited to MRI) and neuropsychological evaluation.
3. The final diagnosis or treatment conclusion can only be made by a physician adequately trained and licensed.
4. The accuracy of the analyses is directly related to the quality of the input signals and images (EEG, annotations, MRI). The results must therefore always be interpreted taking into account the original input's quality.
5. The results only visualize results without any interpretation of the signal. It is up to the clinical user to assess the displayed cluster activity as artefact, physiological, or genuine spike activity.

420 Stevens Avenue Suite 210
Solana Beach, CA 92075, USA
Product: Persyst ESI powered by Epilog
support@persyst.com
www.persyst.com

For questions or more details about this solution, please contact support@persyst.com

4 Additional Product Specifications

4.1 Recurrent testing and maintenance

Persyst ESI Powered by Epilog will be continuously maintained by Clouds of Care. Any required updates will be implemented by following the product change control process. Updates will be automatically pushed to the production environment. No action from the user is required. Customers will be informed of any changes impacting them.

4.2 System requirements

Persyst ESI powered by Epilog is provided to the clinical user as a service. Interaction with the service will be fully integrated in the Persyst software.

Refer to system requirements of Persyst software to identify requirements for your system.

4.3 Decommissioning and disposal

No decommissioning and disposal is required by the user, as Persyst ESI powered by Epilog is provided to the clinical user as a service. Interaction with the service will be fully integrated in the Persyst software.

5 Definitions

5.1 Terms and abbreviations

Table 1: Definitions for terms and abbreviations used in this document

Term or abbreviation	Definition
ESI	EEG Electrical Source Imaging
QC	Quality Control

5.2 Symbols glossary

Symbol	Title	Description
	Manufacturer	Indicates the medical device manufacturer.
	Consult (electronic) instructions for use	Indicates the need for the user to consult the instructions for use.
	Caution	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.
	Medical device	Indicates the item is a medical device.
	Unique device identifier	Indicates a carrier identifier that contains unique device identifier information.

Symbol	Title	Description
	Distributor	Indicates the entity distributing the medical device into the locale.
Rx only	Prescription Only	Indicates that the product is for prescription use only and must be used under the supervision of a licensed healthcare professional

6 Version history

Version	Author	Description of changes
6	Sarineh Keshishzadeh	Clarified MRI and EEG data requirements related to artifacts, setups, duration, and spike handling.
5	Maria Silos Viu	Initial release of the document intended for external use.

End of document

TMP730-32-PROD01-002 (DOC-2240) Ver. 6

Approved By:

Sarineh Keshishzadeh - Author

April 10, 2026 10:49 AM CEST fa081962-2475-4151-ac62-1c765a36454c

Jens Goeman - Reviewer

April 10, 2026 1:14 PM CEST 7d345d7b-f2e9-4840-b74a-e164251a65f1

Maurice D'hiet - Document Control

April 10, 2026 12:00 PM CEST 1bc493c3-d19c-473e-9fdd-ff985f7395ba

Pieter van Mierlo - Reviewer

April 13, 2026 9:57 AM CEST d56f3ae2-7973-4820-905b-fe248e843051

Sindhu Ranganath - Regulatory

April 10, 2026 10:50 AM CEST ec121c5c-51a4-4c3f-a67a-fb43dec57e90

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Sarineh Keshishzadeh	April 13, 2026 11:44 AM CEST	Not Available	6	Published
Maria Silos Viu	July 14, 2025 8:43 AM CEST	Not Available	5	Superseded
Nick de la Croix	May 24, 2024 1:49 PM CEST	Not Available	4	Superseded
Nick de la Croix	March 20, 2024 8:18 PM CET	CO-302	3	Superseded
Nick de la Croix	October 23, 2023 5:29 PM CEST	Not Available	2	Superseded
Eline De Schutter	October 16, 2023 12:14 PM CEST	Not Available	1	Superseded
Eline De Schutter	July 4, 2023 3:54 PM CEST	Not Available	0	Superseded