K120260

510K Summary

JUN 29 2012

Date: June 19, 2012

Submitted by: Natus Medical Incorporated
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Propietary Name: ICTA

Common Name: EEG software or Electroencephalogram

Classification Name: Automatic event detection software for full-montage electroencephalograph.

Product code: OMB

Device Class: II

Predicate Devices: NeuroWorks Seizure Detector (K090019)

Description

ICTA is a software only product. It runs on a personal computer and requires no specialized hardware. It identifies electroencephalographic activity that might correspond to seizures (referred as "events"). These events are then reviewed, accepted, modified and/or deleted by the qualified medical practitioner. The software does not make any final decisions that result in any automatic diagnosis or treatment. The EEG input is read from a file on the personal computer (or available across the network).

ICTA employs Bayesian formulation to provide a detection variable based on the probabilities that a given section of EEG contains a seizure-like activity. The a priori probabilities that a certain set of features represent seizure or non-seizure data were computed from the training data set. These probabilities are used by the detection method for all seizure detections.

The software has two components: ICTA-S for analysis of surface EEG recordings and ICTA-D for analysis of intracranial recordings. Whether a particular module is active is determined by the user. The user also determines parameters that are needed for the algorithm to perform its intended task. None of the components is responsible for data acquisition, review or any other function different from analysis.

Indications for Use

The ICTA software is intended as a review tool to mark previously acquired sections of the adult (greater than or equal to 18 years) EEG recordings (surface or intracranial) that may correspond to electrographic seizures, in order to assist qualified clinical practitioners, who will exercise professional judgment in using the information, in the assessment of EEG traces.

- Surface recordings must be obtained with full montage according to the standard 10/20 system.
- Intracranial recordings must be obtained with depth electrodes (strips and/or grids).

This device does not provide any diagnostic conclusion about the patient's condition to the user.

Predicate Comparison

	Predicate device	Subject device	Comment
	Neuroworks Seizure Detector(K090019)	*ICTA*	
Device Class	Class II	Class II	
Class Name	Automatic event detection software for full-montage electroencephalograph	Automatic event detection software for full-montage electroencephalograph	Same
User Input	Mouse/keyboard	Mouse/keyboard	Same
Intended use	The Seizure Detection component of Neuroworks is intended to mark previously acquired sections of the adult (greater than or equal to 18 years) EEG recordings that may correspond to electrographic seizures, in order to assist qualified clinical practitioners in the assessment of EEG traces. EEG recordings should be obtained with full scalp montage according to the standard 10/20 system.	The ICTA software is intended as a review tool to mark previously acquired sections of the adult (greater than or equal to 18 years) EEG recordings (surface or intracranial) that may correspond to electrographic seizures, in order to assist qualified clinical practitioners, who will exercise professional judgment in using the information, in the assessment of EEG traces. Surface recordings must be obtained with full montage according to the standard 10/20 system. Intracranial recordings must be obtained with depth electrodes (strips and/or grids). This device does not provide any diagnostic conclusion about the patient's condition to the user.	Equivalent. Both devices are intended to for computer –assisted event marking that a qualified user can use for diagnosis. ICTA is able to analyze surface recording and intracranial recordings.
IFU- Intended user	Medical professional trained in EEG analysis	Medical professional trained in EEG analysis	Same
Number of channels	Up to 128 channels	Up to 128 channels	Same

	Predicate device	**Subject device**	**Comment**
	Neuroworks Seizure Detector(K090019)	***ICTA***	
Functional output	Spikes, spike burst, rhythmic burst	Seizures (i.e generically refer to as stellate event in the software)	Equivalent. Only difference is due to ICTA not used in the detection of spikes.
User control of detection parameters	Detection montage customization. User defines detector settings.	Detection montage customization. User defines detector settings.	Same
Event detection sensitivity%*	76%	ICTA-Surface / ICTA-Depth* 75% / 75%	Equivalent
False positive rate for events*	0.6 FP/h	ICTA-Surface / ICTA-Depth* 2.0 / 1.8 FP/h	Equivalent

Brief Summary of Non-Clinical and Clinical Performance Tests

All functionalities and performance of the ICTA software have been verify/validated through Bench and clinical performance tests according to the intended use- and user- of the device.

Non-Clinical: The ICTA Algorithms rely upon underlying mathematical analyses, including signal regularity, maximum frequency, and amplitude variation. Each mathematical analysis was independently calculated and verified against results generated from published methods.

Clinical: Natus conducted an extensive clinical test to: 1) Evaluate the positive percent agreement (i.e., detection sensitivity) and false detection rate of both components (ICTA-S and ICTA-D) of ICTA Algorithms; and, 2) Demonstrate equivalence of the seizure detection performance, in terms of positive percent agreement and false detection rates, of ICTA Algorithms to that of a predicate device and/or to the gold standard, defined as seizures detected by a panel of 3 board certified Neurophysiologists.

ICTA-S Study.

Subject Population and Test Dataset
The seizure detection performance of ICTA-S Seizure detection algorithm was evaluated on scalp EEG recordings from patients with medically refractory seizures. All patients 18 years of age or older with a history of seizures admitted to an Epilepsy Monitoring Unit for long term EEG-video recordings for diagnostic or pre-surgical evaluation were asked to participate. The validation data set includes EEG studies with full montage (21 channels).

Dataset Description
> Number of Seizures: 615
> Total Number of Patients: 102
> Total Number of Hours: 395 (mean ± SD =3.18 ± 0.03; range 2.0 ~5.2)

Under the constraint that no more than 3% of the total seizures were included from one subject; detection performance was tested on 615 seizures in a total of 395 hours of scalp EEG recordings from 102 patients. Otherwise, no additional inclusion/exclusion criteria were applied in the data selection process.

Reference Standard
Each of the EEG recordings was reviewed by three independent, blinded EEG experts (all neurologists/epileptologists) to identify electrographic seizures and spikes. The end point of this independent review was to identify, if any, the seizure onset times in each of the sampled EEG segments. Due to the anticipated inter-rater variability among EEG experts, a majority rule (at least 2 out of 3) was applied to make the final determination of "true" electrographic seizure.

Statistical Analysis for Seizure Detection Algorithm
1. *Inter Rater Performance for Seizure detection:* - Inter-rater Positive Percent Agreement (PPA) ranged between 73 and 85%, while False Detection per hour (FD/h) was very close for all three raters (0.3 FD/h, on average) for Seizure Detection.

	Seizure					
	Rater		Rater2		Rater3	
	PPA	FD/h	PPA	FD/h	PPA	FD/h
Rater 1	-	-	0.85	0.2	0.80	0.4
Rater 2	0.78	0.4	-	-	0.73	0.5
Rater 3	0.80	0.3	0.80	0.3	-	-

2. *Detection Performance for Seizure detection Algorithm:* - Based on the seizure samples determined by the independent EEG review panel, the positive percentage agreement (i.e., detection sensitivity) and false detection rate were estimated for both ICTA-S algorithm and the predicate device. Bootstrap method was applied to construct 95% confidence intervals for the estimated performance statistic.

Results of Seizure Detection Algorithm - Summary
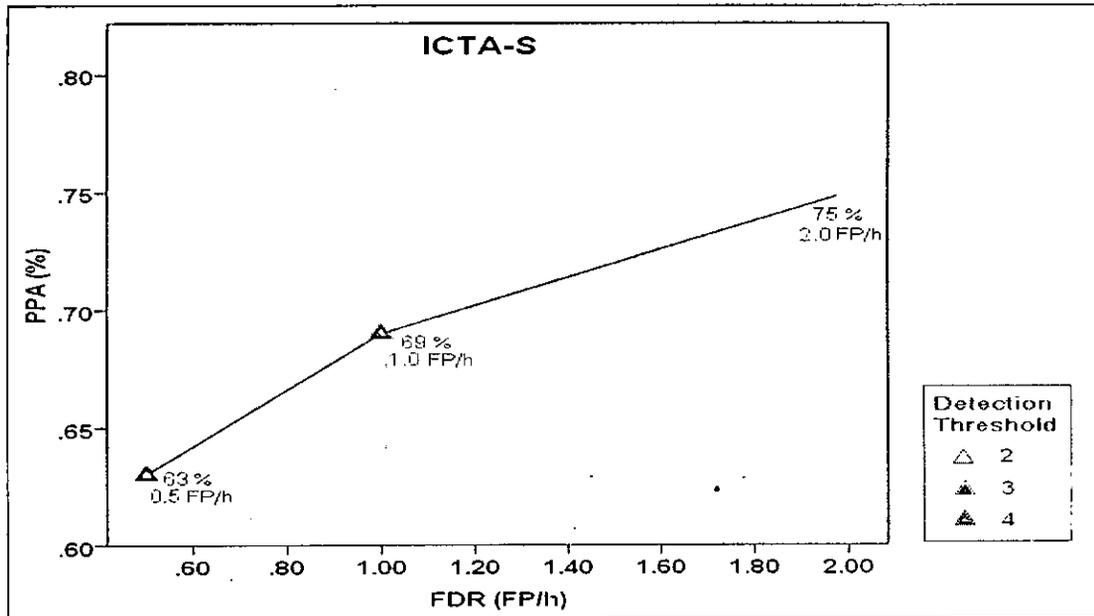
ICTA-S seizure detection algorithm performance as a function of detection threshold level.

One characteristic of the ICTA-S algorithm is the possibility for the user to adjust the detection threshold (Th) value. Changing the threshold value affects performance of the algorithm. As can be seen on the figure above, there is a tradeoff between PPA and the FDR. At lower values of the detection threshold the PPA improves (i.e at Th = 2, PPA= 75%) while the FDR increases. Higher values of Th result in the opposite behavior, that is, PPA decreases and the FDR improves (at Th= 4, FDR= 0.5 FP/h). The ICTA-S Algorithm had a 75% PPA and an FDR of 2.0 FD/h compared to the reference standard. Detailed performance data of the ICTA-S seizure detector is shown on the table below.

Detection Threshold	PPA (95% CI)	FDR (FP/h)
Th_2	75 (70 – 80)	2.0 (1.5 – 2.4)
Th_3	69 (62 – 72)	1.0 (0.7 – 1.3)
Th_4	63 (54 – 66)	0.5 (0.3 – 0.7)

(95% C.I.) - 95% Bootstrap Confidence Interval

ICTA-D Study

Subject Population and Test Dataset

All EEGs used for validation were collected from adult patients seen for routine clinical evaluation at the Epilepsy Monitoring Units of Toronto Western General Hospital and NewYork-Presbyterian Hospital. A physician not taking part on the subsequent review/scoring of the data conducted database query and study inclusion from a patient database of consecutive recordings.

All studies consisted on electrocorticographic (ECoG) recordings obtained using Natus proprietary hardware/software, with full intracranial electrodes (strips and/or grids), and were included independently of ECoG patterns and technical quality.

Dataset Description

Number of Seizures: 429
Total Number of Patients: 93
Number of Hours: 619 hours

AGE (Mean ± SD)	40.8 ± 11.1*
GENDER	57 (Male)
	36 (Female)

All subjects involved in this study were adult patients (≥18 years old).

To avoid over-weighting recordings containing many events, a maximum of 12 events per recording were permitted.

Reference Standard

Each of the ECoG recordings was reviewed by three independent, blinded EEG experts (all neurologists/epileptologists) to identify electrographic seizures. The end point of this independent review was to identify, if any, the presence of seizures in each of the sampled ECoG segments. Due to the anticipated inter-rater variability among EEG experts, a majority rule (at least 2 out of 3) was applied to make the final determination of "true" electrographic seizure.
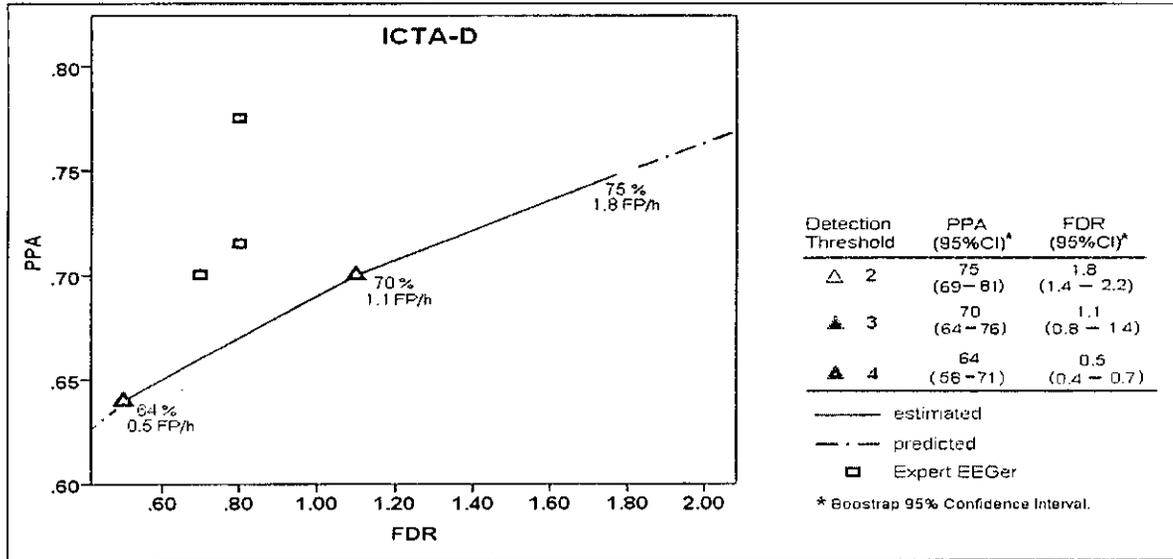
Results

1. Inter Rater Performance

Each Rater was compared against the "consensus" marking of the remaining two raters. The results are shown on table below. Rater 1 showed the highest possible PPA with 77%, which was also accompanied by higher FDR though within the performance of the other reviewers. PPA and FDR for the other reviewers were very similar with 70% PPA. Reviewer 2 (compared to Reviewer 1 + Reviewer 3) showed the lowest FDR of 0.7 FP/h.

Inter-rater Positive Percent Agreement and False Detection Rate

	PPA (95% CI)*	FDR (95% CI)*
REV1 *(vs. Rev2+Rev3)*	77 (74-86)	0.8 (0.6 – 1.0)
REV2 *(vs. Rev1+Rev3)*	70 (66-80)	0.7 (0.5 –0.9)
REV3 *(vs. Rev1+Rev2)*	71 (67-82)	0.8 (0.5 – 1.0)

Results of Seizure Detection Algorithm – Summary

ICTA-D

Detection Threshold		PPA (95%CI)*	FDR (95%CI)*
△	2	75 (69 – 81)	1.8 (1.4 – 2.2)
▲	3	70 (64 – 76)	1.1 (0.8 – 1.4)
▲	4	64 (56 – 71)	0.5 (0.4 – 0.7)

——— estimated
— · — predicted
▫ Expert EEGer
* Boostrap 95% Confidence Interval.

With detection threshold at 2, ICTA-D achieved 75% positive percent agreement and a false detection rate of 1.8 FP/hr. As was the case for ICTA scalp detector, for ICTA-D also the variation of "threshold detection" levels translated into a trade-off between PPA and FDR. At lower threshold values (i.e. =2) PPA increases at same time that the "specificity" decreases, that is, the number of false detections increases.

Unlike other algorithms reported in the scientific literature, ICTA-D was built to allow for user tuneability, which gives the flexibility of regulating performance as desired. Users can control algorithm behavior by adjusting thresholds to tune performance as they see fit. At default thresholds, results comparable to expert reviewers were obtained with no need of altering the algorithm at run time.

Conclusion

Based on the results of the non-clinical and clinical testing we conclude that ICTA (ICTA-S and ICTA-D) seizure detection algorithm is substantially equivalent to the predicate device and reference standard.

Excel-tech Ltd.
c/o Daniel Ramirez, MD, PhD
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Re: K120260
    Trade/Device Name: ICTA
    Regulation Number: 21 CFR 882.1400
    Regulation Name: Electroencephalograph
    Regulatory Class: Class II
    Product Code: OMB
    Dated: April 6, 2012
    Received: June 14, 2012

Dear Dr. Ramirez:

We have reviewed your Section 510(k) premarket notification of intent to market the device
referenced above and have determined the device is substantially equivalent (for the indications
for use stated in the enclosure) to legally marketed predicate devices marketed in interstate
commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to
devices that have been reclassified in accordance with the provisions of the Federal Food, Drug,
and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA).
You may, therefore, market the device, subject to the general controls provisions of the Act. The
general controls provisions of the Act include requirements for annual registration, listing of
devices, good manufacturing practice, labeling, and prohibitions against misbranding and
adulteration. Please note: CDRH does not evaluate information related to contract liability
warranties. We remind you, however, that device labeling must be truthful and not misleading.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it
may be subject to additional controls. Existing major regulations affecting your device can be
found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may
publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR Part 820); and if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

If you desire specific advice for your device on our labeling regulation (21 CFR Part 801), please go to http://www.fda.gov/AboutFDA/CentersOffices/CDRH/CDRHOffices/ucm115809.htm for the Center for Devices and Radiological Health's (CDRH's) Office of Compliance. Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21CFR Part 807.97). For questions regarding the reporting of adverse events under the MDR regulation (21 CFR Part 803), please go to http://www.fda.gov/MedicalDevices/Safety/ReportaProblem/default.htm for the CDRH's Office of Surveillance and Biometrics/Division of Postmarket Surveillance.

You may obtain other general information on your responsibilities under the Act from the Division of Small Manufacturers, International and Consumer Assistance at its toll-free number (800) 638-2041 or (301) 796-7100 or at its Internet address http://www.fda.gov/MedicalDevices/ResourcesforYou/Industry/default.htm.
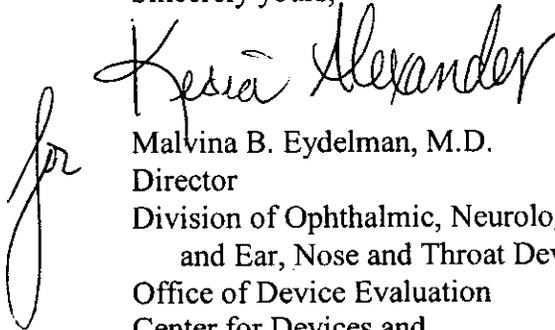
Sincerely yours,

Malvina B. Eydelman, M.D.
Director
Division of Ophthalmic, Neurological,
    and Ear, Nose and Throat Devices
Office of Device Evaluation
Center for Devices and
    Radiological Health

Enclosure

Indications for Use Statement

510(k) Number (if known): K120260

Device Name: ICTA

Indications for Use:

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This device does not provide any diagnostic conclusion about the patient's condition to the user.

Prescription Use __X__   OR   Over-The Counter Use _____
(Per 21 CFR 801.109)

(PLEASE DO NOT WRITE BELOW THIS LINE – CONTINUE ON ANOTHER PAGE IF NEEDED)

Concurrence of CDRH, Office of Device Evaluation (ODE)

John Grimes, Ph.D.

(Division Sign-Off)
Division of Ophthalmic, Neurological and Ear,
Nose and Throat Devices

510(k) Number K120260

(Optional Format 1-2-96)