October 8, 2021

Braincare Desenvolvimento e Inovacao Tecnologica S.A.
% Connie Qiu
Regulatory Consultant
M Squared Associates,Inc.
127 West 30th Street, 9th Floor
New York, New York 10001

Re: K201989
Trade/Device Name: B4C System
Regulation Number: 21 CFR 882.1620
Regulation Name: Intracranial Pressure Monitoring Device
Regulatory Class: Class II
Product Code: GWM
Dated: September 9, 2021
Received: September 10, 2021

Dear Connie Qiu:

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. Although this letter refers to your product as a device, please be aware that some cleared products may instead be combination products. The 510(k) Premarket Notification Database located at https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpmn/pmn.cfm identifies combination product submissions. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration. Please note: CDRH does not evaluate information related to contract liability warranties. We remind you, however, that device labeling must be truthful and not misleading.

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

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's

requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803) for devices or postmarketing safety reporting (21 CFR 4, Subpart B) for combination products (see https://www.fda.gov/combination-products/guidance-regulatory-information/postmarketing-safety-reporting-combination-products); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR Part 820) for devices or current good manufacturing practices (21 CFR 4, Subpart A) for combination products; and, if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21 CFR Part 807.97). For questions regarding the reporting of adverse events under the MDR regulation (21 CFR Part 803), please go to https://www.fda.gov/medical-devices/medical-device-safety/medical-device-reporting-mdr-how-report-medical-device-problems.

For comprehensive regulatory information about medical devices and radiation-emitting products, including information about labeling regulations, please see Device Advice (https://www.fda.gov/medical-devices/device-advice-comprehensive-regulatory-assistance) and CDRH Learn (https://www.fda.gov/training-and-continuing-education/cdrh-learn). Additionally, you may contact the Division of Industry and Consumer Education (DICE) to ask a question about a specific regulatory topic. See the DICE website (https://www.fda.gov/medical-devices/device-advice-comprehensive-regulatory-assistance/contact-us-division-industry-and-consumer-education-dice) for more information or contact DICE by email (DICE@fda.hhs.gov) or phone (1-800-638-2041 or 301-796-7100).

Sincerely,

for
Jay Gupta
Assistant Director
DHT5A: Division of Neurosurgical,
Neurointerventional
and Neurodiagnostic Devices
OHT5: Office of Neurological
and Physical Medicine Devices
Office of Product Evaluation and Quality
Center for Devices and Radiological Health

Enclosure

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Food and Drug Administration

Indications for Use

Form Approved: OMB No. 0910-0120
Expiration Date: 06/30/2023
See PRA Statement below.

510(k) Number *(if known)*
K201989

Device Name
B4C System

Indications for Use *(Describe)*
The B4C System is intended for the monitoring of variation in intracranial pressure in patients with suspected alteration of intracranial pressure (ICP) or change in intracranial compliance, by providing surrogate ICP waveforms and associated parameters (estimated P2/P1 ratio, normalized Time-to-Peak, derived useful ICP pulses and cardiac pulses) for interpretation.

Refer to device labeling for more information regarding the derivation and interpretation of the output of the device.

Type of Use *(Select one or both, as applicable)*

☒ Prescription Use (Part 21 CFR 801 Subpart D) ☐ Over-The-Counter Use (21 CFR 801 Subpart C)

CONTINUE ON A SEPARATE PAGE IF NEEDED.

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510(k) Summary

B4C System

Sponsor: Braincare desenvolvimento e Inovacao Tecnologica S.A.
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Date Prepared: October 8, 2021

Proprietary Name: B4C System

Common Name: Intracranial pressure monitoring device

Regulatory Class: II

Regulation: 21 CFR 882.1620

Product Code: GWM

Predicate Device(s): BcSs-PICNI-2000 Sensor K182073

Device Description

The B4C System is a non-invasive device intended for the monitoring of variation in intracranial pressure, including patients with suspected alteration of intracranial pressure (ICP) or change in intracranial compliance. It consists of a sensor with Bluetooth wireless module, headband, mobile device software application, receiver, external battery pack and charger, as well as processing and analytical software. The sensor contains four strain gauges situated on a metal bar that detects variations in skull deformation through tension and compression of the metal bar in response to changes in intracranial pressure. These resistance measures are converted to a digital signal using a high-resolution ADC (Analog to Digital Converter) in the sensor that is transmitted to software components for viewing, processing and analysis. The proposed device does not measure absolute intracranial pressure values, but produces surrogate waveform morphology, its trend, and associated parameters reflecting changes in ICP. The B4C System and surrogate waveform and associated outputs do not substitute ICP monitoring methods when measurement of the absolute value of ICP is required to make a clinical decision.

The sensor component is supported on a plastic headband worn by the patient, such that the sensor is in contact with the scalp and is perpendicularly positioned in the temporoparietal transition, 2 inches (5-6 cm) above the entrance of the external auditory canal on the coronal plane. Slight pressure is applied so that the sensor pin maintains contact with the scalp throughout the monitoring session. The sensor continuously records and transfers acquired data to the B4C analytical and processing software, and back to the mobile device application or to a compatible multi-parameter monitor that has piezoresistive pressure transducer sensitivities of 5µV/Vex/mmHg or greater and automatic amplitude window adjustment capability via a paired receiver. Data is transferred wireless via Bluetooth connection between sensor and mobile application and HTTPs protocol between mobile application and analytics software. The clinician may view the visualized waveform on the mobile device along with an intermediate or final report of surrogate waveform and associated parameters including surrogate waveform trend line, average waveform per minute and estimated P2/P1 ratio, normalized time-to-peak, as well as derived useful ICP pulses and cardiac pulses. Alternatively, the paired monitor's inherent software interprets the signal received from the B4C System's sensor and displays a surrogate waveform that allows for viewing the same ICP waveform on the monitor's display. Clinicians review the B4C System outputs to assess patients with suspected intracranial hypertension or changes in intracranial compliance based on the characteristic Percussion (P1), Tidal (P2), and Dicrotic (P3) peaks of the waveform morphology and associated parameters.

The B4C System is not intended to be a standalone diagnostic tool. The surrogate waveform and associated parameter outputs do not replace a comprehensive clinical evaluation, but only provide an element for preliminary assessment. The clinician is responsible for determining the additional clinical information that may be required to make a diagnosis.

The B4C System is intended for use for adult patients ages 18 and older.

Indications for Use: The B4C System is intended for the monitoring of variation in intracranial pressure in patients with suspected alteration of intracranial pressure (ICP) or change in intracranial compliance, by providing surrogate ICP waveforms and associated parameters (estimated P2/P1 ratio, normalized Time-to-Peak, derived useful ICP pulses and cardiac pulses) for interpretation.

Refer to device labeling for more information regarding the derivation and interpretation of the output of the device.

Comparison to Predicate Device

The B4C System is an evolution of the first iteration, BcSs-PICNI-2000 Sensor (K182073). Comparison of technological characteristics between the B4C System to the predicate device, BcSs-PICNI-2000 Sensor is presented in **Table 1**. The differences compared to the currently marketed device do not affect the intended use and do not raise new questions of safety and effectiveness.

Table 1 Comparison of B4C System to BcSs-PICNI-2000 Sensor

	B4C System	**Braincare BcSs-PICNI-2000 Sensor**	**Substantial Equivalence**
510k #	K201989	K182073	Not applicable
Product Code	GWM	GWM	Same
Indication for Use	The B4C System is intended for the monitoring of variation in intracranial pressure in patients with suspected alteration of intracranial pressure (ICP) or change in intracranial compliance, by providing surrogate ICP waveforms and associated parameters (estimated P2/P1 ratio, normalized Time-to-Peak, derived useful ICP pulses and cardiac pulse) for interpretation. Refer to device labeling for more information regarding the derivation and interpretation of the output of the device.	The BcSs-PICNI-2000 Sensor is intended for the monitoring of variation in intracranial pressure in patients with suspected alteration of intracranial pressure (ICP) or change in brain compliance, by providing ICP waveforms for interpretation.	Same intended use. Similar indications for use. Brain compliance is replaced to intracranial compliance for consistency with medical terminology. Otherwise, the only difference in the indications for use is that the subject device is intended to provide some associated parameters about the ICP waveform characteristics in addition to the visualized surrogate waveform. However, these do not change the intended use, intended user, or clinical utility compared to the originally cleared device. This difference does not raise new questions of safety or effectiveness.
Prescription Device	Yes	Yes	Same
Device Description	Non-invasive ICP monitoring device consisting of strain gauge pressure sensors supported on a headband to detect skull deformations in response to ICP changes. System wirelessly transmits acquired signal for processing and analytics.	Non-invasive ICP monitoring device consisting of strain gauge pressure sensors supported on a headband to detect skull deformations in response to ICP changes. System requires a wired connection to a compatible patient monitor to view ICP waveforms.	Similar The operating principle of the sensor remains the same. This 510(k) introduces modifications primarily consisting of software components that include: Bluetooth module and firmware embedded in sensor for wireless data/signal

	System outputs surrogate ICP waveform and report of waveform's associated parameters on mobile device application and web portal. ICP waveform may also be viewed on compatible monitor via paired wireless receiver.		transmission, ability to view the surrogate ICP waveform on a mobile device application, wireless transmission of acquired signal to compatible monitor, and reports with associated waveform parameters. Neither the subject nor the predicate devices produce absolute value of ICP, and neither is intended to be used as a standalone diagnostic tool. Performance testing demonstrate that the modified device does not raise new questions of safety and effectiveness.
Clinical Application	Non-invasive application of a sensor on the scalp perpendicularly positioned in the temporoparietal transition, 2 inches (5-6 cm) above the entrance of the external auditory canal on the coronal plane	Non-invasive application of a sensor on the scalp perpendicularly positioned in the temporoparietal transition, 2 inches (5-6 cm) above the entrance of the external auditory canal on the coronal plane	Same
Contraindications	The B4C System is contraindicated for use in patients who have: ● Undergone decompressive craniectomy or craniotomy; ● Cranial defects (portion of skull missing); ● Any other conditions that the health practitioner deems to be unsuitable for use of this device.	The BcSs-PICNI-2000 Sensor is contraindicated for use in patients who have: ● Undergone decompressive craniectomy or craniotomy; ● Cranial defects (portion of skull missing); ● Any other conditions that the health practitioner deems to be unsuitable for use of this device.	Same
Device Materials	● Polycarbonate sensor casing and contact pin ● Silicone base around sensor ● Polypropylene headband	● Polyoxymethylene sensor and headband. ● Adaptor cable: TPU (thermoplastic polyurethane) and ABS (Acrylonitrile butadiene styrene) case.	Different While there are differences in specific device materials, the patient contacting surfaces continue to be comprised of materials that are commonly used in medical devices. Both

			devices have satisfied biocompatibility testing for the patient contacting surfaces. The difference in materials do not raise new questions in terms of safety or effectiveness.
MRI Claim	MR Unsafe	MR Unsafe	Same
Sterilization	Not applicable	Not applicable	Same
Device dimensions	Sensor case: 75.6 X 51.5 X 27.7 mm Receiver case: 94 X 17.5 X 15 mm Receiver cable and connector length: 20 cm Headband size with turnbuckle : XXS: 49.5 cm, XS: 52 cm, S: 54.5 cm, M: 57 cm, L: 59.5 cm, XL: 52 cm, XXL: 64.5 cm	Sensor case: 18.7 x 18.5 x 66.5 mm Sensor pin length: 18mm Sensor pin diameter: 7.5 mm Sensor cable length: 200 cm. Headband Perimeter: Extra Small: 50-55cm, Small: 52.5-57.5 cm, Medium: 55-60 cm, Large: 57.5-62.5 cm. Adaptor cable length: 180 cm.	The differences in dimension do not raise new questions of safety or effectiveness.
Biocompatibility	Limited duration contact (≤24) with intact skin Non-cytotoxic Non-sensitizing Non-irritating	Prolonged contact (>24 hours but within ≤30 days) with intact skin Non-cytotoxic Non-sensitizing Non-irritating	Similar The device continues to be intended only for contact with intact skin. While the predicate device was assessed for prolonged contact as a conservative risk management approach, it is expected that the device will only be applied for limited duration (≤24 hours) in actual use. Biocompatibility evaluation demonstrate that this difference does not raise new questions of safety and effectiveness.
Energy modality	Sensor contains internal rechargeable battery and external rechargeable battery pack	5 volts DC when connected to ICP monitoring device	Different The modified device introduces internal and external batteries, while the predicate device had power supplied by the connected patient monitor. Battery safety, electrical safety, and electromagnetic compatibility testing

			demonstrate that these technological differences do not raise new questions of safety and effectiveness.
ICP Waveform Outputs	Waveform displayed on compatible patient monitor Analytical software also produces the following associated parameters about the surrogate ICP waveform displayed in a report and on the accompanying mobile medical application: ● Surrogate Waveform ● Waveform Trend line ● Average waveform ● Estimated P2:P1 ratio ● Normalized Time-to-Peak ● Derived useful ICP pulses ● Derived Cardiac Pulse These associated parameters are derived based on well-established principles in scientific literature and clinical practice.	Waveform displayed on compatible patient monitor	Similar Both the subject and predicate device produce display of ICP waveforms in real-time. The modified device also provides associated parameters of the surrogate waveform that may be viewed in a convenient report on the accompanying mobile medical application or web portal as an alternative to a compatible multiparameter monitor. The surrogate waveform and associated parameters continue to be interpreted by the clinician per standard clinical practice and with other clinical evaluations and parameters as deemed necessary by the clinician. Performance testing demonstrates that the differences in displayed information do not raise new questions of safety and effectiveness.
Sensing element	Strain gauge	Strain gauge	Same
Functional pressure range	Not applicable as it does not provide absolute values of pressure	Not applicable as it does not provide absolute values of pressure	Same
Functional over pressure range without damage	Not applicable as it does not provide absolute values of pressure, and does not have a specified functional pressure range.	Not applicable as it does not provide absolute values of pressure, and does not have a specified functional pressure range.	Same
Input/ Output Impedance	The wireless sensor is not physically connected to any device and has an internal resistive bridge	350 ohms nominal	The differences in input/output impedance do not raise new questions of safety or effectiveness.

	with input and output impedance of 1000 Ohms.		
Output signal (sensitivity)	Not applicable for the wireless sensor since it is not physically connected to any device. The receiver can output a maximum signal of 25mV and minimum of -2.5mV.	10mV	The differences do not raise new questions of safety or effectiveness.
Zero Drift	Not applicable for the sensor as it does not provide absolute values and brain4care aApp performs auto scale so that the waveform is always visible. The receiver is also capable of automatically readjusting the signal offset level so that the waveform is always visible on the monitor.	The Adaptor cable can be used to adjust offset ±20mV.	The differences do not raise new questions of safety or effectiveness.
Electrical Safety	Complies with IEC 60601-1	Complies with IEC 60601-1	Same
Electromagnetic Compatibility	Complies with IEC 60601-1-2	Complies with IEC 60601-1-2	Same
Software	This device modification introduces a mobile device application, firmware, analytical and processing software, and administrative software components.	None	Different While the predicate did not contain software, the modified device introduces several software components. The new software components are used to analyze the input ICP sensor data, view, store, and transfer device output. Software verification and validation met acceptance criteria. There is no change to the intended use of the device. This difference does not raise new questions in terms of safety and effectiveness.
Sensor Connection to Monitor	Wireless Bluetooth connection to a receiver or micro-USB connection specific to compatible patient	Wired Adaptor Cable with adaptor plug specific to compatible patient monitors	Different While the predicate utilizes a wired connection to display the acquired waveform on the compatible patient monitor, the

	monitors		modified device is able to transmit the signal to the patient monitor wirelessly via a Bluetooth connection and receiver on the monitor. Performance testing demonstrate that this difference does not raise new questions of safety and effectiveness.
Wireless Module	Bluetooth	None	Different The modified device introduces a Bluetooth module to facilitate wireless transmission of the acquired ICP waveform signal to a mobile device and receiver to display the waveform on a connected monitor, and to view the waveform and related parameters on a mobile device. Addition of wireless capability does not change the intended use, intended user, or intended use environment compared to the predicate. Performance data demonstrate that these technological differences do not raise new questions of safety and effectiveness.

Differences from Predicate

Compared to the predicate device, the B4C System converts the analog signal to a digital signal, transfers the acquired signal wirelessly over Bluetooth and HTTPs connection rather than a cable, operates by battery, processes and analyzes the acquired signal to produce the surrogate ICP waveform and associated parameters, and allows the user to view the waveform on either a compatible patient monitor or a mobile application and the associated waveform parameters on either the mobile application or web portal. There are also some minor technological differences with respect to materials and dimensions. Despite these differences, the subject and predicate device share common intended use, sensor technology, operating principle, and clinical utility, and demonstrate comparable device performance.

Discussion of Performance Data

The following performance data in **Table 2** are provided in support of the substantial equivalence determination between the proposed device, B4C System, and predicate device, BcSs-PICNI-2000 Sensor

(K182073).

Table 2 Summary of Non-Clinical Performance Data

TEST	TITLE/TEST METHOD SUMMARY	RESULTS
Biocompatibility		
ISO 10993-5	Biological evaluation of medical devices - Part 5: Tests for in vitro cytotoxicity	Pass Non-cytotoxic
ISO 10993-10	Biological evaluation of medical devices - Part 10: Tests for irritation and skin sensitization	Pass Non-sensitizing Non-irritating
Electrical Safety and Electromagnetic Compatibility		
IEC 60601-1	Medical electrical equipment - Part 1: General requirements for basic safety and essential performance	Pass
ANSI AAMI ES 60601-1		Pass
IEC 60601-1-2	Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral	Pass
AAMI TIR69	Risk management of radio-frequency wireless coexistence for medical devices and systems	Testing not required based on risk assessment
Disinfection		
Disinfection Validation	Validation of Low-Level disinfection method using 70% ethanol.	Pass >6-log microbial reduction
Bench Testing		
Monitor Compatibility	Demonstration of compatibility for use with patient monitors.	Pass
Stability and Reproducibility	Demonstration of stability, repeatability, and reproducibility between the ICP waveform outputs of the wireless and wired sensors.	Pass
Software		
Software Verification and Validation	Demonstrate that all software requirements were appropriately implemented in the software.	Pass

Performance test results demonstrate that the subject device and predicate device, BcSs-PICNI-2000 Sensor (K182073), are substantially equivalent with respect to biocompatibility, electrical safety, electromagnetic compatibility, disinfection, monitor compatibility, and stability and reproducibility for their shared intended use in monitoring of suspected variation in ICP and brain compliance.

Discussion of Clinical Testing

Braincare conducted a combined prospective/retrospective, multi-center, observational study to assess the comparison of the acquired ICP waveform signal and parameters between the B4C System and standard of care invasive ICP monitoring methods. The study device consisted of the B4C processing and analytical software used with the wired sensor (K182073). Although the wired sensor was used in the

study, the results reflect the performance of the B4C System.

Dataset Description

- Total number of centers: 4
- Total number of subjects: 123 enrolled, 107 after device label check, 85 after data quality check (78 adults, 7 pediatric)
- Collected data: ICP Surrogate Waveform (BcSs-PICNI-2000 (K182073) or B4C System); Invasive Arterial Blood Pressure, Invasive ICP Waveform (EVD or Bolt)
- Range of acquisition sessions time: 5 min to 3.5 hours
- Total number of monitoring sessions that passed quality check: 159
- Total acquisition time that passed quality check: 4800 (98% adult, 2% pediatric)

Analyzed participants

Seventy eight adults (18+) who met all eligibility criteria and were admitted to the neurointensive care unit and underwent invasive ICP monitoring and invasive arterial blood pressure monitoring were considered in the dataset. Due to the reduced quantity of pediatric subjects, the analysis could only demonstrate statistically relevant performance for the adult population.

- Total number of analyzed subjects: 78 adults
- Total acquisition time analyzed: 4695 minutes
- Age of analyzed subjects: 52.7±19.4
- Gender of analyzed subjects: 47% female ; 53% male

Study Objective

The goal of the analysis was to verify whether the new medical device developed by Braincare demonstrated a consistent correlation between its recorded waveform with the invasive devices waveform that are currently used in clinical practice. The objective was to evaluate the reliability and accuracy of the correlation between the Braincare device in monitoring ICP waveform in comparison to gold standard invasive ICP monitoring methods such as the external ventricular drain or intraparenchymal micro transducers that are currently used in clinical practice, and utilized in the target population in different centers and medical settings.

Study Procedures

All centers used Braincare's non-invasive sensors with identical principles of operations (3 centers are with BcSs-PICNI-2000 sensor (K182073), 1 with B4C System wireless sensor). The sensors at each site were positioned according to the same protocols, i.e., temporal region avoiding arteries and adjustment to the point that an acceptable waveform appears, a procedure that represents real case usage. Patients at all sites had invasive, non invasive and ABP waveforms captured.

Study Outcomes

The primary objective was to compare the ICP curve morphology obtained with the Braincare and invasive ICP sensors, with focus on the characteristics of peaks P1, P2, P3 amplitudes and their ratios, among other characteristics of the ICP pulse waveform including lags between wave peaks (time to peak) and the absolute curvature of the peaks to determine relative changes and trends over time in ICP and brain compliance.

The analysis aimed evaluate the reliability and accuracy of the Braincare device in assessing ICP waveform in comparison to gold standard invasive ICP monitoring methods such as the external ventricular drain or intraparenchymal micro transducers as well as the ability to monitor relative changes in ICP as well as trends over time. The study hypothesis was that the ICP pulse morphology (waveform) detected by the Braincare noninvasive device presented a statistically significant correlation with the ICP pulse morphology (waveform) detected by the gold standard invasive method(s).

Bland-Altman plots and Deming regression analyses were used to quantify agreement between the invasive ICP waveform and Braincare surrogate ICP waveform parameters – estimated P2/P1 ratio and normalized time to peak (TTP), estimating the differences between the respective averages per minute. Additionally, spearman and normalized mutual information methods were utilized to assess non-linear behavior between waveforms. Considering the differences in positioning of the invasive and non-invasive sensors (inside the ventricle compared to outside the skull), strong agreement between the signals was not expected. Nevertheless, a relatively large region of agreement and presented correlation between the parameters was observed and demonstrated statistical significance confirmed by additional statistical tests.

- Correlation analysis:

Spearman correlation and normalized mutual information were used to assess statistical dependence on the ICP waveform parameters between the Braincare sensor and invasive sensor. For the normalized time to peak, the Spearman correlation was 0.318 [0.291, 0.345], $p<.0001$. The statistical dependence between parameters - estimated using normalized mutual information – was 0.612 [0.564, 0.643]. For the estimated P2/P1 ratio, the Spearman correlation was 0.495 [0.471, 0.517], $p<.0001$. The statistical dependence between parameters - estimated using normalized mutual information – was 0.561 [0.531,0.606]. The joint distributions between ICP and B4C parameters showed statistical dependence between them, thus confirming the statistically significant correlation between the ICP pulse morphology (waveform) detected by the gold standard invasive method(s) and the B4C technology with regard to the P2/P1 ratio and Time to Peak.

- Agreement analysis:

Bland-Altman plots and Deming regression models were used to quantify agreement between the invasive and Braincare measured ICP waveform parameters – estimated P2/P1 ratio and normalized time to peak, estimating the differences between the respective averages per minute. Considering the differences in positioning of the invasive and non-invasive sensors (inside the ventricle compared to outside the skull), strong agreement between the signals was not expected. Nevertheless, a relatively large region of agreement between the parameters was observed and demonstrate statistical significance confirmed by additional statistical tests. The Bland-Altman limits of agreement for the estimated P2/P1 ratio range from

-0.723 to 0.761 (mean distance/bias 0.019; 95% CI: -0.060, 0.101). The limits of agreement for the normalized Time to Peak range from -0.183 to 0.245 (mean distance/bias 0.031; 95% CI: 0.011, 0.050). The Deming regression estimates and 95% confidence intervals for P2/P1 ratio were Y = -0.67 [-1.85, 0.02] + 1.60 [0.97, 2.69]X, and estimates and 95% confidence intervals for Time to Peak were Y = 0.00 [-0.11, 0.09] + 0.84 [0.38, 1.39]X. As can be seen when looking at the mean/bias and limits of agreement in the Bland-Altman results above, our device tends to generate larger observations for Time to Peak than invasive ICP. There are some observed instances where the Time to Peak measured by the device differed from that measured by invasive ICP by >0.2. Additionally, while the mean difference in P2/P1 between our device and invasive ICP is not significantly different from zero, we observed instances where P2/P1 measured by the device differed from that measured by invasive ICP by >0.7.

Both classes of analysis, Bland-Altman / Deming Regression which evaluate agreement, and Normalized Mutual Information / Spearman which evaluate correlation presented statistically meaningful results.

Safety

No adverse events were reported.

Study Conclusion

Results of this study demonstrated a statistically significant correlation in the ICP signal and waveform parameters between the B4C System and the gold standard invasive ICP monitoring device measured over time. The study outcomes demonstrate comparable effectiveness between the Braincare device and commonly used invasive ICP devices for use in monitoring and assessing variations in ICP waveform associated parameters over time.

Conclusion

Based on the results of the performance testing and substantial equivalence comparison, the B4C System has the same intended use as the predicate device. The presented information is sufficient to determine that the B4C System is substantially equivalent to the legally marketed predicate device.