May 15, 2025

Edwards Lifesciences LLC
Chirag Shah
Director, Regulatory Affairs Program Management
17200 Laguna Canyon Rd
Irvine, California 92602

Re: K242518
Trade/Device Name: Hypertension Prediction Index (HePI) Algorithm
Regulation Number: 21 CFR 870.2210
Regulation Name: Adjunctive Predictive Cardiovascular Indicator
Regulatory Class: Class II
Product Code: QAQ
Dated: April 11, 2025
Received: April 11, 2025

Dear Chirag Shah:

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 (the 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 available 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.

Additional information about changes that may require a new premarket notification are provided in the FDA guidance documents entitled "Deciding When to Submit a 510(k) for a Change to an Existing Device" (https://www.fda.gov/media/99812/download) and "Deciding When to Submit a 510(k) for a Software Change to an Existing Device" (https://www.fda.gov/media/99785/download).

Your device is also subject to, among other requirements, the Quality System (QS) regulation (21 CFR Part 820), which includes, but is not limited to, 21 CFR 820.30, Design controls; 21 CFR 820.90, Nonconforming product; and 21 CFR 820.100, Corrective and preventive action. Please note that regardless of whether a change requires premarket review, the QS regulation requires device manufacturers to review and approve changes to device design and production (21 CFR 820.30 and 21 CFR 820.70) and document changes and approvals in the device master record (21 CFR 820.181).

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 Part 803) for devices or postmarketing safety reporting (21 CFR Part 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 Part 4, Subpart A) for combination products; and, if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR Parts 1000-1050.

All medical devices, including Class I and unclassified devices and combination product device constituent parts are required to be in compliance with the final Unique Device Identification System rule ("UDI Rule"). The UDI Rule requires, among other things, that a device bear a unique device identifier (UDI) on its label and package (21 CFR 801.20(a)) unless an exception or alternative applies (21 CFR 801.20(b)) and that the dates on the device label be formatted in accordance with 21 CFR 801.18. The UDI Rule (21 CFR 830.300(a) and 830.320(b)) also requires that certain information be submitted to the Global Unique Device Identification Database (GUDID) (21 CFR Part 830 Subpart E). For additional information on these requirements, please see the UDI System webpage at https://www.fda.gov/medical-devices/device-advice-comprehensive-regulatory-assistance/unique-device-identification-system-udi-system.

Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21 CFR 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 Robert T. Kazmierski -S

LCDR Stephen Browning
Assistant Director
Division of Cardiac Electrophysiology,
Diagnostics, and Monitoring Devices
Office of Cardiovascular 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: 07/31/2026
See PRA Statement below.

Submission Number *(if known)*

K242518

Device Name

Hypertension Prediction Index (HePI) Algorithm

Indications for Use *(Describe)*

The Hypertension Prediction Index (HePI) software provides the clinician with physiological insight into an adult (18 years and older) patient's likelihood of future hypertensive events. The HePI software is intended for use in surgical or non-surgical patients receiving advanced hemodynamic monitoring.

The HePI software is considered to be additional quantitative information regarding the patient's physiological condition for reference only and no therapeutic decisions should be made solely on the HePI parameter.

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.

This section applies only to requirements of the Paperwork Reduction Act of 1995.

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Hypertension Prediction Index (HePI) Algorithm		
510(k) Submitter	Edwards Lifesciences LLC One Edwards Way, Irvine, CA 92614 (949) 250-5466	
Contact Person	Primary Contact Chirag Shah Director, RA Program Management Edwards Lifesciences LLC 17200 Laguna Canyon Rd, Irvine, CA 92602 Email: chirag_shah@edwards.com	Secondary Contact Karen Clement Senior Director, Regulatory Affairs Edwards Lifesciences LLC 17200 Laguna Canyon Rd, Irvine, CA 92602 Email: karen_clement@edwards.com
Date Prepared	May 15, 2025	
Trade Name	Hypertension Prediction Index (HePI)	
Regulation Number / Name	21 CFR 870.2210 / Adjunctive Predictive Cardiovascular Indicator	
Product Code	QAQ	
Regulation Class	Class II	
Primary Predicate Device	HemoSphere Advanced Monitoring Platform, manufactured by Edwards Lifesciences, K213682 cleared June 22, 2022, utilized for the Acumen™ Hypotension Prediction Index (HPI) software.	

<table>
<tr><th colspan="2">Hypertension Prediction Index (HePI) Algorithm</th></tr>
<tr><td>Device Description</td><td>The subject HePI is an algorithm providing the clinician with the likelihood that the patient may be trending towards a hypertensive event, which allows clinicians to take appropriate action sooner than if the algorithm was not available. For the subject algorithm, a hypertensive event is defined as mean arterial pressure (MAP) greater than 115 mmHg for at least 1 minute or a MAP increase of more than 20% when current MAP is greater than 95 mmHg. The software triggers an alert screen whenever the HePI parameter value is greater than 85 for two consecutive readings. The HePI value is updated every 20 seconds and displayed as a value equating to the likelihood that a hypertensive event may occur on a scale from 0 to 100. The higher the value, the higher the likelihood of a hypertensive event.

When the HePI value reaches the default alarm threshold of 85, which cannot be changed by the user, the HePI value and trended graph turn red. After 2 continuous samples above 85, an alarm will also trigger. The acceptability criteria for the validation of the HePI algorithm is defined as a sensitivity and specificity above 80%.</td></tr>
<tr><td>Indications for Use</td><td>The Hypertension Prediction Index (HePI) software provides the clinician with physiological insight into an adult (18 years or older) patient’s likelihood of future hypertensive events. The HePI software is intended for use in surgical or non-surgical patients receiving advanced hemodynamic monitoring.

The HePI software is considered to be additional quantitative information regarding the patient’s physiological condition for reference only and no therapeutic decisions should be made based solely on the HePI parameter.</td></tr>
<tr><td>Intended Use</td><td>The Hypertension Prediction Index (HePI) software is intended to be used by qualified personnel or trained clinicians in a critical care environment in a hospital setting.

<table>
<tr><th>Parameter</th><th>Description</th><th>Patient Population</th><th>Hospital Environment</th></tr>
<tr><td>HePI</td><td>Hypertension Predication Index</td><td>Adult Only</td><td>Surgical and non-surgical</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th colspan="2">Hypertension Prediction Index (HePI) Algorithm</th></tr>
<tr><td>Comparative Analysis</td><td>The subject HePI Algorithm is substantially equivalent to the predicate HemoSphere Advanced Monitoring Platform, with Acumen™ Hypotension Prediction Index (HPI). The subject and predicate devices share similar intended use and indications for use. The subject and predicate maintain the same overall technological characteristics, maintain the same architecture, incorporate the same input, and utilize the same processing and output steps as the primary predicate.

The subject differs from the predicate device since the subject device is a new software algorithm that predicts the likelihood that the patient may be trending toward a hypertensive event instead of hypotensive event and uses a slightly different machine learning model to output the prediction index.

Performance testing executed shows that there are no new concerns of safety and effectiveness.</td></tr>
<tr><td>Performance Data (Bench and/or Clinical)</td><td>The following verification activities were performed in support of a substantial equivalence determination for the subject Hypertension Prediction Index (HePI) Algorithm.

Algorithm Verification
Algorithm performance was tested using retrospective clinical data. Algorithm verification was performed per FDA’s Guidance for Industry and FDA Staff, Guidance for the Content of Premarket Submissions for Software Contained in Medical Devices (issued May 11, 2005) and ANSI/AAMI/IEC 62304:2006/A1:2016, Medical Device Software – Software Life Cycle Processes. The algorithm was tested at the algorithm level to ensure the safety of the device. All tests passed.

The following clinical performance data was submitted to support the indications for use of the subject device.

Patient Demographics:
Table 1: Test Dataset Demographics for US and OUS patients
<table>
<tr><th></th><th colspan="2">Minimally Invasive Sensor</th><th colspan="2">Non-Invasive Finger Cuff</th></tr>
<tr><th></th><th>US</th><th>OUS</th><th>US</th><th>OUS</th></tr>
<tr><td>Number of subjects</td><td>1615</td><td>198</td><td>464</td><td>887</td></tr>
<tr><td>Data Per Patient (min)</td><td>1483.5 ± 11640.9</td><td>1248.0 ± 305.2</td><td>215.4 ± 89.9</td><td>288.7 ± 201.3</td></tr>
<tr><td>Gender</td><td>915 Male, 700 Female</td><td>146 Male, 52 Female</td><td>262 Male, 202 Female</td><td>493 Male, 394 Female</td></tr>
<tr><td>Age (year)</td><td>58.9 ± 17.1</td><td>64.5 ± 11.7</td><td>61.3 ± 11.1</td><td>58.0 ± 15.3</td></tr>
<tr><td>Height (cm)</td><td>170.1 ± 11.1</td><td>172.3 ± 10.5</td><td>171.1 ± 9.6</td><td>173.4 ± 12.4</td></tr>
<tr><td>Weight (kg)</td><td>83.2 ± 25.0</td><td>83.3 ± 20.3</td><td>94.4 ± 25.9</td><td>80.9 ± 18.9</td></tr>
<tr><td>BSA (m^2)</td><td>1.9 ± 0.3</td><td>2.0 ± 0.3</td><td>2.0 ± 0.3</td><td>1.9 ± 0.2</td></tr>
</table></td></tr>
</table>

Hypertension Prediction Index (HePI) Algorithm

Patient Baseline Characteristics:

The validation dataset had no inclusion/exclusion criteria related to patient baseline characteristics. In general, adult surgical and non-surgical patients who were monitored via an A-line and/or a continuous non-invasive blood pressure monitoring cuff were randomly selected for retrospective analysis.

Results of Clinical Performance Testing

Prospective analyses of retrospective clinical data from multiple independent datasets, comprised of data from patients over the age of 18 years undergoing surgical and non-surgical procedures with minimally invasive and non-invasive monitoring, were analyzed to verify the safety and performance of the subject device. The results are as shown in **Table 2**.

Table 2: ROC results of the subject HePI device for minimally invasive and non-invasive, surgical and non-surgical patients, for 15-minute search window and 5-minute step size

Dataset	AUC	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Cutoff
Minimally Invasive (N=1813)	0.989 [0.987, 0.991]	99.7 [99.6, 99.9]	93.7 [92.9, 94.3]	73.5 [71.1, 75.8]	100.0 [99.9, 100.0]	85
Minimally Invasive (N=672, non-surgical)	0.989 [0.986, 0.992]	99.6 [99.3, 99.9]	94.3 [93.4, 95.2]	68.0 [64.4, 71.8]	100.0 [99.9, 100.0]	85
Minimally Invasive (N=1141, surgical)	0.990 [0.989, 0.992]	99.9 [99.7, 100.0]	91.5 [90.6, 92.4]	81.1 [79.4, 82.6]	100.0 [99.9, 100.0]	85
Non-invasive (N=1351)	0.990 [0.987, 0.992]	99.6 [99.1, 100.0]	91.6 [90.7, 92.5]	71.3 [68.8, 73.8]	99.9 [99.8, 100.0]	85
Noninvasive (N=424, non-surgical)	0.986 [0.981, 0.990]	99.9 [99.5, 100.0]	90.6 [88.8, 92.4]	64.2 [58.4, 69.8]	100.0 [99.9, 100.0]	85
Noninvasive (N=927, surgical)	0.992 [0.989, 0.995]	99.5 [98.7, 100.0]	92.3 [91.3, 93.3]	75.4 [72.8, 77.9]	99.9 [99.7, 100.0]	85

Conclusion

The subject HePI algorithm has successfully passed functional and performance testing, including software and algorithm verification and validation and bench studies. Completion of all performance verification and validation activities demonstrated that the subject device meets the predetermined design and performance specifications. Verification activities performed confirmed that the differences in the features did not adversely affect the safety and effectiveness of the subject device. The testing performed demonstrates that the HePI software is substantially equivalent to its legally marketed predicate.