DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
10903 New Hampshire Avenue
Document Control Center – WO66-G609
Silver Spring, MD 20993-0002

July 10, 2015

INO Therapeutics/Ikaria
Mr. Robert Bovy
Associate Director, Regulatory Affairs
6603 Femrite Drive
Madison, WI 53718

Re: K143213
Trade/Device Name: INOmax DSIR® Plus MRI
Regulation Number: 21 CFR 868.5165
Regulation Name: Nitric Oxide Administration Apparatus
Regulatory Class: II
Product Code: MRN, MRO, MRP, MRQ
Dated: June 3, 2015
Received: June 4, 2015

Dear Mr. Bovy:

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 contact 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. 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,

*Tejashri Purohit-Sheth, M.D.*

**Tejashri Purohit-Sheth, M.D.**
**Clinical Deputy Director**
**DAGRID/ODE/CDRH FOR**

Erin I. Keith, M.S.
Division Director
Division of Anesthesiology, General Hospital,
Respiratory, Infection Control and
Dental Devices
Office of Device Evaluation
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: January 31, 2017
*See PRA Statement below.*

510(k) Number *(if known)*
K143213

Device Name
INOmax DSIR Plus MRI

Indications for Use *(Describe)*

The INOmax DSIR® Plus MRI delivery system is indicated for delivery of INOMAX® (nitric oxide for inhalation) therapy gas into the inspiratory limb of the patient breathing circuit in a way that provides a constant concentration of nitric oxide (NO), as set by the user, to the patient throughout the inspired breath. The INOmax DSIR® Plus MRI is indicated for use only with MR Conditional ventilators validated to be compatible, as identified in the device labeling.

The INOmax DSIR® Plus MRI is indicated for continuous integrated monitoring of inspired O2, NO2, and NO.

The INOmax DSIR® Plus MRI is considered MR Conditional with the use of 1.5 Tesla and 3.0 Tesla static magnetic field scanners ONLY in areas where the field strength is less than 100 gauss.

The target patient population is controlled by the drug labeling for INOMAX® and is currently neonates. The primary targeted clinical setting is a clinical 1.5 Tesla and 3.0 Tesla diagnostic imaging environment.

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)

**PLEASE DO NOT WRITE BELOW THIS LINE – CONTINUE ON A SEPARATE PAGE IF NEEDED.**

**FOR FDA USE ONLY**

Concurrence of Center for Devices and Radiological Health (CDRH) *(Signature)*

# 5. 510(K) SUMMARY

## 510(k) Summary

In accordance with 21 CFR 807.92 the following summary of information is provided:

**Submitter Information**

| | |
|---|---|
| Date: | July 10, 2015 |
| Company: | INO Therapeutics doing business as Ikaria<br>6603 Femrite Drive<br>Madison, Wisconsin 53718 |
| Contact Person: | Robert Bovy |
| | Associate Director, Device Regulatory Affairs |
| Email: | Robert.Bovy@Ikaria.com |
| Telephone: | 608-226-3450 |
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| Secondary Contact Person: | David Trueblood |
| Email: | David.Trueblood@Ikaria.com |
| Telephone: | 608-395-3910 |

**Identification of the Device**

| | |
|---|---|
| Device Name: | INOmax DSIR® Plus MRI |
| Common Name: | Nitric Oxide Administration Apparatus (primary)<br>Nitric Oxide Administration Apparatus, Back-up System<br>Nitric Oxide Analyzer<br>Nitrogen Dioxide Analyzer |
| Classification Name: | Apparatus, Nitric Oxide Delivery, or Apparatus, Nitric Oxide Backup Delivery |
| Device Classification: | Class II – 21 CFR 868.5165 |
| Product Code: | MRN (Primary), MRO, MRP, MRQ |

**Predicate Device(s)** K131686

**Description of Device**

The INOmax DSIR® uses a "dual-channel" design to provide delivery of INOMAX®. The first channel has the delivery CPU, the flow controller and the injector module to ensure the accurate delivery of NO. The specially designed injector module enables tracking of the ventilator waveforms and the delivery of a synchronized and proportional dose of NO. The second channel is the monitoring system, which includes a separate monitor CPU, the gas cells (NO, $NO_2$, and $O_2$ cells) and the user interface including the display and a comprehensive alarm system. The dual-channel approach to delivery and monitoring permits INOMAX® delivery independent of monitoring but also allows the monitoring system to shut down INOMAX® delivery if the monitored NO concentration exceeds 100 ppm for 12 consecutive seconds. The delivery system can also shut down delivery if it detects certain serious problems with the monitoring system.

The INOmax DSIR Plus MRI incorporates a battery that provides up to 6 hours of uninterrupted NO delivery in the absence of an external power source.

The INOmax DSIR Plus MRI includes a backup NO delivery capability that provides a fixed flow of 250 mL/min of NO, which along with user supplied 10 L/min of oxygen, provides 20 ppm of NO to a patient breathing circuit. The INOblender® can also be used for backup.

**Intended Use**

The INOmax DSIR® Plus MRI delivery system is indicated for delivery of INOMAX® (nitric oxide for inhalation) therapy gas into the inspiratory limb of the patient breathing circuit in a way that provides a constant concentration of nitric oxide (NO), as set by the user, to the patient throughout the inspired breath. The INOmax DSIR® Plus MRI is indicated for use only with MR Conditional ventilators validated to be compatible, as identified in the device labeling.

The INOmax DSIR® Plus MRI is indicated for continuous integrated monitoring of inspired $O_2$, $NO_2$, and NO.

The INOmax DSIR® Plus MRI is considered MR Conditional with the use of 1.5 Tesla and 3.0 Tesla static magnetic field scanners ONLY in areas where the field strength is less than 100 gauss.

The target patient population is controlled by the drug labeling for INOMAX® and is currently neonates. The primary targeted clinical setting is a clinical 1.5 Tesla and 3.0 Tesla diagnostic imaging environment.

**Technological Characteristics**

All revisions of INOmax DSIR® utilize component technology to deliver Nitric Oxide gas to the patient. The components consist of the Delivery System unit, the INOblender®, a stand/cart and the NO gas tanks. In this revision of the INOmax DSIR®, the cart hardware, the NO delivery cable and tubing, the gas sampling tubing, the software and the labeling have been updated.

**Determination of Substantial Equivalence**

The modifications to INOmax DSIR® for the INOmax DSIR® Plus MRI device included hardware modifications to the cart, an update of the software to version 3.1.2 and modified labeling. The INOmax DSIR® Plus MRI has the same intended therapeutic effect and patient population as the cleared INOmax DSIR® predicate device. All features are the same except those described in the table below.

**Comparison to Predicate Device**

| **Feature / Specification** | **INOmax DSIR® - K131686** | **INOmax DSIR® Plus MRI with four respiratory care devices** |
|---|---|---|
| Indicated Use Environment | The device is not classified as MR Conditional<br><br>The primary targeted clinical setting is the Neonatal Intensive Care Unit (NICU) and secondary targeted clinical setting is the transport of neonates | The device is classified as MR Conditional with the use of 1.5 Tesla and 3.0 Tesla static magnetic field scanners<br><br>The primary targeted clinical setting is a clinical 1.5 Tesla and 3.0 Tesla diagnostic imaging environment |
| Cart Caster Hardware | (4) manually locking casters | (2) automatically locking casters with disengagement lever on cart handle |
| Cart-Mounted Gauss Alarms | None | (2) GaussAlert model 9957-A-01828-B (100 Gauss) |
| User Convenience Features | Wizards are available on the device display for pre-use checkout, gas cell calibration, use of backup NO delivery mode and troubleshooting of alarms | These same wizards are available with the addition of a wizard for device setup in the MRI suite |
| Labeling for compatibility with respiratory care devices | A variety of transport, neonatal, adult/pediatric, high frequency and anesthesia ventilators, nasal CPAP and nasal high flow cannulas | Compatible respiratory care devices include:<br>Bio-Med MVP-10/MRI<br>Nasal Cannula<br>Maquet Servo-i MR Environment Option<br>Pulmonetics LTV Series 1200 MR Conditional |

**Summary of Nonclinical Tests**

The following quality assurance measures were applied to the modification of the system:

- Risk analysis
- Formative usability study
- Requirements reviews
- Design reviews
- Testing on unit level (module verification)
- Integration testing (system verification)
- Performance testing (verification)

Support for the substantial equivalence of the INOmax DSIR® Plus MRI was provided as a result of risk management and testing which included electrical safety, performance and software tests. This testing includes conformity to the FDA recognized consensus standards and voluntary standards as follows:

- IEC 60601-1:2005 – Medical electrical equipment - Part 1: General requirements for basic safety and essential performance
- IEC 60601-1-2:2007 – General requirements for basic safety and essential performance – Collateral standard: Electromagnetic compatibility – Requirements and tests
- IEC 60601-1-8:2006 – General requirements for basic safety and essential performance – Collateral Standard: General requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems
- ASTM F2052-06 – Standard Test Method for Measurement of Magnetically Induced Displacement Force on Medical Devices in the Magnetic Resonance Environment
- ASTM F2119-07 – Standard Test Method for Evaluation of MR Image Artifacts from Passive Implants
- ASTM F2503-13 – Standard Practice for Marking Medical Devices and Other Items for Safety in the Magnetic Resonance Environment

A formative usability study was conducted per ANSI/AAMI HE75 Human Factors Engineering, Design of Medical Devices, to aid in the development of hardware and software requirements and verification confirmed the INOmax DSIR® Plus MRI meets its system level requirements and that the new/modified features function as specified.

To confirm compatibility with the new respiratory care devices, both devices were set up and calibrated according to the manufacturer's recommendations and tested using the settings established for each respiratory care device test. The INOmax DSIR® was set up and calibrated according to the manufacturer's recommendations.

Five INOmax DSIR® settings were used [0 (baseline), 5, 10, 20, 40, and 80 ppm] for each mode of ventilation, as well as the Backup mode.

The measured values on the INOmax DSIR® were also recorded along with any anomalies found.

The testing concluded four requirements necessary for the operation of the INOmax DSIR® and the four respiratory care devices to be compatible:

- $O_2$ dilution
- Effect on delivered pressures
- INOmax DSIR® delivery accuracy
- $NO_2$ generation

Testing Conclusion:

The INOmax DSIR® performed within published specifications when used with each of the ventilators in both primary and backup delivery.

**Summary of Clinical Tests**

The subject of this premarket submission, INOmax DSIR® Plus MRI, did not require clinical studies to support substantial equivalence.

**Conclusion**

INO Therapeutics/Ikaria considers the INOmax DSIR® Plus MRI to be as safe and as effective as the predicate device, with performance substantially equivalent to the predicate device.