DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
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Silver Spring, MD 20993-0002

December 19, 2014

NxStage Medical, Inc.
Mary Lou Strombos
Director, Regulatory Affairs
350 Merrimack Street
Lawrence, MA 01843

Re: K141752
Trade/Device Name: NxStage System One
Regulation Number: 21 CFR 876.5860
Regulation Name: High Permeability Hemodialysis System
Regulatory Class: Class II
Product Code: ODN
Dated: November 20, 2014
Received: November 21, 2014

Dear Mary Lou Strombos,

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 Industry and Consumer Education 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" (21 CFR 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 Industry and Consumer Education 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,

Herbert P. Lerner -S

for

Benjamin R. Fisher, Ph.D.
Director
Division of Reproductive, Gastro-Renal,
and Urological Devices
Office of Device Evaluation
Center for Devices and Radiological Health

Enclosure

INDICATIONS FOR USE

510(k) Number (if known): K141752

Device Name: NxStage® System One™

Indications for Use: The NxStage System One is indicated for the treatment of acute and chronic renal failure, or fluid overload using hemofiltration, hemodialysis, and/or ultrafiltration, in an acute or chronic care facility.

The System is also indicated for home hemodialysis, including home nocturnal hemodialysis.

All treatments must be administered under physician's prescription, and must be performed by a trained and qualified person, considered to be competent in the use of this device by the prescribing physician.

Prescription Use ___X____ **AND/OR** **Over-The-Counter Use_____**
(Part 21 CFR 801 Subpart D) **(21 CFR 807 Subpart C)**

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

Concurrence of CDRH, Office of Device Evaluation (ODE)

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NxStage System One
510(k) Premarket Notification

This 510(k) Summary is being submitted in accordance with the requirements of the Safe Medical Device Act (SMDA) of 1990. The content contained in this 510(k) summary has been provided in conformance with 21 CFR §807.92

A. Date Prepared:	June 27, 2014
B. Submitter's Information:	
Name:	NxStage Medical, Inc.
Address:	350 Merrimack Street Lawrence, MA 01843
FDA Establishment Owner/Operator Number:	9045797
Contact Person:	Mary Lou Stroumbos Director, Regulatory Affairs
Phone:	(978) 687-4872
Fax:	(978) 687-4750
Manufacturer:	NxStage Medical, Inc. 350 Merrimack Street Lawrence, MA 01843
FDA Establishment Registration Number:	3003464075
Sterilization Site:	Steris Isomedix (NxStage Cartridge Express) 1000 S. Sarah Place Ontario, CA 91761

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C. Device Name:

Trade/Proprietary Name:	NxStage System One
Common/Usual Name:	Hemodialysis System
Classification Name:	High Permeability Hemodialysis System
Regulation Number:	876.5860
Product Code:	ODN
Device Classification:	Class II
Device Panel:	Gastroenterology/Urology

D. Substantial Equivalence:

The NxStage System One has the same intended use and utilizes the same fundamental technology as the predicate NxStage System One. The NxStage System One has been compared to the legally marketed predicate device as cleared through K140526 (May 19, 2014) and was found to be substantially equivalent.

E. Device Description/Indications for Use:

The NxStage System One is comprised of the NxStage Cycler, an electromechanical control unit; the NxStage Cartridge, a sterile, single-use extracorporeal blood and fluid management circuit (with or without a pre-attached high permeability filter) that mounts integrally within the NxStage Cycler. The combined system is designed to deliver hemofiltration, hemodialysis and/or ultrafiltration in an acute or chronic care facility. The NxStage System One is also indicated for home hemodialysis, including home nocturnal hemodialysis.

Indications for use:

The NxStage System One is indicated for the treatment of acute and chronic renal failure or fluid overload using hemofiltration, hemodialysis, and/or ultrafiltration, in an acute or chronic care facility.

The System is also indicated for home hemodialysis, including home nocturnal hemodialysis.

All treatments must be administered under physician's prescription, and must be performed by a trained and qualified person, considered to be competent in the use of this device by the prescribing physician.

F. Technological Characteristics:

The proposed device has the same technological characteristics and is similar in design and configuration as compared to the predicate device. The proposed device is designed with similar software, components and features also used in the predicate device.

Table 1
Device Technological Characteristics Comparison Table

Parameter	**Proposed Device NxStage System One**	**Predicate Device NxStage System One (K140526)**
Intended Use		
Hemodialysis	Yes	Yes
Hemofiltration	Yes	Yes
Ultrafiltration	Yes	Yes
Technology / Components:		
Pumps	Same	4 peristaltic pumps
Valves (clamps)	Same	2 solenoid actuated pinch clamps
	Same	8 cam driven pinch clamps
Air / fluid detectors	Same	3 ultrasonic air/ fluid detectors
Blood leak detector	Same	1 optical blood leak detector
Pressure transducers	Same	5 electronic pressure transducers
Temperature sensors	Same	1 electronic temperature sensor

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Table 1
Device Technological Characteristics Comparison Table

Parameter	**Proposed Device NxStage System One**	**Predicate Device NxStage System One (K140526)**
Flow Rates:		
Blood	Same	10-600 ml/min
Prescription Fluid /Dialysate Flow	Same	0-18000 ml/hr
Ultrafiltration	Same	0-2400 ml/hr
Transmembrane Pressure Monitoring Specification	Same	Yes
Venous Pressure Monitor	Same	0 to 400 mmHg
Effluent fluid Pressure Monitor	Same	0 to 500 mmHg
Air Detector	Same	Reduction of detector signal lasting 6 ms minimum (Approximates a 60 micro liter bubble at 400 mmHg venous pressure and 600 ml/min blood flow)
Blood Leak Detector	Same	15% reduction in detector signal lasting 20 seconds minimum. Signal reduction % based on a 0.35 ml/min leak rate of 32 Hct blood.
Effluent Volume Accuracy	Same	Greater of 300 ml/ 12 hr or 3% of exchange volume (For software versions 4.7 and below) For software versions 4.8 and higher: Therapy Fluid Flow Rate L/hr) / Specification greater of > 3 / + 5% UF* or / ±100 ml/hr* ≤ 3 / + 5% UF* or / ± 25 ml/hr* *Representing 95/90 tolerance interval established under controlled laboratory testing conditions.
IV Prescription Fluid	Same	Off-line, sterile- physician prescribed, indicated for infusion
Dialysate	Same	Dialysate available as pre-packaged pre-mixed sterile fluids or via the PureFlow SL (K043436 K060296, K090919, K111174 & K140571)
Compatible Blood Tubing Set	Same	NxStage Standard Cartridge
Software	Software version 4.10	Software version 4.9

G. Summary of Non-Clinical Test/Performance Testing – Bench and Clinical Testing

NxStage believes that the information and data provided in this submission clearly describes the proposed device and demonstrates that the device is adequately designed for the labeled indications for use. Performance, verification and validation; and clinical testing was conducted to characterize performance of the proposed device and the predetermined acceptance criteria were met.

The following non-clinical testing was conducted:

- System Verification and Software Validation
  - Software verification & validation
  - Regression testing
  - Safety systems verification
  - Labeling verification testing
  - Simulated dialysis treatments

The following clinical testing was conducted:

Clinical testing included 2 crossover studies with a total of 58 patients. There were 38 in the first study and 20 in the second study. Results were provided separately and pooled together to show substantial equivalence of nocturnal hemodialysis to daily hemodialysis in the home setting.

Pivotal Studies:

NxStage conducted a US prospective, multi-center, two-treatment, two-phase, open-label, cross-over Investigational Device Exemption clinical study titled “Comparison of Nocturnal Hemodialysis (NHD) and Short Daily Hemodialysis (DHD) with the NxStage System One.” The objective of the study was to determine whether or not NHD (6-10 hours) was substantially equivalent to DHD (2-4 hours) on a per treatment basis, using the NxStage System One (NSO) in the home setting. The first phase (DHD) consisted of 2 to 4 hour treatments, and the second phase (NHD) consisted of 6 to 10 hour treatments. Both phases consisted of either 5 or 6 treatments per week over an 8 week period (40 or 48 treatments in total) using the NSO in the home environment. A 4 week training/transition period took place between the two phases. A total of 58 End Stage Renal Disease (ESRD)

patients >18 years of age who were currently stable on home DHD were enrolled, of which 39 completed the study period and 19 discontinued.

Primary effectiveness endpoint:
The primary efficacy endpoint for the study was the ability to deliver the clinically prescribed amount of therapy, defined by attainment of a delivered volume that was at least 90% of the prescribed volume (10% difference in success rate is the upper boundary of the 95% confidence interval).

Primary safety endpoint:
The primary safety endpoint was the composite intradialytic and interdialytic adverse event (AE) profile.

Effectiveness:
The primary endpoint for the study focused on the ability to deliver the clinically prescribed amount of therapy (success or failure). For the ITT population, the probability of a successful treatment was 90.9% in the DHD phase versus 91.7% in the NHD phase. The upper limit of the confidence interval (2.9%) was less than the protocol-specified limit (10%). Hence, the treatment success rates were similar and the protocol specified non-inferiority criterion was attained.

Safety:
For the ITT population, the composite AE rate per 100 treatments was 8.3 in the DHD phase versus 6.9 in the NHD phase. The event profiles were similar for both phases. Results were similar for the PP population.

The study reported one death not related to study participation or the study device and no unanticipated adverse device effects. In the DHD phase there were 21 severe AEs reported, and in the NHD phase there were 6 severe AEs reported. Device relatedness was recorded as cannot be ruled out for one of the severe AEs: patient was unable to self-cannulate due to a non-dialysis related surgery. The remaining 26 severe AEs were considered not related to the device. The rate of severe AEs per 100 treatments was 0.9 for DHD vs. 0.3 for NHD.

The most commonly occurring AEs were OTH-other, hypotension, and muscle cramping. OTH-other included non-dialysis related injuries and surgeries (e.g. broken ankle, knee surgery, toe infection, etc.), out of range blood laboratory values, access related events, episodes of depression, infection, kidney stone, and other isolated events. OTH-other occurred at a rate of 1.3 vs. 1.6 per 100 treatments in DHD vs. NHD, respectively. Hypotension occurred at a rate of 1.9 vs. 0.2 per 100 treatments. The rate of muscle cramping was 1.1 per 100 treatments for both study phases.

The rates of adverse events were similar in the DHD and NHD phases, and the events experienced were typical of those commonly reported for dialysis patients, including episodes of hypotension and muscle cramping.

Summary

Based on the clinical performance as documented in the pivotal clinical studies, the NxStage System One in the home setting delivers NHD therapy that is substantially equivalent to DHD therapy on a per treatment basis.

Conclusion: Results of the non-clinical testing and clinical data have documented that the proposed NxStage System One is substantially equivalent to the predicate device and is suitable for the labeled indications for use.