

Summary of Safety and Effectiveness Data

I. GENERAL INFORMATION

Device Generic Name: Iliac Stent

Device Trade Name: Bard® E-LUMINEXX™ Vascular Stent

Applicant's Name and Address: Bard Peripheral Vascular, Inc.
1415 West 3rd Street
Suite 109
Tempe, AZ 85281

Date of Panel Recommendation: None

Premarket Approval (PMA) Application Number: P080007

Date of Notice of Approval to Applicant: December 4, 2008

Expedited: Not Applicable

II. INDICATIONS FOR USE

The Bard E-Luminexx Vascular Stent is indicated for the treatment of iliac occlusive disease in patients with symptomatic vascular disease of the common and/or external iliac arteries up to 126mm in length, with a reference vessel diameter of 5 to 9 mm.

III. CONTRAINDICATIONS

There are no known contraindications.

IV. WARNINGS AND PRECAUTIONS

The Warnings and Precautions can be found in the labeling for the Bard® E-LUMINEXX™ Vascular Stent System.

V. DEVICE DESCRIPTION

Bard® E-LUMINEXX™ Vascular Stent

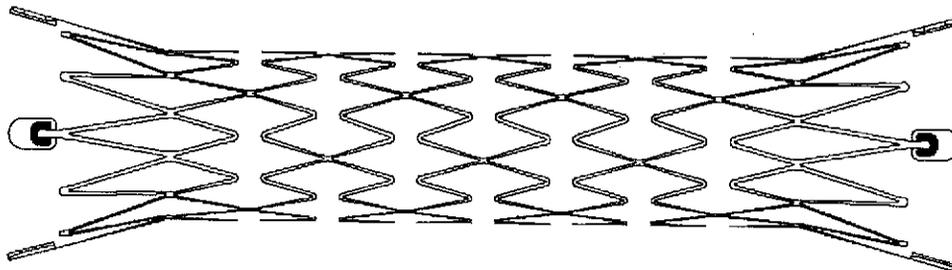
The Bard® E-LUMINEXX™ Vascular Stent is an electropolished, self-expanding, flexible, nitinol (nickel-titanium alloy) stent that expands to its preset diameter upon exposure to body temperature (see Figure 1). The Bard® E-LUMINEXX™ Vascular Stent is supplied sterile and is pre-loaded on the Bard® S.A.F.E.® Delivery System with the PerforMAXX® Grip. The stent has a segmental repeating pattern and open cell geometry with flared ends to help prevent dislocation or migration. Partial cuts around the circumference of the stent provide enhanced flexibility and allow segment-by-segment expansion. The product line has a range of diameters (7-10 mm) and lengths (20-100 mm) all available on either an 80 cm or 135 cm long 6 French (F) stent delivery system (see Table 1 for product codes and sizes). Each end of the stent has 4 radiopaque tantalum markers to enhance visibility, thereby facilitating accurate stent placement.

Table 1. Bard® E-LUMINEXX™ Vascular Stent Product Codes/Description

80 cm Delivery System		Stent Length						
		20 mm	30 mm	40 mm	50 mm	60 mm	80 mm	100 mm
	7 mm	ZBM07020	ZBM07030	ZBM07040	ZBM07050	ZBM07060	ZBM07080	ZBM07100
	8 mm	ZBM08020	ZBM08030	ZBM08040	ZBM08050	ZBM08060	ZBM08080	ZBM08100
	9 mm	ZBM09020	ZBM09030	ZBM09040	ZBM09050	ZBM09060	ZBM09080	ZBM09100
	10 mm	ZBM10020	ZBM10030	ZBM10040	ZBM10050	ZBM10060	ZBM10080	ZBM10100

135 cm Delivery System		Stent Length						
		20 mm	30 mm	40 mm	50 mm	60 mm	80 mm	100 mm
	7 mm	ZBL07020	ZBL07030	ZBL07040	ZBL07050	ZBL07060	ZBL07080	ZBL07100
	8 mm	ZBL08020	ZBL08030	ZBL08040	ZBL08050	ZBL08060	ZBL08080	ZBL08100
	9 mm	ZBL09020	ZBL09030	ZBL09040	ZBL09050	ZBL09060	ZBL09080	ZBL09100
	10 mm	ZBL10020	ZBL10030	ZBL10040	ZBL10050	ZBL10060	ZBL10080	ZBL10100

Figure 1. Bard® E-LUMINEXX™ Vascular Stent



Bard® E-LUMINEXX™ Vascular Stent Delivery System

Figures 2 and 3 represent the BARD S.A.F.E.^{®1} Delivery System with and without the PerforMAXX[®] Grip.

Figure 2. BARD S.A.F.E.[®] Delivery System with The PerforMAXX[®] Grip

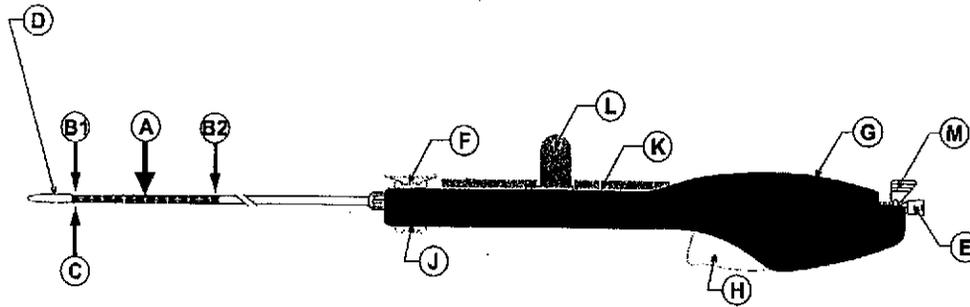


Figure 3. BARD S.A.F.E.[®] Delivery System after Removal of The PerforMAXX[®] Grip

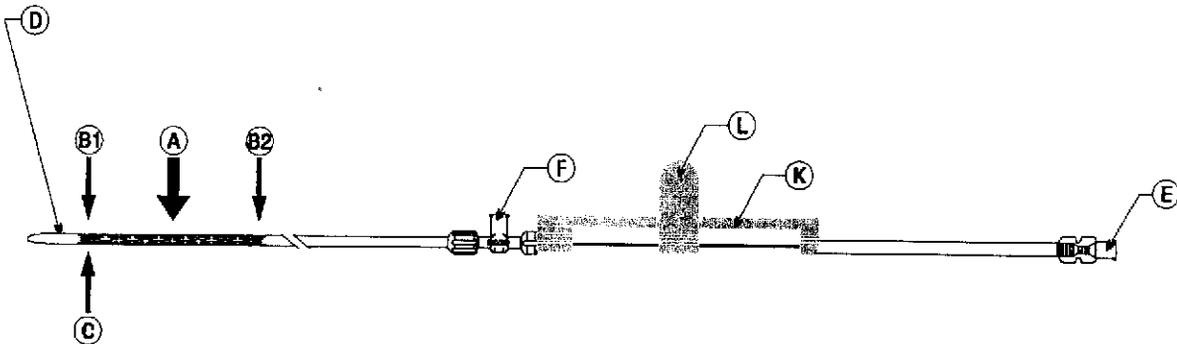


Table 2. Bard® E-LUMINEXX™ Vascular Stent Component Identification Codes (Figures 3 and 4)

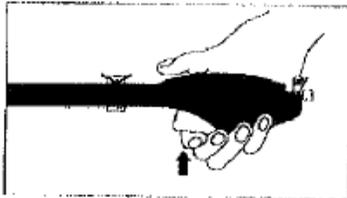
A	Stent	D	Flexible catheter tip	H	Trigger
B1	4 Distal PUZZLE™ Tantalum Markers	E	Proximal Luer port	J	Slide mechanism
B2	4 Proximal PUZZLE™ Tantalum Markers	F	Distal T-Luer adapter	K	Safety clip
C	A single radiopaque marker on the outer catheter	G	PerforMAXX [®] Grip	L	Safety clip tabs
M	Conversion Tab				

¹ S.A.F.E.= Secure Adhesive Free Tip Design

The BARD S.A.F.E.[®] Delivery System with the PerforMAXX[®] Grip (Table 2, G) is a multifunctional stent deployment system that offers four different stent deployment options (see Figure 4):

Figure 4. Deployment Methods Diagram

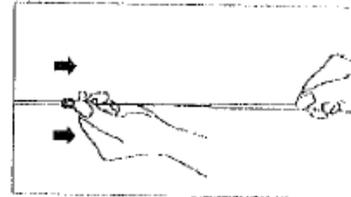
Trigger Method:



Slide Method:



Conventional Method:



i. **The Trigger Method:** Stent deployment can be accomplished using “The Trigger Method” by pumping the trigger of the handle (Table 2, H). “The Trigger Method” offers micro-clicks for ultimate control (2mm at a time) or full pumps for rapid, one-handed stent deployment. (see Figure 1: Trigger Method).

ii. **The Slide Method:** Using “The Slide Method”, the stent can be deployed by pulling back the slide mechanism (Table 2, J; see Figure 1: Slide Method).

iii. **The Combination Method (Trigger/Slide Methods):** “The Combination Method” uses both “The Trigger Method” and “The Slide Method.” Using this method, the trigger handle is pumped until the stent has achieved wall apposition, and then the user switches to “The Slide Method” by pulling back the slide mechanism to complete the deployment (see Figure 1: Trigger Method and Slide Method).

iv. **The Conventional Method (Pin & Pull-Back):** The “Conventional Method” requires the user to remove the conversion tab from the proximal luer port and snap the catheter out of the PerforMAXX[®] Grip and deploy the stent using the “Pin & Pull-Back” technique by pulling back on the T-Luer adapter (Table 2, F; see Figure 1: Conventional Method).

The delivery system requires a minimum 8F guiding catheter or a minimum 6F introducer sheath. The delivery system has a soft and flexible catheter tip (Table 2, D) formed from the outer catheter. The catheter tip is tapered to accommodate a 0.035 inch (0.89 mm) guidewire. The BARD S.A.F.E.[®] Delivery System features a StentLoc[®] Mechanism where the distal catheter is specifically designed to apply compression along the entire length of the stent to prevent unintentional movement or misplacement during deployment. Stent deployment is controlled using one of the four methods described above.

VI. ALTERNATIVE PRACTICES AND PROCEDURES

Alternative procedures to treat occlusive disease of the iliac arteries include percutaneous transluminal angioplasty (PTA) alone, PTA accompanied by stenting, stenting using another legally marketed stent system, thrombolytic therapy, conservative medical management, and/or surgical procedures.

VII. MARKETING HISTORY

The Bard® LUMINEXX® Vascular Stent received CE approval 20 April 2001 and has been marketed in the following countries: Germany, France, Portugal, Spain, Belgium, United Kingdom, Ireland, Luxemburg, Netherlands, Austria, Italy, Denmark, Sweden, Finland, Greece, Switzerland, Liechtenstein, Iceland, Norway, Argentina, Brazil, China, Korea, Mexico, Peru, Singapore, Taiwan, Thailand, Uruguay, Canada, and Japan.

The Bard® LUMINEXX® 6F Vascular Stent received CE approval 06 May 2002 and has been marketed in the following countries: Germany, France, Portugal, Spain, Belgium, United Kingdom, Ireland, Luxemburg, Netherlands, Austria, Italy, Denmark, Sweden, Finland, Greece, Switzerland, Liechtenstein, Iceland, Norway, Argentina, Brazil, China, India, Korea, Mexico, Peru, Singapore, Taiwan, Thailand, Uruguay, Canada, Australia and Japan.

The Bard® LUMINEXX® 3 Vascular Stent received CE approval 13 December 2003 and has been marketed in the following countries: Germany, France, Portugal, Spain, Belgium, United Kingdom, Ireland, Luxemburg, Netherlands, Austria, Italy, Denmark, Sweden, Finland, Greece, Switzerland, Liechtenstein, Iceland, Norway, Slovenia, Poland, Czech Republic, Hungaria, Malta, Cyprus, Latvia, Macedonia, Israel, Argentina, Brazil, China, India, Korea, Mexico, Peru, Singapore, Taiwan, Thailand, Canada, Australia, South Africa and Japan.

The Bard® E-LUMINEXX™ Vascular Stent received CE approval 01 December 2006 and has been marketed in the following countries: India, Singapore, Taiwan, Mexico, Brazil, Malaysia, Argentina, Hong Kong, France, Spain, Portugal, Germany, Italy, UK, Ireland, Norway, Sweden, Denmark, Finland, Belgium, Netherlands, Switzerland, Austria, Slovenia, Czech Republic, Poland, Malta, Turkey, Greece, Hungary, Lithuania, Canada, Australia, and Japan

The Bard® LUMINEXX® Vascular Stent and the Bard® E-LUMINEXX™ Vascular Stent have not been withdrawn from marketing for any reason relating to the safety or effectiveness of the device. However, the Bard® LUMINEXX® 3 Vascular Stent and the Bard® LUMINEXX® 6F Vascular Stent produced between March 1, 2005 and May 22, 2005 were voluntarily withdrawn from the market in 2005 due to a manufacturing change that had the potential to lead to device malfunction. This manufacturing change was corrected. The voluntary recall affected the following countries: Austria, Spain, Belgium, Canada, Sweden, Denmark, Germany, Israel, Czech Republic, South Africa, Hungary,

Romania, Macedonia, Finland, France, Greece, Ireland, Italy, United Kingdom, Japan, Netherlands, Norway, India, China, Singapore, and Taiwan.

VIII. POTENTIAL ADVERSE EFFECTS OF THE DEVICE ON HEALTH

Below is a list of the potential adverse effects (i.e., complications) associated with with the use of the device.

- Abrupt stent closure
- Allergic reaction to nitinol
- Amputation
- Aneurysm
- Angina/coronary ischemia
- Arterial aneurysm
- Arterial occlusion/thrombus
- Arterial occlusion/restenosis of the treated vessel
- Arterial rupture
- Arteriovenous fistula
- Arrhythmia
- Atheroembolization
- Death related to procedure
- Death unrelated to procedure
- Embolization, arterial
- Embolization, stent
- Fever
- Hematoma/bleed: puncture site, device path, or remote site
- Hypersensitivity reactions
- Hypotension/hypertension
- Intimal injury/dissection
- Ischemia/infarction of tissue/organ
- Ischemia requiring intervention (bypass or amputation of toe, foot, or leg)
- Local infection
- Malposition (failure to deliver the stent to the intended site)
- Myocardial infarction
- Pseudoaneurysm
- Pulmonary embolism
- Renal failure
- Restenosis of the stented artery
- Septicemia/bacteremia
- Stent migration
- Stent strut fracture
- Stroke
- Vasospasm

- Tissue necrosis
- Venous occlusion/thrombus: remote site or puncture site
- Worsened claudication/rest pain

For the specific adverse events that occurred in the clinical study, please refer to Section X below.

IX. SUMMARY OF PRECLINICAL STUDIES

A. Laboratory Studies

Biocompatibility

Biocompatibility testing on the materials used in the Bard® E-LUMINEXX™ Vascular Stent was performed in accordance with International Organization for Standardization (ISO) 10993-1, General Program Memorandum – #G95-1, and Guidance for Industry and FDA Staff: Non-Clinical Tests and Recommended Labeling for Intravascular Stents and Associated Delivery Systems (January 13, 2005).

The components of the stent and delivery system were categorized per ISO 10993-1, *Biological Evaluation of Medical Devices Part 1: Evaluation and Testing* based on the intended duration and contact with or within the body. The delivery system, which is composed of a coaxial catheter and grip, allows placement of the stent at the site of treatment. The delivery system was categorized as an externally communicating device with limited (≤ 24 hours) exposure to circulating blood. The grip of the delivery system does not contact skin, blood or tissue; therefore, biocompatibility testing was not performed on this part of the device. The nitinol stent was categorized as a permanent implant with direct blood contact for durations longer than 30 days.

Specific biocompatibility tests were performed based on the categorization of the stent and delivery system in accordance with ISO 10993-1, *Biological Evaluation of Medical Devices*. Table 3 demonstrates the specific biocompatibility tests required per this standard. Additionally, Tables 4 and 5 provide summaries of the biocompatibility tests and results from sterile components of the stent and delivery system that were tested separately. All biocompatibility tests were conducted in accordance with Good Laboratory Practices (GLP) per 21 CFR, Part 58. All test results indicated that the materials and processes used to manufacture the Bard® E-LUMINEXX™ Vascular Stent and delivery system are biocompatible and suitable for their intended use.

Table 3. Biocompatibility Testing Requirements

		DEVICE CATEGORIES			BIOCOMPATIBILITY TESTS								
		Body Contact		Contact Duration	Cytotoxicity	Sensitization	Intracutaneous Reactivity	Systemic Toxicity	Subchronic Toxicity	Genotoxicity	Implantation	Hemocompatibility	
BARD E-LUMINEXX™ Vascular Stent	Stent	Nitinol Stent	Implant Devices	Blood	> 30 days	x	x	X	x	x	x	x	x
	Delivery System	Coaxial Catheter	External Communicating Devices	Circulating Blood	≤ 24 hrs.	x	x	X	x	NA	NA	NA	x

Table 4. Stent Biocompatibility Results

Biocompatibility Test	Method	Result
Cytotoxicity	ISO 1 X MEM elution method	Pass
Sensitization	ISO murine local lymph node assay; SC and DMSO	Pass
Irritation or Intracutaneous Reactivity	ISO Intracutaneous Injection test; SC and CSO	Pass
Acute Systemic Toxicity	ISO systemic injection, SC and CSO	Pass
Material Mediated Pyrogenicity	Material mediated USP rabbit pyrogen test	Pass
Subchronic Toxicity	ISO 14-day intravenous toxicity study	Pass
Genotoxicity	ISO <i>Salmonella thyphimurium</i> & <i>Escherichia coli</i> reverse mutation assay, ISO Chromosomal aberration study, and ISO rodent bone marrow micronucleus assay	Pass
Implantation	ISO 1, 4, and 12 week muscle implantation and USP 26, 52, and 78 week muscle implantation study	Pass
Hemocompatibility	ISO hemolysis and ISO thrombogenicity assay	Pass
Complement Activation	C3a complement assay and SC5b-9 complement assay	Pass

Table 5. Delivery System Biocompatibility Results

Biocompatibility Test	Method	Result
Cytotoxicity study	ISO 1 X MEM elution method	Pass
Sensitization	ISO murine local lymph node assay; SC and DMSO	Pass
Irritation/Intracutaneous Reactivity	ISO Intracutaneous Injection test; SC and SO	Pass
Acute Systemic toxicity	USP and ISO systemic toxicity; SC and SO	Pass
Material Mediated Pyrogenicity	Material mediated USP rabbit pyrogen test	Pass
Hemocompatibility	<i>In vitro</i> hemolysis study, plasma recalcification study, and <i>in vivo</i> thromboresistance study	Pass
Complement Activation	C3a complement assay and SC5b-9 complement assay	Pass

Summary of *In Vitro* Preclinical Testing

The Bard® E-LUMINEXX™ Vascular Stent was tested according to the recommendations set forth in the FDA Guidance Document entitled, *Non-Clinical Tests and Recommended Labeling for Intravascular Stents and Associated Delivery Systems* (Jan. 13, 2005). Table 6 summarizes the bench tests performed for the clinical study LUMINEXX® device and the approved E-LUMINEXX™ device. As demonstrated in the table, all results support the safety and effectiveness of the device.

Table 6. *In Vitro* Preclinical Testing for the Bard® E-LUMINEXX™ Vascular Stent

Test	Purpose/Objective	Specification / Acceptance Criteria	E-LUMINEXX™ Results	LUMINEXX® Results	
Material Characterization	Material Composition	To demonstrate that the Bard® E-LUMINEXX™ Vascular Stent consists of the basic elements nickel and titanium (stent body) and tantalum (radiopaque spoons) and to detect traces of other elements according to the Material Specification and ASTM F2063-00 and ASTM F560-04.	ASTM F2063-00 and ASTM F560-04	PASS	PASS
	Shape Memory and Superelasticity	To describe the austenite finish transition temperature and mode of action for stent material.	Characterization Study	Characterization Only	Characterization Only
	Mechanical Properties	To determine the mechanical properties (e.g., yield strength, tensile strength, upper / lower plateau stresses, and permanent set) of nitinol tubing on the basis of a uniaxial tensile test.	Characterization Study	Characterization Only	Characterization Only
	Corrosion Resistance	To evaluate the stent's corrosion resistance under conditions simulating the intended <i>in vivo</i> conditions using electrochemical degradation methods for pitting, crevice, and galvanic corrosion. Additionally, to evaluate the fretting corrosion for stents in an overlapped condition in a simulated 10 year pulsatile fatigue environment.	<p>Pitting, Crevice, and Galvanic: In an active degradation Electrochemical Characterization Test, the open circuit potential and the SEM investigations for the evaluation of pitting, crevice and inherent galvanic corrosion are for informational purposes only. The breakdown potential has to exceed the historical data of a device currently approved and marketed for the vascular system in the US (503 mV ± 70 mV)</p> <p>Fretting: stents able to withstand 10 year pulsatile fatigue environment without clinically relevant fretting or leachables.</p>	PASS	PASS (Note: Fretting Corrosion test not performed)

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Test		Purpose/Objective	Specification / Acceptance Criteria	E-LUMINEXX™ Results	LUMINEXX® Results
Stent Dimensional and Functional Attributes	Dimensional Verification	To verify that the unconstrained/expanded stent diameter falls within the predetermined specifications.	$\pm 0.5\text{mm}$ from nominal stent diameter	PASS	PASS
	Percent Surface Area of the Stent	To calculate the stent free surface area percentage by subtracting the area covered by the E-LUMINEXX™ Stent from the total vessel area stented and dividing by the total vessel area stented.	Characterization Study	Characterization Only	Characterization Only
	Foreshortening	To determine the increase/decrease in stent length between the catheter-loaded condition and the deployed condition.	$\pm 10\%$ at 1mm oversizing	PASS	Characterization Only
	Recoil for Balloon Expandable Stents	The Bard® E-LUMINEXX™ Vascular Stent is a nitinol self expanding stent and therefore this testing does not apply.	Not Applicable	Not Applicable	Not Applicable
	Stent Integrity	To detect contaminants or impurities on the surface of the stent. Additionally, the investigation was extended to verify that the manufacturing processes did not induce flaws that were not completely removed by electropolishing.	Surface contaminants and impurities, which could adversely affect the performance as long term implant are not acceptable	PASS	PASS
	Radial Stiffness and Radial Strength	The Radial Stiffness (compression force) test was intended to determine the diameter change of the stent in a simulated tissue environment as a result of external radial pressure and to verify that it meets a predetermined specification.	$\geq 2.5\text{ kPa}$ ($>2.5\text{ kPa}$ for LUMINEXX®)	PASS	PASS

Test	Purpose/Objective	Specification / Acceptance Criteria	E-LMINNEXX™ Results	LUMINEXX® Results
Stress Analysis	To determine the stresses that the stents may experience during processing, manufacturing, deployment, and physiological conditions. Further, to verify that the device does not experience stresses that are unreasonable for the indication or the material.	Maximum stresses of the stents should be below the yield limit	PASS	PASS
Fatigue Analysis	To verify that the stent has a suitable fatigue resistance for the indication using Finite Element Analysis and a Goodman Diagram.	All resulting stress points should be below (within) the Goodman line, indicating the theoretical safety of the stent design in fatigue	PASS	PASS
Accelerated Durability Testing	To validate the fatigue analysis and demonstrate the durability of the stent at 10 years of simulated use in both overlapped and non-overlapped stent conditions.	No stent migration and no loss of structural integrity of stents	PASS	PASS (Note: testing of overlapped stents was not performed)
MR Compatibility	To evaluate the magnetic field interactions, heating and imaging artifacts of the stent under Magnetic Resonance Imaging (MRI) at 1.5 and 3 Tesla, and to verify that the stent will not present an additional hazard or risk to a patient undergoing an MRI procedure.	Characterization study to determine Labeling for MR Conditional Restrictions	PASS (See Labeling for MR Conditional Restrictions)	PASS
Radiopacity	To evaluate the radiopacity of the stent with radiographic and angiographic imaging.	Equal or greater radiopacity when compared to comparison device(s).	PASS	PASS
Coating Durability (coated stents only)	The Bard® E-LUMINEXX™ Vascular Stent does not have a coating; therefore, this testing does not apply.	Not Applicable	Not Applicable	Not Applicable

Stent Dimensional and Functional Attributes (continued)

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Test		Purpose/Objective	Specification / Acceptance Criteria	E-LMINNEXX™ Results	LUMINEXX® Results
Stent Dimensional and Functional Attributes	Crush Resistance (<i>peripheral indications only</i>)	The crush resistance (compression force) test was intended to demonstrate the ability of the stent to support the vessel lumen against external pressure and to return to the initial diameter following deformation.	Crush Resistance: Ability to return to deployed diameter after full compression. Focal Crush: Ability to return to deployed diameter after subjection to 50% focal compression.	PASS	PASS
	Kink Resistance (<i>peripheral indications only</i>)	To verify that the stent does not experience deformation from being passed through or deployed in tortuous anatomy (both in overlapped and non-overlapped conditions) and to verify that the stent does not experience irrecoverable deformation.	No stent deformation after tracking and deployment in 10 mm radius bend. No kinking of struts or protrusion of struts into vessel lumen.	PASS	PASS
Delivery System Dimensional and Functional Attributes	Delivery, Deployment and Retraction	To verify overall product functionality (ability to access, deploy, and retract) in relationship to simulated use conditions. To verify flushability/leakproofness, trackability, pushability, torquability, and flexibility. Additionally, to verify the forces required to deploy the stent and the accuracy of stent placement.	Flushable, Leakproof, Trackable, Pushable, Torquable. Deployment force: < 28N (E-LUMINEXX™). Deployment force: < 35N (LUMINEXX®). Deployment Accuracy: ± 3.0 mm (E-LUMINEXX™). Deployment Accuracy: ± 2.5 mm (LUMINEXX®)	PASS (Note: also met the ± 2.5 mm deployment accuracy specification)	PASS (Note: also met the < 28N deployment force specification)
	Balloon Rated Burst Pressure (<i>balloon expandable stents only</i>)	The Bard® E-LUMINEXX™ Vascular Stent is not mounted over a balloon and therefore this testing does not apply.	Not Applicable	Not Applicable	Not Applicable

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Test		Purpose/Objective	Specification / Acceptance Criteria	E-LMINNEXX™ Results	LUMINEXX® Results
live system Dimensional and Functional Attributes (continued)	Balloon Fatigue (<i>balloon expandable stents only</i>)	The Bard® E-LUMINEXX™ Vascular Stent is not mounted over a balloon and therefore this testing does not apply.	Not Applicable	Not Applicable	Not Applicable
	Stent Diameter vs. Balloon Pressure (Compliance Chart) (<i>balloon expandable stents only</i>)	The Bard® E-LUMINEXX™ Vascular Stent is not mounted over a balloon and therefore this testing does not apply.	Not Applicable	Not Applicable	Not Applicable
	Catheter Bond Strength	To verify that the tensile strength of all bond/fixation joints of the delivery system meet the predetermined specifications.	Varies depending on specific test (acceptance criteria ranged from ≥ 2 N to ≥ 35 N)	PASS	PASS

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Sterility, Packaging, and Shelf Life Testing

Sterility: The Bard® E-LUMINEXX™ Vascular Stent is ethylene oxide sterilized and validated according to ISO 11135, *Medical Devices - Validation and Routine Control of Ethylene Oxide Sterilization*. The validation data demonstrate that this sterilization cycle is reproducible and delivers a reliable minimum sterility assurance level (SAL) of 10^{-6} .

Shelf Life Tests: The Bard® E-LUMINEXX™ Vascular Stent was stability tested after accelerated aging to an equivalence of three years under a validated stability testing protocol. Testing demonstrated that the E-Luminexx™ Vascular Stent met the specified acceptance criteria. Based on this testing, it was determined that the device could be labeled for a shelf life of three years.

Packaging Tests: Packaging verification and validation for the Bard® E-LUMINEXX™ Vascular Stent was performed in accordance with the appropriate sections of the following standards: ASTM D 4728-01, ASTM D 5276-98, DIN EN ISO 2247 2002, ASTM F 1929-98. The device met all of the predetermined acceptance criteria.

In vitro bench testing was conducted on both the LUMINEXX® and E-LUMINEXX™ Vascular Stents. Testing demonstrated that the two stents have comparable characteristics and performance. Although the clinical trial was conducted using the LUMINEXX® stent, FDA determined that the data supports the approval of the E-LUMINEXX™ stent.

B. Animal Studies

In Vivo Preclinical Animal Studies

An *in vivo* animal study was conducted to evaluate the delivery catheter performance, stent patency rates, and the biologic response of the host tissue to the device. The study was conducted in a porcine model (n = 29) of both diseased and non-diseased carotid arteries. Devices were explanted at 24 hours, 8 weeks, or 6 months post-implantation. All studies were conducted in accordance with FDA Non-Clinical Good Laboratory Practice Regulation 21 CFR, Part 58. The results of the *in vivo* animal study are summarized in Table 7.

Table 7. Summary of *In Vivo* Preclinical Animal Study

Animal Study	Total Number of Animals and Time Points	Devices Tested	Relevant Findings
Acute and Chronic Evaluation in the Porcine Carotid Artery	24 hour (n=5), 8 week (n=8), and 6 month (n=16)	54 Devices	All stents were successfully deployed in the intended location. The functional requirements of the delivery system were met. The stent demonstrated long-term performance <i>in vivo</i> with no evidence of migration or device-related adverse events up to 6 months following implant. The host tissue response was judged to be acceptable at histological evaluation. There was no significant loss of lumen dimension at follow-up.

X. SUMMARY OF PRIMARY CLINICAL STUDY

The sponsor conducted a clinical study to establish a reasonable assurance of safety and effectiveness for iliac stenting with the Bard® LUMINEXX® vascular stent for the treatment of symptomatic vascular disease of the common and/or external iliac arteries in the U.S. under IDE G980318. The U.S. clinical trial proved the device to be safe and effective for its intended use. Data gathered from the clinical study were collected on both the Bard® LUMINEXX® Iliac Stent and the Bard® LUMINEXX® 6F Iliac Stent (referred to collectively as the LUMINEXX® Stent). The stent in each of these devices was the same; however, the delivery systems were different. The Bard® LUMINEXX® Iliac Stent has a 7F profile and the Bard® LUMINEXX® 6F Iliac Stent has a 6F profile. The commercial device, the Bard® E-LUMINEXX™ Vascular Stent, uses an electropolished version of the LUMINEXX® Stent and includes a handgrip on the 6F delivery system. Based on the *in vitro* testing which demonstrated comparable performance between the Bard® LUMINEXX® Vascular Stent and the Bard® E-LUMINEXX™ Vascular Stent, FDA determined that the clinical data collected with both the Bard® LUMINEXX® Iliac Stent and the Bard® LUMINEXX® 6F Iliac Stent support the safety and effectiveness of the Bard® E-LUMINEXX™ Vascular Stent.

A. Study Design

A prospective, multi-center, non-randomized clinical study was conducted at nine sites in the United States using the LUMINEXX® Stent. A total of 156 lesions were treated in 151 limbs using 164 devices. The study objective was to determine the safety and effectiveness of the LUMINEXX® Stent for the treatment of common and/or external iliac artery occlusive disease.

The rate of Major Adverse Clinical Events (MACE) was the primary combined safety and effectiveness endpoint for the study. MACE was defined as peri-procedural death (death during the procedure or prior to hospital discharge), target lesion

revascularization (any treatment to bypass or increase lumen diameter within the stented segment or within 5mm of its margins), or stented segment restenosis (> 50% stenosis as determined by duplex ultrasound) at nine months post-procedure. Bayesian statistical models, using non-informative prior probabilities for the parameters of interest, were used to evaluate whether there was at least a 96% probability that the MACE rate would be less than a maximum threshold of 25% at nine months post-procedure.

Additionally, for informational purposes, anatomic success (i.e., achievement of < 30% final residual diameter stenosis), and primary patency (continuous flow through the treated segment without revascularization at nine months post-procedure) were also evaluated.

Evaluations and definitions were adapted from standards established by the Society of Interventional Radiology (SIR), the Society for Vascular Surgery (SVS), the International Society of Cardiovascular Surgery (ISCVS), and described by the SIR Technology Assessment Committee.

To ensure impartiality, all adverse events were submitted for review by an independent Medical Monitor (i.e., a physician independent of the LUMINEXX® Clinical Study and Sponsor). All available information, either from the source documents or summarized on the case report forms was used to adjudicate an event.

B. Accountability of PMA Cohort

At 30 days post-procedure, a telephone contact was made to assess any potential adverse events since the time of the procedure. At nine months post-procedure, a clinic visit was required and the primary endpoint and secondary outcomes were assessed. The nine-month follow-up evaluation included a clinical examination, an assessment of adverse events, and a duplex ultrasound evaluation.

Results of the LUMINEXX® Clinical Study are presented in Table 11. Thirty-day follow-up compliance was 97.76% (131/134 patients). The percentage of in-office follow-up at nine months post-procedure was 82.09% (110/134 patients); three additional patients were contacted by telephone and one patient's medical chart was reviewed. Ninety-seven of 134 patients had evaluable ultrasounds that were included in the nine-month assessment interval.

C. Study Population Demographics and Baseline Parameters

Demographic and Baseline Medical History Data

The protocol allowed for a broad spectrum of patients with iliac artery occlusive disease to be treated with the LUMINEXX® Stent, including patients with poor distal runoff, concomitant or recent distal bypass surgery, and/or restenotic lesions. The intent was to test the device in a non-select population that would more closely represent the clinical population following device commercialization. Patients diagnosed with preoperative coagulation disorders, contraindications to antiplatelet

therapy, or who demonstrated the presence of soft, thrombotic, or embolic material within or adjacent to the lesion(s) being treated with the study device were excluded. Characteristics of patients enrolled in the study including age, gender, medical history, and previous vascular procedures are presented in Table 8. Males accounted for 54.48% of patients in the study. A comparison between gender and MACE demonstrated a slightly higher incidence of MACE in females than males, but the difference was not significant (Fisher's Exact Test, $p = 0.184$).

Table 8 – Baseline Medical History / Demographics		
Characteristic	Summary Statistics ²	95% Confidence Interval (CI) ³
Age (Years) ⁴	67.31 ± 10.31	65.55 to 69.07
Percent Male	54.48% (73/134)	46.04% to 62.67%
History of Myocardial Infarction (MI)	23.13% (31/134)	16.80% to 30.96%
History of Percutaneous Transluminal Coronary Angioplasty (PTCA)	40.30% (54/134)	32.38% to 48.76%
History of Coronary Artery Bypass Graft (CABG)	25.37% (34/134)	18.76% to 33.36%
History of Cardiovascular Accident (CVA) or Transient Ischemic Attack (TIA)	14.18% (19/134)	9.27% to 21.09%
History of Diabetes Mellitus	26.87% (36/134)	20.08% to 34.94%
History of Hyperlipidemia	73.68% (98/133 ⁵)	65.61% to 80.43%
History of Hypertension	89.55% (120/134)	83.23% to 93.67%
History of Peripheral Vascular Disease (PVD)/Claudication	97.76% (131/134)	93.62% to 99.24%

Baseline Vascular Status and Anatomical Data

Baseline patient assessments included a clinical examination and clinical history targeting the extent of peripheral vascular disease, a clinical category determination, and a thigh/brachial index measurement. At the time of the procedure, lesions were assessed angiographically to determine whether they fit the protocol requirements. Table 9 provides pre-treatment lesion characteristics.

² All tables: *Mean ± Standard Deviation* for all quantitative variables, *Percent (# with characteristic / sample size)*

³ All tables: the Score Interval Method was used for confidence interval percentages²⁴

⁴ Number of patients reporting = 134

⁵ One patient did not have a value recorded for History of Hyperlipidemia

Table 9 – Baseline Study Lesion Characteristics

Characteristic		Summary Statistics	95% Confidence Interval (CI)
Limb to be Treated	Left	42.54% (57/134)	34.49% to 51.00%
	Right	44.78% (60/134)	36.62% to 53.22%
	Both	12.69% (17/134)	8.07% to 19.38%
De Novo Lesion		99.36% (155/156)	96.46% to 99.89%
Angiographic Core Lab Data Combined with Site-Reported Data for Missing Core Lab Values (by Lesion)			
Minimum Lumen Diameter (MLD) (mm)		2.16 ± 1.16 (n=156)	1.97 to 2.34
Mean Reference Lumen Diameter* (RLD) (mm)		6.95 ± 1.15 (n=156)	6.77 to 7.13
Percent Stenosis		69.07% ± 14.88% (n=156)	66.71% to 71.42%
Lesion Length (mm)		25.72 ± 18.16 (n=155) ⁶	22.84 to 28.60

*Minimum RLD treated = 4.195mm, Maximum RLD treated = 9.35mm

⁶ Lesion length was not reported by the core lab or the site for one patient.

Devices Implanted

Table 10: Device Sizes Deployed	
Devices Implanted Diameter (mm) x Length (mm)	All Lesions
N (Data Available)	156
One Device Implanted	149 (95.5%)
7x30	24
7x40	6
7x60	2
7x80	4
7x100	1
8x30	17
8x40	11
8x60	4
8x80	4
8x100	1
9x30	11
9x40	11
9x60	5
9x80	1
9x100	1
10x30	19
10x40	14
10x60	8
10x80	3
10x100	2
Two Devices Implanted	7 (4.5%)
7x30, 7x30	1
7x80, 8x60	1
8x30, 8x40	1
8x40, 8x60	1
9x40, 9x60	1
10x4, 10x60	1
10x80, 10x100	1

One stent was deployed to treat 149 of the 156 total lesions (95.5%) in the study, and two stents were used to treat 7 of the 156 lesions (4.5%).

D. Safety and Effectiveness Results

Primary Effectiveness and Safety Endpoint

Using Bayesian statistical models, the study was considered a success if there was at least a 96% probability that the nine-month MACE rate was less than a maximum threshold of 25%. The model was developed on a time-to-event basis within various subintervals of the follow-up period⁷. At final analysis, the posterior probability was 99.24% that the nine-month MACE rate was less than 25%. Therefore, the LUMINEXX[®] Clinical Study successfully achieved the primary endpoint outlined in the protocol and demonstrated that the LUMINEXX[®] Stent was safe and effective for its intended use.

Table 11- The LUMINEXX[®] Clinical Study Endpoint and Secondary Outcomes

Primary Endpoint:
Posterior Probability: 99.24% that the nine-month ⁸ MACE rate was < 25% ⁹

Additional Collected Data:

- **Primary Patency:** Primary patency was defined as continuous flow through the treated segment without revascularization at nine months post-procedure (i.e., the patient did not have a revascularization procedure, amputation, or bypass surgery). The primary patency rate at nine months post-procedure was 94.03% (95% CI: 88.66% to 96.94%).
- **Stent Deployment Success:** The Stent Deployment Success rate, defined as the ability of the stent to be successfully delivered and deployed at the target lesion without device malfunction or local arterial complication, was 95.12%.
- **Anatomic Success:** Anatomic Success was defined as achievement of >30% final residual diameter stenosis measured at the narrowest point of the stented lumen. The rate of anatomic success based on core lab measurements was 87.5%, while the rate reported by the investigative sites was 98.72%.

⁷ A three-piece piece-wise exponential model was employed for the time until MACE event. The first and last months of exposure were assumed to have different risks than the middle seven months. The three parameters, λ_1 , λ_2 , and λ_3 were used within the model to characterize the efficacy of the Luminexx Iliac stent. The probability conditional on λ_1 , λ_2 , and λ_3 that a patient is free of MACE at 9 months is $\exp(-\lambda_1 - 7\lambda_2 - \lambda_3)$. Non-informative priors were used in the model.

⁸ Nine months post-procedure (defined as 240-365 days)

⁹ Using per protocol Bayesian model

Primary Patency	94.03% (88.66% to 96.94%)
Stent Deployment Success	95.12% (90.67% to 97.51%)
Anatomic Success (Core Lab)	87.50% (81.11% to 91.94%)
Anatomic Success (Site Reported)	98.72% (95.45% to 99.65%)

Observed Adverse Events

A prospective, multi-center, non-randomized clinical study was conducted at nine sites in the United States using both the Bard® LUMINEXX® Iliac Stent and the Bard® LUMINEXX® 6F Iliac Stent systems (earlier generations of the Bard® E-LUMINEXX™ Vascular Stent).

All adverse events through the nine-month follow-up window were submitted for adjudication by an independent Medical Monitor. The incidence of adverse events was presented descriptively as a percentage of events (i.e., patients could have more than one event) per the total patient population (with 95% CI). No unanticipated adverse device effects (UADE) were reported in the LUMINEXX® Clinical Study. Adverse events were summarized as serious or non-serious and attributed to the stent, procedure, or pre-existing or concomitant condition.

Seven patients died through the nine-month follow-up interval (5.2%). None of the deaths occurred within the peri-procedural (< 30 days post-index procedure) timeframe. One patient death (0.75%) was related to complications of thrombectomy of the target lesion and a subsequent chain of revascularization procedures and systemic events. The remaining deaths were the result of pre-existing and/or concomitant conditions, and were not related to the study procedure or the study device.

Table 13 provides a summary of Serious Adverse Events (SAEs) that occurred in-hospital and Table 14 provides a cumulative summary of all reported SAEs ≤ nine months post-procedure (≤ 365 days).

**Table 13 - In-Hospital Serious Adverse Events
Events per Total Patient Population**

Event	Summary Statistics	95% Confidence Interval (CI)
Distal Revascularization (Target Limb)	4.48% (6/134)	2.07% to 9.42%
Revascularization (Non-target Limb)	4.48% (6/134)	2.07% to 9.42%
Major Bleed	1.49% (2/134)	0.41% to 5.28%
Arterial Thrombosis	1.49% (2/134)	0.41% to 5.28%
False Aneurysm	1.49% (2/134)	0.41% to 5.28%
Respiratory Failure	1.49% (2/134)	0.41% to 5.28%
Amputation on Study Side Limb	0.75% (1/134)	0.13% to 4.11%
Arrhythmia	0.75% (1/134)	0.13% to 4.11%
Hypertension	0.75% (1/134)	0.13% to 4.11%
AV Fistula Stenosis	0.75% (1/134)	0.13% to 4.11%
Dissection (Target Vessel)	0.75% (1/134)	0.13% to 4.11%
Myocardial Infarction	0.75% (1/134)	0.13% to 4.11%
Cerebrovascular Disease	0.75% (1/134)	0.13% to 4.11%
Claudication/Rest Pain (Non-target limb)	0.75% (1/134)	0.13% to 4.11%
Claudication/Rest Pain (Target Limb)	0% (0/134)	0% to 2.79%
Critical Limb Ischemia	0% (0/134)	0% to 2.79%
Sepsis	0% (0/134)	0% to 2.79%
Target Lesion Revascularization	0% (0/134)	0% to 2.79%
Death	0% (0/134)	0% to 2.79%

The more prevalent SAEs observed through the nine-month follow-up interval are summarized below:

- **Target Limb Revascularization:** Target *limb* revascularization was defined as a revascularization procedure outside the margins of the treatment area (i.e., > 5mm from the proximal or distal end of the stent), but in the same limb. Target limb revascularization was noted in 15 patients (11.19%) through the nine-month follow-up. Revascularization procedures were performed to treat progression of disease or conditions that were not present or did not need treatment at baseline. None of the revascularization events were attributed to either the LUMINEXX[®] Stent or the study procedure.
- **Non-Target Limb Revascularization:** Non-target limb revascularizations were noted in 12 patients (8.96%) through the nine-month follow-up period. As with target limb revascularization, these non-target limb procedures represent a progression of the peripheral disease process.
- **Amputation:** Four amputations were reported (2.24%) through the nine-month interval. All four amputations were performed on the study-limb and were associated

with distal-disease progression. Two amputations were performed below-the-knee, one above-the-knee, and one amputation involved a toe.

- **Major Bleeding Event:** Eight patients (5.97%) experienced major bleeding events throughout the course of the study. Six of these events were unrelated to the study device or procedure. Two patients experienced major bleeding events attributed to the index procedure (1.49%) conditions.
- **Sepsis:** Six patients (eight incidences) experienced sepsis during the course of the study; five patients (3.73%) and six incidences occurred through the nine-month follow-up interval (≤ 365 days). No incidents of sepsis were attributable to either the device or the iliac stenting procedure.

**Table 14 - Cumulative Serious Adverse Events through “9 Months” (≤ 365 days)
Events per Total Patient Population**

Event	Summary Statistics	95% Confidence Interval (CI)
Distal Revascularization (Target Limb)	11.19% (15/134)	6.90% to 17.65%
Revascularization (Non-target Limb)	8.96% (12/134)	5.2% to 15.0%
Major Bleed	5.97% (8/134)	3.06% to 11.34%
Death	5.22% (7/134)	2.55% to 10.39%
Angina/Coronary Ischemia	5.22% (7/134)	2.55% to 10.39%
Sepsis/Infection	4.48% (6/134)	2.07% to 9.42%
Arterial Thrombosis	3.73% (5/134)	1.60% to 8.44%
Target Lesion Revascularization	3.73% (5/134)	1.60% to 8.44%
False Aneurysm	2.99% (4/134)	1.17% to 7.42%
Amputation on Study Side Limb	2.99% (4/134)	1.17% to 7.42%
Arrhythmia	2.99% (4/134)	1.17% to 7.42%
Stroke	2.24% (3/134)	0.76% to 6.38%
Myocardial Infarction	2.24% (3/134)	0.76% to 6.38%
Carotid Artery Disease	2.24% (3/134)	0.76% to 6.38%
Congestive Heart Failure	1.49% (2/134)	0.41% to 5.28%
Hypertension	1.49% (2/134)	0.41% to 5.28%
Renal Complications	1.49% (2/134)	0.41% to 5.28%
Respiratory Failure	1.49% (2/134)	0.41% to 5.28%
Anemia	1.49% (2/134)	0.41% to 5.28%
AV Fistula Stenosis	1.49% (2/134)	0.41% to 5.28%
Wound Infection	1.49% (2/134)	0.41% to 5.28%
Claudication/Rest Pain (Non-target limb)	1.49% (2/134)	0.41% to 5.28%
Claudication/Rest Pain (Target Limb)	0.75% (1/134)	0.13% to 4.11%
Dissection (Target Vessel)	0.75% (1/134)	0.13% to 4.11%
Critical Limb Ischemia	0.75% (1/134)	0.13% to 4.11%
Hypotension	0.75% (1/134)	0.13% to 4.11%
Aneurysm – Site Other	0.75% (1/134)	0.13% to 4.11%
Cerebrovascular Disease	0.75% (1/134)	0.13% to 4.11%
Cholelithiasis	0.75% (1/134)	0.13% to 4.11%
Colon Cancer	0.75% (1/134)	0.13% to 4.11%

**Table 14 - Cumulative Serious Adverse Events through "9 Months" (≤365 days)
Events per Total Patient Population**

Event	Summary Statistics	95% Confidence Interval (CI)
Distal Revascularization (Target Limb)	11.19% (15/134)	6.90% to 17.65%
Revascularization (Non-target Limb)	8.96% (12/134)	5.2% to 15.0%
Major Bleed	5.97% (8/134)	3.06% to 11.34%
Death	5.22% (7/134)	2.55% to 10.39%
Angina/Coronary Ischemia	5.22% (7/134)	2.55% to 10.39%
Sepsis/Infection	4.48% (6/134)	2.07% to 9.42%
Arterial Thrombosis	3.73% (5/134)	1.60% to 8.44%
Target Lesion Revascularization	3.73% (5/134)	1.60% to 8.44%
False Aneurysm	2.99% (4/134)	1.17% to 7.42%
Diabetes Mellitus	0.75% (1/134)	0.13% to 4.11%
Fever	0.75% (1/134)	0.13% to 4.11%
Hematuria	0.75% (1/134)	0.13% to 4.11%
Ischemic Colitis	0.75% (1/134)	0.13% to 4.11%
Lumbar Spinal Stenosis	0.75% (1/134)	0.13% to 4.11%
Malnutrition	0.75% (1/134)	0.13% to 4.11%
Myocardial Ischemia	0.75% (1/134)	0.13% to 4.11%
Prostatic Hypertrophy	0.75% (1/134)	0.13% to 4.11%
Shortness of Breath	0.75% (1/134)	0.13% to 4.11%
Small Bowel Obstruction	0.75% (1/134)	0.13% to 4.11%
Sudden Cardiac Death	0.75% (1/134)	0.13% to 4.11%
Urinary Retention	0.75% (1/134)	0.13% to 4.11%
Cardiovascular Disease	0.75% (1/134)	0.13% to 4.11%

Observed Device Malfunctions

Two device malfunctions were reported during the study. In one case, the investigator reported that the stent "jumped forward" during deployment. In a second case, the investigator noted that the study stent did not fully expand after deployment. An additional stent was used to successfully treat the lesion in both cases, and the patients did not experience any adverse events during the course of the study.

XI. PANEL MEETING RECOMMENDATION AND FDA'S POST-PANEL ACTIONS

In accordance with the provisions of section 515(c)(2) of the act as amended by the Safe Medical Devices Act of 1990, this PMA was not referred to the Circulatory System Devices Panel, an FDA advisory committee, for review and recommendation because the information in the PMA substantially duplicates information previously reviewed by this panel.

XII. CONCLUSIONS DRAWN FROM PRECLINICAL AND CLINICAL STUDIES

A. Safety and Effectiveness Conclusion

Results of all bench tests and other non-clinical studies support the safety and effectiveness of the Bard® E-LUMINEXX™ Vascular Stent.

The U.S. multi-center study of the LUMINEXX® Stent achieved its primary safety and effectiveness endpoint. The posterior probability was 99.24% that the MACE rate was less than 25% at nine months post-procedure. This probability along with observed rates for other clinical outcomes demonstrated that the LUMINEXX® Stent is safe and effective for use in the treatment of iliac artery occlusive disease.

Combining the data from the U.S. multi-center study with the non-clinical data provides reasonable assurance of the safety and effectiveness of the Bard® E-LUMINEXX™ Vascular Stent when used in accordance with the Indications for Use.

XIII. CDRH DECISION

CDRH issued an approval order on December 4, 2008. The final conditions of approval cited in the approval order are described below.

The applicant's manufacturing facilities were inspected and found to be in compliance with the device Quality System (QS) regulation (21 CFR 820).

XIV. APPROVAL SPECIFICATIONS

Directions for Use: See device labeling.

Hazards to Health from Use of the Device: See Indications, Contraindications, Warnings, Precautions, and Adverse Events in the device labeling.

Post-approval Requirements and Restrictions: See approval order.