March 23, 2022

Bone Solutions, Inc.
% Kevin Thomas, PhD
Vice President and Director of Regulatory Affairs
PaxMed International, LLC
12264 EL Camino Real, Suite 400
San Diego, California 92130

Re: K212991
Trade/Device Name: OSTEOREVIVE™
Regulation Number: 21 CFR 888.3045
Regulation Name: Resorbable calcium salt bone void filler device
Regulatory Class: Class II
Product Code: MQV, OIS

Dear Kevin Thomas:

The Food and Drug Administration (FDA) is sending this letter to notify you of an administrative change related to your previous substantial equivalence (SE) determination letter dated January 21, 2022. Specifically, FDA is updating this SE Letter to include all relevant product codes on the SE letter - as an administrative correction.

Please note that the 510(k) submission was not re-reviewed. For questions regarding this letter please contact Laura Rose, Ph.D., OHT6: Office of Orthopedic Devices, by phone at (301) 348-1947 or email at Laura.Rose@fda.hhs.gov.

Sincerely,

Laura C. Rose -S

Laura C. Rose, Ph.D.
Assistant Director
DHT6C: Division of Restorative, Repair and Trauma Devices
OHT6: Office of Orthopedic Devices
Office of Product Evaluation and Quality
Center for Devices and Radiological Health

January 21, 2022

Bone Solutions, Inc.
% Kevin Thomas, Ph.D.
Vice President and Director of Regulatory Affairs
PaxMed International, LLC
12264 El Camino Real, Suite 400
San Diego, California 92130

Re: K212991
Trade/Device Name: OSTEOREVIVE™
Regulation Number: 21 CFR 888.3045
Regulation Name: Resorbable Calcium Salt Bone Void Filler Device
Regulatory Class: Class II
Product Code: MQV
Dated: December 21, 2021
Received: December 22, 2021

Dear Kevin Thomas:

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

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

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part

801); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803) for devices or postmarketing safety reporting (21 CFR 4, Subpart B) for combination products (see https://www.fda.gov/combination-products/guidance-regulatory-information/postmarketing-safety-reporting-combination-products); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR Part 820) for devices or current good manufacturing practices (21 CFR 4, Subpart A) for combination products; and, if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

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

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

Sincerely,

Pooja Panigrahi -S

for

Laura C. Rose, Ph.D.
Assistant Director
DHT6C: Division of Restorative, Repair
and Trauma Devices
OHT6: Office of Orthopedic Devices
Office of Product Evaluation and Quality
Center for Devices and Radiological Health

Enclosure

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Food and Drug Administration

Indications for Use

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

510(k) Number *(if known)*
K212991

Device Name

OSTEOREVIVE™

Indications for Use *(Describe)*

OSTEOREVIVE™ is intended for bony voids or defects of the extremities, posterolateral spine, and pelvis that are not intrinsic to the stability of the bony structure. These defects may be surgically created osseous defects or osseous defects created by traumatic injury to the bone. OSTEOREVIVE™ can be used as an adjunct to conventional rigid hardware fixation by supporting the bone fragments during the surgical procedure only in the extremities and pelvis. Once the material has set, it acts as a temporary support medium and is not intended to provide structural support during the healing process. OSTEOREVIVE™ is intended to be placed into bony voids either before or after final fixation. OSTEOREVIVE™ is resorbed and replaced with bone during the healing process. OSTEOREVIVE™ must be used with morselized autograft bone at a ratio of 1:1 by volume in the posterolateral spine. OSTEOREVIVE™ is not intended to treat large defects that in the surgeon's opinion would fail to heal spontaneously.

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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PRAStaff@fda.hhs.gov

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510(k) Summary
K212991
OSTEOREVIVE™
Bone Solutions, Inc.

January 21, 2022

ADMINISTRATIVE INFORMATION

Manufacturer Name	Bone Solutions, Inc. 5712 Colleyville Boulevard, Suite 210 Colleyville, Texas 76034 Telephone +1 817-809-8850
Official Contact	Drew Diaz, CEO
Representative/Consultant	Kevin A. Thomas, PhD Floyd G. Larson, MS, MBA PaxMed International, LLC 12264 El Camino Real, Suite 400 San Diego, CA 92130 Telephone +1 858-792-1235 Fax +1 858-792-1236 Email kthomas@paxmed.com flarson@paxmed.com

DEVICE NAME AND CLASSIFICATION

Trade/Device Name	OSTEOREVIVE™
Common Name	Filler, bone void, calcium compound
Regulation Number	21 CFR 888.3045
Regulation Name	Resorbable calcium salt bone void filler device
Regulatory Class	Class II
Product Code	MQV
Classification Panel	Orthopedic
Reviewing Office	Office of Health Technology 6 (Orthopedic Devices)
Reviewing Division	Division of Health Technology 6 C (Restorative, Repair and Trauma Devices)

PREDICATE DEVICE INFORMATION

Primary Predicate Device
K071004, OsteoCrete™ Bone Void Filler, Bone Solutions, Inc.

Additional Predicate Devices
K140375, MASTERGRAFT® Strip; MASTERGRAFT® Putty, Medtronic Sofamor Danek USA, Inc.
K173362, DSM Biomedical Calcium Phosphate Cement, Kensey Nash Corporation dba DSM Biomedical

INDICATIONS FOR USE STATEMENT

OSTEOREVIVE™ is intended for bony voids or defects of the extremities, posterolateral spine, and pelvis that are not intrinsic to the stability of the bony structure. These defects may be surgically created osseous defects or osseous defects created by traumatic injury to the bone. OSTEOREVIVE™ can be used as an adjunct to conventional rigid hardware fixation by supporting the bone fragments during the surgical procedure only in the extremities and pelvis. Once the material has set, it acts as a temporary support medium and is not intended to provide structural support during the healing process. OSTEOREVIVE™ is intended to be placed into bony voids either before or after final fixation. OSTEOREVIVE™ is resorbed and replaced with bone during the healing process. OSTEOREVIVE™ must be used with morselized autograft bone at a ratio of 1:1 by volume in the posterolateral spine. OSTEOREVIVE™ is not intended to treat large defects that in the surgeon's opinion would fail to heal spontaneously.

SUBJECT DEVICE DESCRIPTION

OSTEOREVIVE™ is a magnesium-based synthetic bone void filler that is drillable, resorbable, radiopaque, and osteoconductive. OSTEOREVIVE™ consists of a powder component and a liquid component (modified saline solution) that are mixed at the time of surgery. The powder components include β-tricalcium phosphate, magnesium oxide, monopotassium phosphate, and monosodium phosphate. The mixing liquid is saline with monosodium phosphate. After mixing and setting OSTEOREVIVE™ is a non-porous solid material. OSTEOREVIVE™ is provided sterile to the end user in 5 cc, 10 cc, and 15 cc sizes.

PERFORMANCE DATA

Non-clinical testing data were submitted according to the guidance documents *Guidance for Industry and FDA Staff - Class II Special Controls Guidance Document: Resorbable Calcium Salt Bone Void Filler Device* (issued June 2003) and *Submission and Review of Sterility Information in Premarket Notification (510(k)) Submissions for Devices Labeled as Sterile* (issued January 2016). The non-clinical testing data submitted, referenced from K071004, or relied upon to demonstrate substantial equivalence included: chemical composition, physical properties, sterilization, sterile barrier shelf life, product shelf life, and biocompatibility.

Bacterial endotoxin testing has been performed to ensure the device meets pyrogen limit specifications. The *Limulus* amebocyte lysate (LAL) test, kinetic turbidimetric method, was performed according to USP *<85> Bacterial Endotoxins Test*. The LAL testing met the limit acceptance criterion of ≤ 20 EU/device, based upon the recommendations for implanted devices in the FDA guidance document *Submission and Review of Sterility Information in Premarket Notification (510(k)) Submissions for Devices Labeled as Sterile*, issued January 21, 2016 (Section V, A, 4).

Performance testing data also were submitted to demonstrate that the subject device is drillable, and may be used as an adjunct to conventional rigid hardware during the surgical procedure (only when used in the extremities and pelvis).

Animal testing was performed in a rabbit posterolateral spine fusion model to demonstrate substantial equivalence to the additional predicate device K140375. Animals were evaluated after implantation with the subject device, the additional predicate device K140375, and autograft (positive control). The study

time points included baseline (time 0), 6 weeks, 9 weeks, and 12 weeks; subject device animals also were evaluated at 2 hours, 3 days, and 7 days. Evaluation endpoints included radiography, manual palpation, range of motion/flexibility testing, micro-computed tomography (micro-CT) imaging, undecalcified histologic evaluation, and histomorphometric analysis. Histology sections also were graded according to ISO 10993-6 (Annex E).

No clinical data were included in this submission.

EQUIVALENCE TO MARKETED DEVICES

The subject device is substantially equivalent in indications and design principles to the primary predicate device and the additional predicate devices listed above. Provided at the end of this summary is a table comparing the Indications for Use Statements and the technological characteristics of the subject device, the primary predicate device, and the additional predicate devices.

The primary predicate device is K071004, for the identical formulation, packaging, and sterilization as the subject device. The subject device differs from K071004 only in terms of the additional indications for use in the posterolateral spine and the claims regarding drillable properties.

The predicate device is K140375 for support of substantial equivalence in the posterolateral spine animal model performance testing. The predicate device K173362 for support of substantial equivalence in terms of the indications for use associated with the additional product code OIS.

The subject device, the primary predicate device K071004, and the additional predicate devices K140375 and K173362 have the same intended use, the same product classification and product code (MQV), and have similar Indications for Use statements. The subject device, the primary predicate device, and the additional predicate devices are indicated for use as bone void fillers in the extremities and pelvis. The subject device and the predicate device K140375 are indicated for use with autograft bone (as a bone graft extender) in the posterolateral spine; K140375 also is indicated for stand-alone use in the posterolateral spine. Although the subject device, the primary predicate device, and the additional predicate devices have slightly different Indications for Use language, these differences in language do not change the intended use as a bone void filler.

The subject device, the primary predicate device, and the additional predicate devices all incorporate calcium phosphate materials that are mixed to form a solid after setting (subject device and primary predicate device) or are within a polymeric binder or scaffold (additional predicate devices). The subject device and primary predicate device have identical materials, formulation and processing; the subject device is mixed to form a non-porous solid after setting.

The radiographic, histologic, and histomorphometric performance of the subject device was compared to that of the primary predicate device K140375 in a rabbit posterolateral fusion model. The results of the study demonstrated the performance of the subject device was equivalent to that of the predicate device K140375 in the posterolateral spine. Performance testing provided demonstrated the subject device to be substantially equivalent to the additional predicate K173362 in terms of the indications associated with the additional product code OIS.

Differences among the subject device, the primary predicate device, and the additional predicate devices include the exact indications for use in the posterolateral spine (mixed with autograft or used alone), the

calcium phosphate and other mineral components, and the scaffold or binder material (bovine collagen in the additional predicate devices K140375 and K173362).

The subject device and the predicate devices are all provided in comparable volumes, sterilized by irradiation, and are for single-patient, single-use.

The similarities described, combined with the animal performance testing, support substantial equivalence of the subject device. The minor differences among the subject device, the primary predicate device, and the additional predicate devices do not raise new issues of safety or effectiveness, and therefore, do not impact substantial equivalence.

CONCLUSION

The subject device, the primary predicate device, and the additional predicate devices have the same intended use, have similar technological characteristics, and are made of similar materials. The subject device, the primary predicate, and the additional predicate devices encompass the same range of physical dimensions, are packaged in similar materials and are sterilized using similar methods. The data included in this submission demonstrate substantial equivalence to the predicate device and the additional predicate devices listed above.

Table of Substantial Equivalence

Comparison	Subject Device	Primary Predicate Device	Predicate Device	Predicate Device
	K212991 OSTEOREVIVE™ Bone Solutions Inc.	K071004 OsteoCrete™ Bone Void Filler Bone Solutions Inc.	K140375 MASTERGRAFT® Strip; MASTERGRAFT® Putty Medtronic Sofamor Danek USA, Inc.	K173362 DSM Biomedical Calcium Phosphate Cement Kensey Nash Corporation dba DSM Biomedical
Indications for Use Statement	OSTEOREVIVE™ is intended for bony voids or defects of the extremities, posterolateral spine, and pelvis that are not intrinsic to the stability of the bony structure. These defects may be surgically created osseous defects or osseous defects created by traumatic injury to the bone. OSTEOREVIVE™ can be used as an adjunct to conventional rigid hardware fixation by supporting the bone fragments during the surgical procedure. Once the material has set, it acts as a temporary support medium and is not intended to provide structural support during the healing process. OSTEOREVIVE™ is intended to be placed into bony voids either before or after final fixation. OSTEOREVIVE™ is resorbed and replaced with bone during the healing process. OSTEOREVIVE™ must be used with morselized autograft bone at a ratio of 1:1 by volume in the posterolateral spine. OSTEOREVIVE™ is not intended to treat large defects that in the surgeon's opinion would fail to heal spontaneously.	Bone Solutions, Inc., OsteoCrete™ Bone Void Filler is intended only for bony voids or defects that are not intrinsic to the stability of the bony structure. Bone Solutions, Inc., OsteoCrete™ Bone Void Filler is intended to be placed or injected into bony voids or gaps of the skeletal system (the long bone and pelvis). These defects may be surgically created osseous defects or osseous defects created from traumatic injury to the bone. The product provides a bone void filler that resorbs and is replaced with bone during the healing process. OsteoCrete™ Bone Void Filler is not intended to treat large defects that in the surgeon's opinion would fail to heal spontaneously.	MASTERGRAFT® Putty combined with either autogenous bone marrow, and/or sterile water, and/or autograft is indicated as a bone void filler for bony voids or gaps that are not intrinsic to the stability of the bony structure. Additionally, MASTERGRAFT® Putty can be used with autograft as a bone graft extender. MASTERGRAFT® Putty is to be gently packed into bony voids or gaps of the skeletal system (e.g., the posterolateral spine, pelvis, ilium, and/or extremities). These defects may be surgically created osseous defects or osseous defects created from traumatic injury to the bone. MASTERGRAFT® Putty resorbs and is replaced with bone during the healing process.	DSM Biomedical Calcium Phosphate Cement is indicated to fill bony voids or gaps of the skeletal system (i.e. extremities and pelvis) . These defects may be surgically created or osseous defects created from traumatic injury to the bone. The DSM Biomedical Calcium Phosphate Cement is indicated only for bony voids or gaps that are not intrinsic to the stability of the bony structure. The DSM Biomedical Calcium Phosphate Cement cured in situ provides an open void/ gap filler that can augment provisional hardware (e.g. K-Wires, plates, screws) to help support bone fragments during the surgical procedure. The cured cement acts only as a temporary support media and is not intended to provide structural support during the healing process. The Calcium Phosphate Cement resorbs and is replaced by bone during the healing process.
Reason for Predicate/Reference Device	*Not applicable – Subject Device*	Identical to the subject device in materials, formulation, and manufacturing	Performance in animal model in the posterolateral spine (as bone graft extender with autograft)	Reference device for OIS product code and indications
Product Code	MQV	MQV	MQV	MQV, OIS
Intended Use	Bone void filler for skeletal system (extremities, pelvis, and posterolateral spine)	Bone void filler for skeletal system (extremities, pelvis)	Bone void filler for skeletal system (Extremities, pelvis, and posterolateral spine)	Bone void filler for skeletal system (extremities, pelvis)
Design				
Form	Powder and liquid components; after mixing device is injectable and sets in the surgical site	Same as subject device	Granules uniformly dispersed in collagen scaffold	Powder component; after mixing device is injectable and sets in the surgical site
Granule Size	Not applicable, non-porous solid after mixing and setting	Same as subject device	0.5 mm – 1.6 mm in diameter	*Not in 510(k) Summary*
Porosity	Not applicable, non-porous solid after mixing and setting	Same as subject device	Granules – 80 % Final device – not stated in 510(k) Summary	*Not in 510(k) Summary*
Materials				
Mineral component Calcium/other salts	β-tricalcium phosphate Magnesium oxide Monopotassium phosphate Monosodium phosphate	Same as subject device	β-tricalcium phosphate Hydroxyapatite	Calcium phosphate that converts to hydroxyapatite *in vivo*
Scaffold/Binder	None	Same as subject device	Type I bovine collagen	Powdered bovine collagen
For Use in Extremities and Pelvis	Yes	Yes	Yes	Yes
Mix with bone prior to use	No Not indicated for mixing with autograft in extremities or pelvis	No Not indicated for mixing with autograft in extremities or pelvis	Autograft bone (optional)	*Not in 510(k) Summary*
For Use in Posterolateral Spine	Yes	No	Yes	No
Mix with bone prior to use	Yes Required to mix with autograft 1:1 by volume for use in the posterolateral spine	*Not applicable*	Autograft bone (optional)	*Not applicable*
How Provided				
Sizes	Kits of powder and mixing liquid components for volumes of: 5 cc, 10 cc, and 15 cc	Kits of powder and mixing liquid components for volumes of: 5 cc, 10 cc, and 15 cc	MASTERGRAFT® Putty Various volumes: 0.75 cc, 1.5 cc, 3.0 cc, 6.0 cc, and 9.0 cc packages	Powder packaged with a mixing and delivery syringe and accessories; *Sizes not in 510(k) Summary*
Sterility	Provided sterile to end user	Provided sterile to end user	Provided sterile to end user	Provided sterile to end user
Sterilization	Gamma irradiation	Gamma irradiation	Irradiation	Gamma irradiation
Usage	Single-patient, single-use	Single-patient, single-use	Single-patient, single-use	Single-patient, single-use