Welcome to Synovetin OA Regulatory Starter Packet

This packet should be provided to any licensee newly administering or preparing to administer Synovetin OA.

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Note that all of the above are available in the veterinary nuclear medicine training section of the website www.fxmasse.com.

Synovetin OA®

[Homogeneous Tin (^{117m}Sn) Colloid]
Veterinary Device for Use in Dogs

NAME: Synovetin OA®
Tin (^{117m}Sn) stannic colloid in ammonium salt. It is supplied as a 2–4 mCi (74–148 MBq)/mL suspension for intra-articular (IA) injection.

NET QUANTITY
Vials contain a prescribed dose up to 6.0 mCi (222 MBq) at the date and time to treat one dog.

1 mL of suspension contains 2–4 mCi (74–148 MBq) of tin (^{117m}Sn) stannic colloid in ammonium salt at the date and time of end use.

PRODUCT DESCRIPTION
Synovetin OA® is a conversion electron therapeutic veterinary device comprising a colloidal, sterile suspension with a pH between 6.5 and 9.0 where at least 90% of the particles have a size between 1.5 µm and 20 µm (HORIBA light scatter instrument). The ^{117m}Sn emits monoenergetic conversion electrons (significant energies 127–158 keV; emission probability 113%) and imageable gamma radiation (159 keV, 86% abundant). Accompanying low-energy emissions are Auger electrons (<22 keV) and X-rays (<30 keV). The half-life of ^{117m}Sn is 14 days. ^{117m}Sn decays by isomeric transition to stable ^{117}Sn.

Excipients include ammonium carbonate ($(NH_4)_2CO_3$), ammonium chloride (NH_4Cl), ammonium iodide (NH_4I), and trace tin (Sn) salts.

MECHANISM OF ACTION
Synovetin OA® is a veterinary device consisting of a homogeneous tin colloid which emits discrete (<300 µm) low-energy conversion electrons confined to the joint space. The colloid is composed of microparticles (1.5 µm to 20 µm) that are retained in the joint space of the dog. The particles are absorbed and retained by synoviocytes and macrophages in the synovium, resulting in apoptosis and reduction of inflammatory cells. Elimination of the pro-inflammatory cells reduces inflammation of the joint synovium, thereby reducing pain associated with synovitis. The data, including radiographic evidence, supports use in Grade 1, 2, and 3 osteoarthritis (OA) of the elbow joint.

CAUTION
Federal law restricts this device to sale by or on the order of a licensed veterinarian trained in the use of radioactive veterinary medical products.

Use of this product is restricted to facilities with a compatible Radioactive Materials (RAM) license.

INTENDED USE
Synovetin OA® is intended to reduce synovitis and associated pain of canine elbow joints afflicted with osteoarthritis.

WARNINGS
Do not exceed 6.0 mCi (222 MBq) of radiation activity per dog per treatment. Not for use in humans. Keep this and all medications out of reach of children. Consult a physician in case of accidental injection or ingestion by humans.

PRECAUTIONS
Injection should be performed only by a licensed veterinarian skilled in the delivery of intra-articular (IA) injections who is located at a facility that has a RAM license.

Rigorous aseptic technique must be ensured during injection.

DIRECTIONS FOR USE
Use the chart below to determine the appropriate dose. Doses were determined using the elbow joint.

For example, a dog weighing 25 lbs. receives an IA dose of 0.9 mCi in each elbow to be treated.

Dog Weight (lbs.)	Synovetin OA® Dose per Elbow Joint (mCi)*
10–19 lbs.	0.6
20–29 lbs.	0.9
30–39 lbs.	1.2
40–49 lbs.	1.5
50–59 lbs.	1.7
60–69 lbs.	1.9
70–79 lbs.	2.2
80–89 lbs.	2.4
90–99 lbs.	2.6
100–109 lbs.	2.8
110 lbs. and over	3.0

***Dose will be limited to 3.0 mCi/elbow joint when weight exceeds 110 lbs., with the total body dose not exceeding 6.0 mCi (i.e., two elbow joints in 110-lb. or greater-sized dogs).**

PREPARATION FOR USE
Synovetin OA® is provided in a 3 mL glass vial within a lead cylinder. Each vial is for use with a single dog.

The product should be stored in the cardboard shipping container until needed for use. The **prescribed dose** should be **administered on the date noted** on the certificate accompanying the Synovetin OA®; however, it can be administered the day before or after if circumstances require injection on a different day. Always use proper personal protection equipment and precautions for handling radioactive medical products, including nitrile gloves, splash shield, safety goggles, back-fastening gowns, head covers, booties, and surgical masks.

STEP 1: When ready to withdraw the dose into a syringe and prior to removing the shrink wrap around the lead cylinder, gently **shake the lead cylinder for approximately 10 seconds to ensure proper mixing** of the product.

STEP 2: Remove the shrink wrap from the lead cylinder and dispose of it appropriately.

STEP 3: Remove the lead cylinder lid, but do not remove the glass vial from the lead cylinder.

STEP 4: Remove the colored flip cap from the vial and retain for placement on the vial after the dose is withdrawn.

STEP 5: Attach a plastic syringe (3 mL or other appropriate volume) to a 22-ga. needle. Where practical, use a syringe shield to maintain operator radiation doses as low as reasonably achievable and to meet existing license conditions.

STEP 6: While holding the container at an approximate 45° angle, insert the needle through the septum.

STEP 7: **Draw the prescribed volume into the syringe** for an individual elbow. **Under no circumstances should the volume be modified.** Repeat immediately for the second elbow dose. If both elbows are to be treated, both doses will be contained in a single vial. If there are any questions or concerns, contact Exubrion Therapeutics® Customer Service at 833-942-1247.

STEP 8: The dose should be resuspended by gently inverting the syringe if more than 10 minutes has elapsed since dose was drawn into the syringe.

STEP 9: Following use of Synovetin OA®, replace the colored flip cap on the vial, then place the lid on the lead container and secure the lid with tape. Mark the vial with a tentative disposal date 5 months from the present date. After 5 months, the vial should be measured with a handheld rate meter (GM detector) to verify that radioactivity has decayed. If the vial is less than or equivalent to background radiation, it can then be disposed of as regular trash. All waste disposals should be documented according to your radioactive materials license and federal or state regulations. Do not return the vial, any packaging components, or supplies to the manufacturer.

The shielded syringe or syringes and needles that are used for administration should be placed in shielded sharps containers for radionuclides of similar half-lives (two weeks) and disposed of according to local, state, and federal regulations.

ROUTE OF ADMINISTRATION

Intra-articular injection. The product must NOT be administered by any other route. Confirmation of needle placement is recommended, whether by anatomical landmarks, fluoroscope, C-arm, ultrasound, or radiography.

DIRECTIONS FOR ADMINISTRATION

Dogs should be appropriately anesthetized or sedated prior to administration. With the canine elbow positioned at 45 degrees of flexion, inject Synovetin OA® through a 22-ga. needle into the joint. This can be done between the lateral condyle of the humerus and the triceps tendon, but other approaches to the joint can be used. Following injection, gently flex and extend the treated joint through a range of motion to disperse the colloid throughout the joint compartments.

FREQUENCY OF ADMINISTRATION

If needed, Synovetin OA® can be readministered to a previously treated elbow at least 12 months after the last treatment.

DURATION OF EFFECT FROM ADMINISTRATION

Effectiveness has been shown to last up to 12 months following a single treatment of dogs with naturally occurring OA of the elbow.

MAXIMUM ANNUAL DOSE

Total radiation dose per joint should not exceed 3.0 mCi/joint, with the total body dose not exceeding 6.0 mCi (i.e., two elbow joints during a 12-month period).

ADVERSE REACTIONS

Dogs participating in clinical studies to evaluate safety and effectiveness (n=74 dogs, 97 elbow joints) exhibited no significant adverse reactions when administered Synovetin OA®. If adverse events are observed or suspected, please report them by calling Exubrion Therapeutics® Customer Service at 833-942-1247.

POST-INJECTION CARE

Following administration of Synovetin OA®, the dog can recover with other post-operation animals in the general clinic population. Once the dog has fully recovered, it can be discharged to go home with the approval of the facility radiation safety officer or authorized user. All treatment site policies and license requirements should be observed.

FACILITY CONTAMINATION ASSESSMENT

Removable radioactive contamination is assessed by using filter paper to wipe a known area (typically 100 cm^2), then count the number of interactions on the filter paper using a radiation detector with a known efficiency for counting the specific isotope in question. Empirical data using a Ludlum model 3 rate meter and 44-9 GM probe show the efficiency for ^{117m}Sn detection to be approximately 20% under 2D geometry. With a background rate of 100 counts per minute (cpm), this radiation detection system has a minimum detectable activity (MDA) of approximately 400 disintegrations per minute (dpm). The standard regulatory threshold for removable contamination in an unrestricted area is 2000 dpm for similar isotopes. Therefore, a Ludlum rate meter and GM is an adequate instrument to use for compliance measurements of removable contamination.

Note, ^{117m}Sn has a similar gamma emission as the commonly used medical radioisotope ^{99m}Tc along with several low-energy conversion electron emissions which would only aid in the detection efficiency of contamination.

EXPOSURE RATE MEASUREMENTS

Radioactive materials licenses require daily closeout surveys of all areas where unsealed radioactive material was used. These surveys can be completed with any rate meter capable of detecting the type of radiation emitted by the radioactivity. Further, license conditions require that release exposure rate measurements be completed prior to releasing animals who have been administered radioactivity. Most license conditions require the measurement taken not exceed 0.5 mR/h at 1 meter from the treatment site. The exposure rate release measurement and daily closeout surveys can be completed with either a standard volume ion chamber such as the Ludlum 9DP or Victoreen 451P, a Ludlum Model 3 rate meter and energy compensated GM probe 44-38, or a Ludlum 26-1 DOSE with energy flattening cover. While the ion chamber is the gold standard for exposure rate measurements, the Ludlum model 26-1 DOSE is the most practical because it can satisfy both contamination and exposure rate measurements (with dose flattening cover).

OWNER INSTRUCTIONS FOR POST-TREATMENT CARE

When the level of radiation is determined to be below the established levels for release, the dog can be discharged. The dog will, however, retain a low level of radioactivity in the treated joint(s) for a short period of time. There is no requirement for rehabilitation or restraint of the dog, and it can resume its normal level of activity. Specific written instructions based on the post-treatment radiation dosimetry for care and proximity to the treated dog will be provided by the radiation safety officer (RSO) or authorized user (AU) of a radioactive materials (RAM)-licensed veterinary hospital to the dog owner. A RAM-licensed veterinary hospital RSO or AU should contact Exubrion Therapeutics® if there are specific questions.

MANUFACTURED BY Theragenics Corporation for Exubrion Therapeutics®

Manufacturer's contact information:
Theragenics Corporation
5203 Bristol Industrial Way
Buford, GA 30518
Customer Service Phone: 833-942-1247
info@exubrion.com

STORAGE INSTRUCTIONS

Store in the shipping container at controlled room temperature (10°–30°C or 50°–86°F) until ready to use.

EXUBRION®
THERAPEUTICS

SAFETY DATA SHEET

Sn-117m Colloid

FILE NO.:SDS Exu001, v.1
SDS DATE: 3/19/2020

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Sn-117m Colloid
SYNONYMS: Synovetin OA™
PRODUCT CODES: N/A

MANUFACTURER: Exubrion Therapeutics, Inc.
DIVISION:
ADDRESS: 5203 Bristol Industrial Way, Buford, GA 30518

EMERGENCY PHONE: 877-444-7333
CHEMTREC PHONE:
OTHER CALLS:
FAX PHONE:

CHEMICAL NAME: Hydrated tin(IV) oxide, Sn-117m enriched
CHEMICAL FAMILY:
CHEMICAL FORMULA: $SnO_2 \bullet XH_2O$

PRODUCT USE: Radiotherapeutic device
PREPARED BY: IsoTherapeutics Group, LLC, 1004 S. Velasco St., Angleton, TX 77515 or Theragenics Corporation, 5203 Bristol Industrial Way, Buford, GA 30518
SECTION 1 NOTES:

SECTION 2: COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT:

CAS NO.	% WT	% VOL	SARA 313 REPORTABLE
7732-18-5 (Water)	92-94		No
7790-47-8 (SnI_4)	0.4-0.8		No
57-13-6 (Urea)	2.5-3.0		No
7647-01-0 (HCl)	3.3-3.8		No
	ppm	mg/m3	

OSHA PEL-TWA: no data available
OSHA PEL STEL : no data available
OSHA PEL CEILING: no data available

ACGIH TLV-TWA: no data available
ACGIH TLV STEL: no data available
ACGIH TLV CEILING: no data available

SECTION 2 NOTES:
Urea and SnI_4 are consumed in the process. The product mixture contains hydrated tin(IV) oxide (α-stannic acid), Sn-117m enriched and various ammonium salts (chloride, iodide, and bicarbonate).

SECTION 3: HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: RADIOACTIVE MATERIAL. Promptly remove any contamination from the skin, eyes, or clothing. Radioactive drugs must be handled by qualified personnel in conformity with regulations appropriate to the government agency authorized to license the use of this radionuclide. The vial containing the drug should be kept within its container or within heavier shielding. Avoid contact with the radioactive contents which would cause unnecessary exposure to radiation.

ROUTES OF ENTRY: Absorption (skin and eyes); ingestion; inhalation; injection

POTENTIAL HEALTH EFFECTS

EYES: irritant; some radiation damage is possible

SKIN: irritant; some radiation damage is possible

INGESTION: slightly hazardous; GI injury due to radiation is possible

INHALATION: toxic to mucous membranes. In the unlikely event that the substance is inhaled, damage to airways due to radiation is also possible

INJECTION: subcutaneous injection will likely cause irritation, some possible radiation damage at the site of injection; intravenous injection

ACUTE HEALTH HAZARDS: Hazardous in case of inhalation. Radiation effects dependent on the amount of radioactive Sn-117m present.
CHRONIC HEALTH HAZARDS: The health risks associated with chronic radiation exposure (cancer, leukemia, etc.) are dependent on accumulated dose.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: no data available

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CARCINOGENICITY
OSHA: ACGIH: NTP: IARC:
OTHER:

SECTION 3 NOTES:

SECTION 4: FIRST AID MEASURES

EYES: If a splash occurs, wash eyes with water for at least 15 minutes or until no more radioactivity can be removed. Notify radiation safety personnel.

SKIN: If skin contact occurs, wash the affected area thoroughly with soap and water until no more radioactivity can be removed. Always blot dry. Do not abrade skin. Notify radiation safety personnel.

INGESTION: Notify radiation safety personnel immediately. The amount ofSn-117m ingested should be assessed and documented. Consult a physician for proper therapy.

INHALATION: Notify radiation safety personnel immediately. The amount of material inhaled should be assessed and documented.

INJECTION (inadvertent): Notify radiation safety personnel immediately. The amount ofSn-117m injected should be assessed and documented. Consult a physician for proper therapy.

NOTES TO PHYSICIANS OR FIRST AID PROVIDERS: Wear proper protective equipment to avoid contact with the product.

SECTION 4 NOTES:

SECTION 5: FIRE-FIGHTING MEASURES

FLAMMABLE LIMITS IN AIR, UPPER: not determined
(% BY VOLUME) LOWER: not determined

FLASH POINT: not determined. Not considered a fire or explosion hazard.
F:
C:
METHOD USED:

AUTOIGNITION TEMPERATURE: not determined
F:
C:

NFPA HAZARD CLASSIFICATION
HEALTH: FLAMMABILITY: REACTIVITY:
OTHER:

HMIS HAZARD CLASSIFICATION
HEALTH: FLAMMABILITY: REACTIVITY:
PROTECTION:

EXTINGUISHING MEDIA: Use any means suitable for extinguishing surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Not considered a fire or explosion hazard.

HAZARDOUS DECOMPOSITION PRODUCTS: Sn-117m-containing particles

SECTION 5 NOTES:

SECTION 6: ACCIDENTAL RELEASE MEASURES

ACCIDENTAL RELEASE MEASURES: If the product is received in a leaking condition or any loss or release of the radioactive contents occurs, notify your Radiation Safety Department and IsoTherapeutics Group 979-848-0800. All cleanup operations should be performed according to the Standard Operating Procedures (SOPs) established for your facility and by the NRC or other applicable local, state or federal regulations.

SECTION 6 NOTES:

SECTION 7: HANDLING AND STORAGE

HANDLING AND STORAGE: Store at 15°C to 30°C. Handling time should be kept to a minimum and appropriate shielding should be used. Handling devices such as syringe shields and tongs should be used. Storage and disposal of product should be controlled in a manner which is in compliance with the appropriate regulations of the federal or state government agency authorized to license the use of this radionuclide (Sn-117m).

OTHER PRECAUTIONS:

SECTION 7 NOTES:

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: shields and shielded containers appropriate for low-energy gamma emissions

VENTILATION : Properly sealed containers are not expected to require any special ventilation.

RESPIRATORY PROTECTION: Not expected to require personal respirator usage.

EYE PROTECTION:safety glasses or goggles

SKIN PROTECTION: Disposable plastic, latex, or rubber gloves; labcoat.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT: (see ENGINEERING CONTROLS)

WORK HYGIENIC PRACTICES: No smoking, eating, or drinking should be allowed in any area where radioactive materials are handled or stored. Dispose of radioactively contaminated clothing and PPE according to regulatory requirements.

EXPOSURE GUIDELINES: no data available

SECTION 8 NOTES:

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: cream/yellow/pale orange suspension

ODOR: none

PHYSICAL STATE: solid/liquid suspension

pH AS SUPPLIED: 6.5-9.0
pH (Other):
BOILING POINT: not determined
F:
C:
MELTING POINT: not determined
F:
C:

FREEZING POINT: not determined
F:
C:
VAPOR PRESSURE (mmHg): not determined
@
F:
C:
VAPOR DENSITY (AIR = 1): not determined
@
F:
C:
SPECIFIC GRAVITY (H2O = 1): not determined
@
F:
C:
EVAPORATION RATE: not determined

BASIS (=1):

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES (con't)

SOLUBILITY IN WATER: The solids are insoluble. The vehicle is aqueous (miscible with water.)

PERCENT SOLIDS BY WEIGHT: ~0.5

PERCENT VOLATILE: 0
BY WT/ BY VOL @
F:
C:
VOLATILE ORGANIC COMPOUNDS (VOC):

WITH WATER: 0 LBS/GAL
WITHOUT WATER: 0 LBS/GAL

MOLECULAR WEIGHT: Amount of hydration variable. Molecular weight of anhydrous SnO_2 = 150.7
VISCOSITY: not determined
@
F:
C:

SECTION 9 NOTES:

SECTION 10: STABILITY AND REACTIVITY

STABLE **UNSTABLE**

STABILITY: Stable under ordinary conditions of use and storage.

CONDITIONS TO AVOID (STABILITY):

INCOMPATIBILITY (MATERIAL TO AVOID): anything incompatible with water (alkali metals, etc.)

HAZARDOUS DECOMPOSITION OR BY-PRODUCTS: Sn-117m-containing particles, ammonia

HAZARDOUS POLYMERIZATION: N/A

CONDITIONS TO AVOID (POLYMERIZATION): N/A

SECTION 10 NOTES:

SECTION 11: TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION: It is widely accepted by the scientific community that exposure to sufficient quantities of ionizing radiation can potentially cause harmful biological effects which include cancer, leukemia, and other effects.

SECTION 11 NOTES:

SECTION 12: ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION: Insoluble Sn-117m colloids must not be discharged into sanitary sewage systems. Excreta from humal or animal patients treated with diagnostic or therapeutic doses of Sn-117m colloids may be discharged into sanitary sewage systems.

SECTION 12 NOTES:

SECTION 13: DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Sn-117m colloids are Radioactive Waste until the activity has decayed to non-detectable levels. Radioactive waste must be handled in accordance with procedures established by your Radiation Safety Officer, NRC and other applicable regulations.

RCRA HAZARD CLASS: unknown

SECTION 13: DISPOSAL CONSIDERATIONS (con't)

SECTION 13 NOTES:

SECTION 14: TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION
PROPER SHIPPING NAME: Radioactive Material, Type A Package
HAZARD CLASS: 7
ID NUMBER: UN2915
PACKING GROUP:
LABEL STATEMENT:

WATER TRANSPORTATION
PROPER SHIPPING NAME:
HAZARD CLASS:
ID NUMBER:
PACKING GROUP:
LABEL STATEMENTS:

AIR TRANSPORTATION
PROPER SHIPPING NAME: Radioactive Material, Type A Package
HAZARD CLASS: 7
ID NUMBER: UN2915
PACKING GROUP:
LABEL STATEMENTS:

OTHER AGENCIES:

SECTION 14 NOTES:

SECTION 15: REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS
TSCA (TOXIC SUBSTANCE CONTROL ACT): not currently regulated

CERCLA (COMPREHENSIVE RESPONSE COMPENSATION, AND LIABILITY ACT): not currently regulated

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT):

311/312 HAZARD CATEGORIES: acute/chronic

313 REPORTABLE INGREDIENTS: none

STATE REGULATIONS: not currently regulated

INTERNATIONAL REGULATIONS: not currently regulated

SECTION 15 NOTES:

SECTION 16: OTHER INFORMATION

OTHER INFORMATION:

PREPARATION INFORMATION:

DISCLAIMER: Employers should use this information only as a supplement to other information gathered by them, and make independent judgment of the suitability of this information to ensure proper use, and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

Procedure for Use of Synovetin OA®

[*Note: Licensee to modify to match specific facility operations.*]

Scope

This procedure is designed to be used in conjunction with the veterinary hospital's normal operating procedures and addresses those aspects which are unique to Synovetin OA®.

A primary objective of this procedure is to ensure that pet owners understand and can comply with any post-treatment restrictions and instructions before treatment is initiated, and again before the dog is released. In this procedure, there are three interactions with veterinary personnel specifically trained in the use of unsealed sources. If, during any of these interactions compliance with instructions and restrictions cannot be confirmed, then treatment will not be administered, or the dog will not be released.

The following process is summarized in a flow chart in Appendix A

Procedure A: Identification of Dogs for Treatment with Synovetin OA®.

The purpose of Procedure A is to:

1. Determine the common behavior patterns of the owner(s) with the dog,
2. Determine if those behavior patterns create any risk for any household member to exceed the public dose limits and,
3. If necessary, examine whether or not the owner(s) can modify certain behaviors necessary to comply with the public dose limits.

If the licensee concludes the owner is not willing or able to comply with any limitations necessary to preserve the public dose limits, then treatment will not be offered.

A1. The veterinarian will examine the dog and determine if Synovetin OA is medically appropriate.

A2. If so, the veterinarian will discuss Synovetin OA with the owner.

A3. The licensee will conduct the Pre-Screening Questionnaire (Appendix B) with the owner to determine the behavior patterns of the dog and owner(s). The owner will have full knowledge of household member's interaction with the proposed dog.

A3.1. The Pre-Screening Questionnaire is contained in Appendix B. Follow each prompt in the Pre-Screening Questionnaire with assistance from the content included in this Procedure (A3.2.-A3.9.).

A3.2. Collect information regarding the dog(s) and household members (anyone that shares the residence where the dog lives).

A3.3. Ask the owner to describe the behavior of their dog. Use leading questions that need more than a yes/no answer. Suggested questions include:

- What does your dog typically do during the day?
- Where does it sleep?
- Who primarily interacts with the dog?

A3.3.4. How does the dog interact with family members on a daily basis? For each activity, determine:

- What is the interaction?
- Which person?
- For how long?
- At what distance? [Note the owner will typically think of the distance from the dog's body to the closest portion of the owner's anatomy. Attempt to discern the distance from the dog's elbow to the center of the owner's torso and categorize as <1 foot, 1 foot, 3 feet, or more than 3 feet. Round down for added conservatism.]

A3.3.5. Are there any other behaviors or interactions we have not discussed yet?

A3.4. Compile the answers to determine the amount of time each person spends at distances of <1 foot, 1 foot, or 3 feet on a daily basis. The time at more than 3 feet does not need to be considered.

A3.5. Complete the questions on the remainder of the questionnaire.

A3.5.1 The "Additional Items" section of the Pre-Screening Questionnaire is the opportunity for licensee to provide a focused discussion on applicable items to that household. Examples may include the general ALARA principle, strategies to minimize public dose with attention to kids and potentially pregnant members of the household, clarifying dialogue about the distances associated with direct, close, and intermediate contact (anytime less than 1ft falls into the direct category", how to carry a treated dog to minimize dose, reminders that the duration of Release Instructions apply to the behaviors that the owner(s) provide, what to do if their pet is injured or expires, when boarding the treated animal would be appropriate, what to do if the owner thinks any of the limits have been exceeded etc.

A3.6. Flag any asterisked questions where the answer was yes. Review those in detail and discuss with the owner whether the identified behavior can be changed and if so how. Note any specific behavior modifications on the Pre-Screening Questionnaire and also on the Release Instructions. [Note: The objective is to eliminate or reduce duration of identified behaviors such that the daily interactions with the dog are for no more than 1 minute a day at less than a foot, 15 minutes a day at 1 foot, and 4 hours a day at 3 feet]

A3.6.1 The asterisked questions on the Pre-Screening Questionnaire reflect those conditions which may contraindicate the therapy. If the owner(s) are not able to modify their behaviors to comply with the Release Instructions, the Authorized User may make an informed decision to contraindicate the therapy. There may be other clinical factors which may influence the decision of the AU such as unique time and distance behaviors exhibited by the dog/owner, split time caring for the dog by multiple owners, or other conditions that are not expressly covered in the Questionnaire. The AU has the ultimate responsibility to ensure regulatory limits are met.

A3.7. Determine which of the four categories of dog/owner distance behaviors is applicable and explain to owner. Determination should be conservatively based on each household member's interactions. This table will aid in the determination of the duration of the Release Instructions. Note that only category will apply for the entire household.

Common Contact
Up to 5 min/day direct contact (e.g., joint to torso) 15 min/day @ 1 ft 4 h/day @ 3 ft e.g., feeding, grooming, petting, dog walking
Extended Duration Intermediate Contact
Up to 5 min/day direct contact (e.g., joint to torso) 15 min/day @ 1 ft 12 h/day @ 3 ft e.g., dog rests at the feet of the owner etc.
Extended Duration Close Contact
Up to 5 min/day direct contact (e.g., joint to torso) 3 h/day @ 1 ft e.g., holding dog in lap or on the couch, extended grooming, etc. 4 h/day @ 3 ft
Prolonged Close and Intermediate Contact
Up to 5 min/day direct contact (e.g., joint to torso) 11 h/day @ 1ft 9 h/day @ 3 ft e.g., dog sleeps in the owner's bed etc.

A3.8. If the licensee is confident the owner understands the need to comply with public dose limits and the household can comply with the Release Instructions, then proceed with scheduling the procedure, ordering Synovetin OA® and then continue with the following procedures. If the licensee is not confident the owner and other household members can comply with the Release Instructions as needed, exit this procedure and do not offer treatment with Synovetin OA®.

A3.9. If the procedure moves forward, the licensee will retain the signed copy of the Pre- Screening Questionnaire.

Procedure B: Review Release Instructions, Scheduling Treatment

The purpose of this procedure is to ensure that owners appreciate and understand the Release Instructions they would receive immediately after treatment (including any specific behavior limitations that may have been identified in Procedure A). The licensee will explain that dogs cannot be released without a signed copy of the Release Instructions specific to each dog, so care is taken to ensure owners understand those Release Instructions and confirm their ability to comply before treatment is planned. Only if the owner gives that confirmation, will treatment be scheduled and Synovetin OA ordered.

B1. Review the Release Instructions with the owner. Confirm that the owner understands and will comply with all of the applicable instructions.

B2. Schedule treatment and then order Synovetin OA in accordance with manufacturer requirements and schedule treatment.

B3. When the Synovetin OA arrives, receive and handle the package in accordance with site shipping and receiving procedure and radiation safety program precautions.

Procedure C: Treatment and Release

In this procedure, the owners are reminded of the Release Instructions prior to treatment. After the dog is treated and the release measurements taken, the licensee completes the Release Instructions with the appropriate duration, and presents them to the owner for signature. The dog will not be released until the owner signs the Release Instructions. Upon release, the owner is given a copy of the signed Release Instructions for ongoing reference. The licensee will retain a copy of the signed Release Instructions. Additionally, the licensee should review the Release Instructions with the owner(s) should any follow up care be provided to ensure public dose limits are met.

C1. Treatment

C1.1. On the day of treatment, re-review the Release Instructions with the owner, discuss any behavior modifications that are required.

C1.2. Follow standard site personnel safety requirements.

C1.3. Prepare the injection in accordance with the directions on the package insert.

C1.4. The dog shall be injected by trained staff under the supervision of the AU.

C1.4.1. If the injection site is missed, the owner must be informed that re-treatment can be scheduled 1 year from the initial treatment date.

C1.5. After the procedure, perform contamination surveys in accordance with the site procedures. Check the treatment site for removable contamination and decontaminate as needed.

C2. Release

C2.1 Once the dog is recovered and medically stable for release, perform exposure rate surveys of the dog at a distance of 1 meter from the nearest treated elbow. Surveys should be performed at the dog's elbow height anteriorly and left and right laterally. Record the highest reading.

C2.2 If the highest reading is greater than 0.45 mR/h, the dog must be held at the facility until such time as the highest reading is 0.45 mR/h or less. A decrease in the exposure rate reading of approximately 5% per day can be expected.

C2.2.1 If the dog must be held, kennel the dog in the kennel(s) identified for holding dogs treated with Synovetin OA.

C2.2.2 Resurvey the dog periodically (typically daily) until the release exposure rate criteria is met.

C2.2.3 Fill in the duration of time on the Release Instructions and present to the owner for signature.

C2.2.4 After the owner signs the Release Instructions, releasethe dog and provide the owner with a copy of the signed Release Instructions. The licensee will retain a copy of the signed Release Instructions.

C2.2.5 Reinforce to the owner that they may return to their normal interactions with the dog after expiration of the written instruction but that they should continue to practice ALARA (time and distance moderation) for the next two weeks afterwards.

C2.2.6 Instruct owner that if the dog dies within 20 weeks to contact you. In the event that the dog dies, burial may proceed without restriction. Delay cremation until less than 10 uCi is present (e.g., approximately 20 weeks for largest dog treated with both elbows).

C3. Post-Release

C3.1 Retain in the files a copy of the completed and signed Pre-Screening Questionnaire.

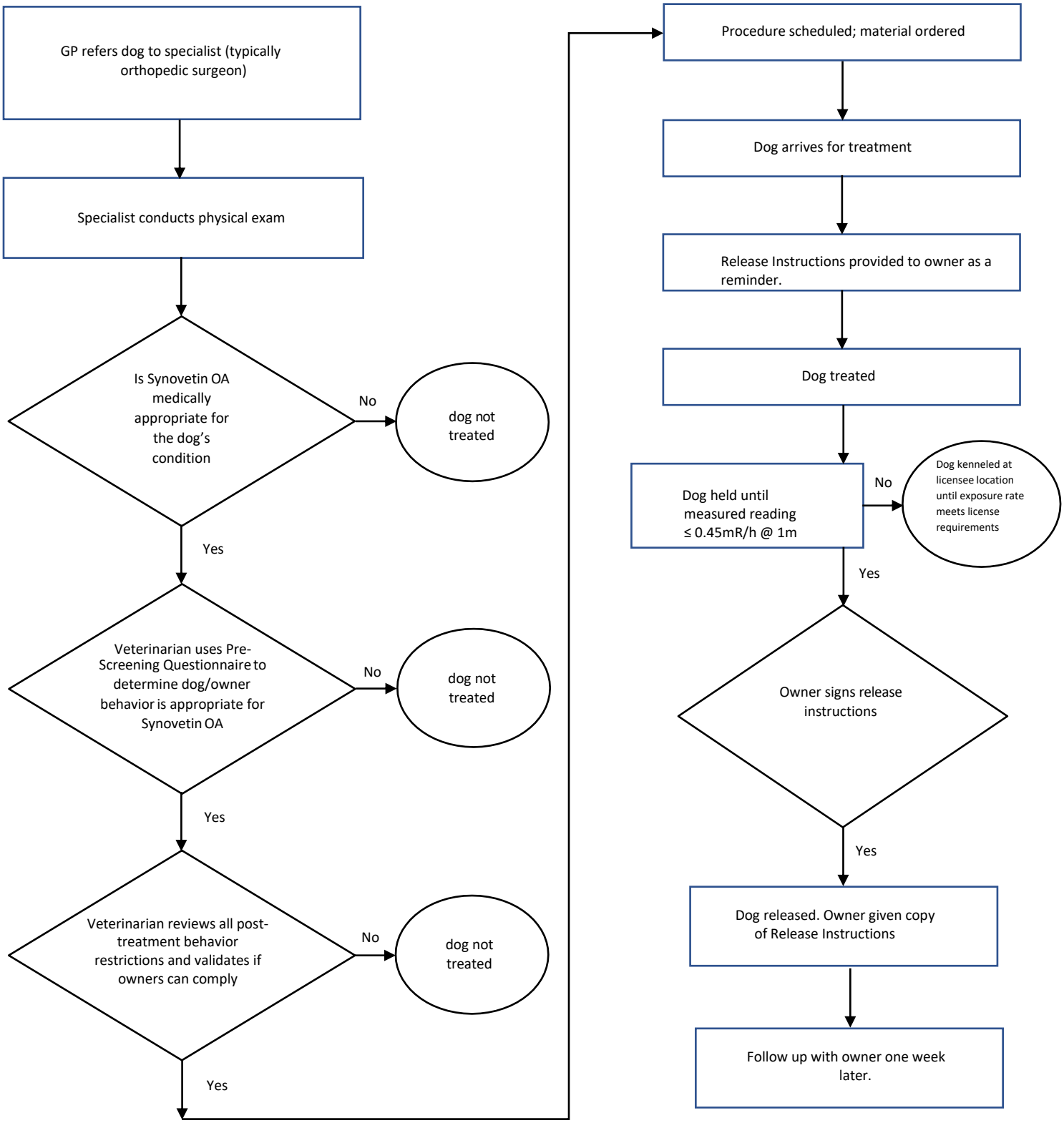
C3.2 Retain in the files a copy of the signed Release Instructions with the recorded release exposure rate.

C3.3 Follow up with the patient's owner approximately one week after the procedure. Remind the owner on how to keep doses ALARA and review compliance with the Release Instructions. Document in the files if follow up contact was successful or not and the date of follow up. If the owner indicates that the household has not complied with the written instructions, perform a dose assessment to determine the dose to date of the individual household members and formulate corrective actions for the household members to follow as necessary.

C3.4 Investigate any instances where public dose limits may have been exceeded including instances when owners have self-reported exceeding the limitations prescribed in the Release Instructions. If at any point, it is determined that the dose to a member of the public has exceeded 100 mrem, send the NRC a written report within 30 days as required by 10 CFR 20.2203.

Appendix A

Process Flow Chart



Appendix B
Synovetin OA® Pre-Screening Questionnaire

You and your veterinarian are assessing the suitability of treating your dog with Synovetin OA® in one or more arthritic joints. Synovetin OA®, a radio-therapeutic treatment, emits ionizing radiation within the joint to relieve pain and inflammation over an extended time period. Your dog's coat and surroundings will not be affected, and the activity will naturally decrease over time. To maintain overall exposure below federally established limits, there will be certain procedures to follow in the period after treatment.

Revised 9/20

I. Initial Information

Owner Name:_____ Date:_____

Pet Name:_____ Date:_____

Person Interviewed: Owner_____Other_____

II. Household Member Information

Household members: Sex: _____ _____ _____ _____ _____ _____ _____

Age: _____ _____ _____ _____ _____ _____ _____

III. General Contact Information

Describe each household member's interaction(s) with your dog (direct, close and intermediate activities – as defined below the following table):

Person 1	
Activity and type of contact involved (direct, close or intermediate):	Duration:

Direct activities are <1ft (e.g., carrying the dog where the elbow is in contact or lap sitting where the elbow is directly on the torso). **Close** activities are at 1ft (e.g., feeding, grooming, sleeping, and routine lap-sitting) **Intermediate** activities are at 3ft (e.g., walking, jogging, and officing).

Person 2	
Activity and type of contact involved (direct, close or intermediate):	Duration:

Add additional pages for other household members, if necessary.

Can interactions with children and pregnant women be modified to minimize close contact with the dog?

Yes:___No:____* N/A:_____

If the answer to the above question is yes, describe proposed modifications:

_____

_____

Does your dog currently sleep in the same bed with any household members?

Yes:___No:_____

If yes, can arrangements be made to avoid this for the duration indicated on the Release Instructions? Yes:___No:____* N/A:_____

If the answer to the above question is yes, describe proposed modifications:

_____

_____

Is your pet mobile enough to climb stairs and/or enter and exit a vehicle independently?

Yes:___No:____ N/A:_____

If the answer to the above question is no, provide the owner with additional strategies.

Does your dog jump up to beds or furniture with family members, or lap sit?

Yes:___No:_____

If yes, can arrangements be made to avoid this for the duration indicated on the Release Instructions (i.e., not lap sit)? Yes:___No:____* N/A:_____

If the answer to the above question is yes, describe proposed modifications:

_____

_____

Does your dog currently sit in very close proximity (i.e., next to your chair or at your feet) to you for more than 3 hours per day? Yes:___No:_____

If yes, can arrangements be made to avoid this for the indicated time frames on the Release Instructions? Yes:___No:____* N/A:_____

If the answer to the above question is yes, describe proposed modifications:

Has the owner been provided with an example Release Instructions sheet? Yes:___No:____*

Does the owner fully understand the procedure they have arranged for their pet?

Yes:___No:____*

Are you and your household members able and willing to modify your routine interaction with your pet for the time frames indicated on the Release Instructions? Yes:___No:____*

If the answer to the above question is yes, describe proposed modifications:

*Any "No" checkmark may be contraindicated for the procedure. Contraindication is based on owner responses, proposed dose to pet, or other clinical factors.

Additional Items Discussed with Animal Owner(s)	Comments
_____Release Instructions / ALARA considerations:	
_____Importance of modifying time and distance from pet:	
_____Sleeping arrangements:	
_____Added precaution for children and pregnant women:	
_____What to do if their pet dies or needs medical attention:	
_____Transport/carrying techniques to minimize contact:	
_____Other: (such as 1 animal treated per house per year, boarding, traveling, commercial grooming, or tactile treatment)	

By signing below, I acknowledge I fully understand the radiation safety aspects associated with Synovetin OA.

Name of Owner or interviewee: _____

Signature: Date:

Name of individual who conducted interview: _____

Signature: Date:

Categories of Dog/Owner Distance Behaviors

Measured Exposure Rate at Release (mR/h @ 1m)	0.45	0.4	0.3	0.2	0.1	0.05
Common Contact	Release Instructions Duration (weeks)					
Up to 5 min/day direct contact (e.g. joint to torso) 15 min/day @ 1 ft 4 h/day @ 3 ft e.g., feeding, grooming, petting, dog walking	2	2	2	2	2	2

If Not Common Contact Distance Behaviors, Select One Below

Measured Exposure Rate at Release (mR/h @ 1m)	0.45	0.4	0.3	0.2	0.1	0.05
Extended Duration Intermediate Contact	Release Instructions Duration (weeks)					
Up to 5 min/day direct contact (e.g. joint to torso) 15 min/day @ 1 ft 12 h/day @ 3 ft e.g., dog rests at the feet of the owner etc.	2	2	2	2	2	2
Extended Duration Close Contact						
Up to 5 min/day direct contact (e.g. joint to torso) 3 h/day @ 1 ft e.g., holding dog in lap or on the couch, extended grooming, etc. 4 h/day @ 3 ft	3	3	2	2	2	2
Prolonged Close and Intermediate Contact						
Up to 5 min/day direct contact (e.g joint to torso) 11 h/day @ 1ft 9 h/day @ 3 ft e.g., dog sleeps in the owner's bed etc.	6	5	4	3	2	2

Use the above table to fill in the duration (number of weeks) in the following Release Instructions. Assess the duration for each household member that has substantial interaction with the dog. Use the greatest duration value (weeks) in the Release Instructions. For example, if the table indicates a duration of 2 weeks for Person #1 and 3 weeks for Person #2, insert 3 weeks in the Release Instructions. Determination of which dog/owner behavior is decided upon owner answers to the Pre-Screening Questionnaire.

Reset Entire Form

Content

EXUBRION THERAPEUTICS

Synovetin OA® Order Form

Page 1 to be Completed by the Clinic

Ship to Address: (All Fields are Required) Reset Address Fields

Facility Name:

Street Address: City:

Contact Name: State: Select State Zip Code:

Email: Phone:

Order Date: **The Order Date will automatically be filled in when the SUBMIT button is selected at the bottom of the first page. Once the Order Form is submitted it can not be revised.**

Dog 1 Dosage and Data: Reset Dog 1 Data — Internal Use - Dog 1 Exubrion Order #:

Injection Date: Dog's Name/Family Name: Breed: Select or Enter Breed Dog's Age: Select

Dog's Weight: Select lbs Dog's Gender: Select Number of Elbows Injected: Select Dosage/Elbow: mCi

Dog 2 Dosage and Data: Reset Dog 2 Data — Internal Use - Dog 2 Exubrion Order #:

Injection Date: Dog's Name/Family Name: Breed: Select or Enter Breed Dog's Age: Select

Dog's Weight: Select lbs Dog's Gender: Select Number of Elbows Injected: Select Dosage/Elbow: mCi

Dog 3 Dosage and Data: Reset Dog 3 Data — Internal Use - Dog 3 Exubrion Order #:

Injection Date: Dog's Name/Family Name: Breed: Select or Enter Breed Dog's Age: Select

Dog's Weight: Select lbs Dog's Gender: Select Number of Elbows Injected: Select Dosage/Elbow: mCi

Dog 4 Dosage and Data: Reset Dog 4 Data — Internal Use - Dog 4 Exubrion Order #:

Injection Date: Dog's Name/Family Name: Breed: Select or Enter Breed Dog's Age: Select

Dog's Weight: Select lbs Dog's Gender: Select Number of Elbows Injected: Select Dosage/Elbow: mCi

Dog 5 Dosage and Data: Reset Dog 5 Data — Internal Use - Dog 5 Exubrion Order #:

Injection Date: Dog's Name/Family Name: Breed: Select or Enter Breed Dog's Age: Select

Dog's Weight: Select lbs Dog's Gender: Select Number of Elbows Injected: Select Dosage/Elbow: mCi

Dog 6 Dosage and Data: Reset Dog 6 Data — Internal Use - Dog 6 Exubrion Order #:

Injection Date: Dog's Name/Family Name: Breed: Select or Enter Breed Dog's Age: Select

Dog's Weight: Select lbs Dog's Gender: Select Number of Elbows Injected: Select Dosage/Elbow: mCi

By selecting the SUBMIT button below the Order Form will be automatically saved and emailed to Anita Jarrard (ajarrard@exubrion.com)

SUBMIT

Dog Weight (lbs.)	Synovetin OA® Dose (mCi) / Elbow Joint
10 - 19 lbs.	0.6
20 - 29 lbs.	0.9
30 - 39 lbs.	1.2
40 - 49 lbs.	1.5
50 - 59 lbs.	1.7
60 - 69 lbs.	1.9
70 - 79 lbs.	2.2
80 - 89 lbs.	2.4
90 - 99 lbs.	2.6
100 - 109 lbs.	2.8
110 lbs. and over	3.0

Exubrion Therapeutics, Inc.
5203 Bristol Industrial Way
Buford, Ga 30518
770-831-5243
www.synovetin.com

R20200807

EXUBRION THERAPEUTICS

Synovetin OA® Order Form

Exubrion Therapeutics, Inc.

ORDER SUBJECT TO THE ATTACHED TERMS AND CONDITIONS

TERMS AND CONDITIONS

1) Documentation for all necessary and appropriate radioactive material licensing must be provided to Exubrion prior to order acceptance.

2) Each unit of Synovetin OA® is prepared pursuant to a prescription for a specific patient. To ensure fulfillment of the order as requested, orders must be placed at least two weeks prior to the expected injection date. Orders placed less than two weeks before the injection date **will not be accepted.**

3) All orders are subject to acceptance by Exubrion.

4) Pricing is in U.S. dollars, based on quantity and services ordered, plus shipping, and applicable taxes.

5) Payment is required with the order by credit card, debit card or electronic payment.

6) Title and risk of loss will pass to Buyer at the time products are delivered to Buyer's facility. The remedy for product damaged in shipment will be limited to product replacement or refund of the purchase price. Exubrion does not accept product returns. Product that cannot be used should be disposed of appropriately as outlined in your Authorized User's procedures.

7) Exubrion Therapeutics, Inc.
Headquarter Address:
5203 Bristol Industrial Way
Buford, Georgia 30518

8) Customer Service Phone:
770-831-5243

9) The parties to this Order shall be governed by the laws of the State of Georgia, USA, without regard to its conflicts of laws principles. The parties agree that any dispute arising out of this order shall be exclusively decided by a Georgia state or federal court, as has subject matter jurisdiction.

10) Exubrion hereby warrants that each product conforms to its specifications. Buyer's sole remedy for any breach of this warranty is replacement of the nonconforming products. EXCEPT FOR THE FOREGOING WARRANTIES, EXUBRION MAKES NO OTHER WARRANTIES EXPRESSED OR IMPLIED TO BUYER OR ANY CUSTOMERS OF BUYER. EXUBRION EXPRESSLY DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT TO BUYER AND ANY CUSTOMERS OF BUYER.

Synovetin OA® Manufacturing Data Form

Internal Use Only:

Dog 1 Data:

Order #: | Injection Date: | Ship Date :

Name: | Dosage in Vial: 0.0 mCi

The Ship Date is a reference date only. The Ship Date allows for delivery 2 days before the injection Date, and allows for 2 day shipping and excludes weekends and holidays.

Dog 2 Data:

Order #: | Injection Date: | Ship Date :

Name: | Dosage in Vial: 0.0 mCi

The Ship Date is a reference date only. The Ship Date allows for delivery 2 days before the injection Date, and allows for 2 day shipping and excludes weekends and holidays.

Dog 3 Data:

Order #: | Injection Date: | Ship Date :

Name: | Dosage in Vial: 0.0 mCi

The Ship Date is a reference date only. The Ship Date allows for delivery 2 days before the injection Date, and allows for 2 day shipping and excludes weekends and holidays.

Dog 4 Data:

Order #: | Injection Date: | Ship Date :

Name: | Dosage in Vial: 0.0 mCi

The Ship Date is a reference date only. The Ship Date allows for delivery 2 days before the injection Date, and allows for 2 day shipping and excludes weekends and holidays.

Dog 5 Data:

Order #: | Injection Date: | Ship Date :

Name: | Dosage in Vial: 0.0 mCi

The Ship Date is a reference date only. The Ship Date allows for delivery 2 days before the injection Date, and allows for 2 day shipping and excludes weekends and holidays.

Dog 6 Data:

Order #: | Injection Date: | Ship Date :

Name: | Dosage in Vial: 0.0 mCi

The Ship Date is a reference date only. The Ship Date allows for delivery 2 days before the injection Date, and allows for 2 day shipping and excludes weekends and holidays.

Dog Weight (lbs.)	Synovetin OA® Dose (mCi) / Elbow Joint
10 - 19 lbs.	0.6
20 - 29 lbs.	0.9
30 - 39 lbs.	1.2
40 - 49 lbs.	1.5
50 - 59 lbs.	1.7
60 - 69 lbs.	1.9
70 - 79 lbs.	2.2
80 - 89 lbs.	2.4
90 - 99 lbs.	2.6
100 - 109 lbs.	2.8
110 lbs. and over	3.0

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Buford, Ga 30518
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www.synovetin.com

RECORD OF CHECKING-IN SHIPMENTS OF RADIOACTIVE MATERIAL

Receipt Date	Material Received/ Nuclide Amount	Dose Rate Surface mR/h	Dose Rate 1 meter mR/h	Surface Wipe Test* dpm/100 cm^2	Primary Container Contamination dpm/100 cm^2	Meter Used	Checked By	Comments
10/1/20	*Sn117m / 3 mCi*	*0.05*	*0.02*	*0*	*0*	*26-1*	*CAS*	*NA*

* Wipe test instructions:

(1) Wipe approximately 100 cm^2 of each surface.

(2) Count wipe using GM survey meter.

(3) Calculate the net dpm using the known efficiency for isotope (20% for ^{117m}Sn). Note that dpm = cpm/eff.

(4) Notify the AU or RSO if package exceeds DOT requirements.

Appendix C: Synovetin OA Release Instructions

Release Instructions following Synovetin OA® (tin 117m) Canine Arthritis Therapy

Dog's Name:_____Treatment Date: _____

Total Dose Administered:_____mCi Measured Exposure Rate: _____mR/h at 1m

Your dog has been treated with Synovetin OA® (tin-117m) in one or more arthritic joints. Synovetin OA®, a radiotherapeutic treatment, emits ionizing radiation within the joint to relieve pain and inflammation over an extended time period. Your dog's coat and surroundings will not be affected, and the activity will naturally decrease over time. To maintain overall exposure below federally established limits, follow these recommendations for the next_____weeks.

- ✓ Remember to maintain your exposure as low as reasonably achievable (ALARA).
- ✓ Do not sleep with the dog or hold the dog in or near your lap.
- ✓ Each member of the household should avoid direct contact with the treated joint(s) as much as possible. Daily direct contact should be limited to **<1** minute. **Direct** activities are those that are <1ft from the dog's treated elbow to the owner's torso (e.g., carrying the dog where the elbow is in contact or lap sitting where the elbow is directly on the torso).
- ✓ Each member of the household should limit close contact to **15** minutes and should limit intermediate contact to **4** hours. Activities such as walking or playing with your dog can continue with distance limitations maintained. **Close** activities are at 1ft (e.g., feeding, grooming, sleeping, and routine lap-sitting) and **Intermediate** activities are at 3ft (e.g., walking, jogging, and officing).
- ✓ Minimize the time that children and pregnant women spend in close contact with the dog.
- ✓ Avoid long term/daily boarding or commercial grooming of your dog for two weeks or traveling with it by air or across any international borders or very large, organized events (professional sporting events, parades, etc.). Provide a copy of this document should any questions arise.
- ✓ Minimize use of public transportation and staying in public accommodations (e.g., hotels). Transport your dog in its carrier and/or as far from passengers as is reasonable and safe for the dog.
- ✓ Follow up care is recommended where your dog received this treatment. If your dog needs emergency care, please inform the provider about its treatment with radiotherapy, and to contact (*insert contact information here)* with any questions.

  Individualized behavior modifications from Pre-Screening Questionnaire:

  _____
  _____
  _____

If your dog dies for any reason within 20 weeks of treatment, contact (*insert contact information here)*.

After expiration of these instructions, you may return to normal interactions with your dog but continue to be prudent about extended close contact.

Veterinarian signature:_____Date: _____

I have received this information orally and in writing, and I understand it. I have had the opportunity to ask any questions.

Dog owner signature:_____Date: _____

DAILY CLOSEOUT REPORT

DEPARTMENT: Surgery	LOCATION: OR
INSTRUMENT: 26-1	SERIAL NUMBER: 4114

* Unless otherwise specified, measurements made with GM survey meter with results in mR/h.

✓ = background reading 0.02 mR/h

Note that Action level is 0.2 mR/h for an uncontrolled area and 5 mR/h for controlled areas. Daily closeout surveys are only required on days of use.

Date	1	2	3	4	5	6	7	8	9	10	11	12	Survey By
10/1/20	✓	✓	✓	✓	✓	✓	✓	✓					CAS

Insert Lab Map Here:

WEEKLY WIPE TEST REPORT

DEPARTMENT: Surgery	LOCATION: OR
INSTRUMENT: 26-1	SERIAL NUMBER: 4114

* Unless otherwise specified, measurements made with GM survey meter with results in dpm/100 cm^2.

✓ = background reading (<200 dpm/100 cm^2)

Note that Action level is 1000 dpm/100 cm^2 for an uncontrolled area and 10,000 dpm/100 cm^2 for controlled areas. Efficiency for a Ludlum 26-1 or Ludlum 44-9 is 20% for ^{117m}Sn.

Date	1	2	3	4	5	6	7	8	9	10	11	12	Survey By
10/1/20	✓	✓	✓	✓	✓	✓	✓	✓	✓				*CAS*

Insert Lab Map Here:

Contamination Assessment and Exposure Rate Measurements of ^{117m}Sn

This guide is written for veterinary licensees using ^{117m}Sn. Content includes specific guidance using a GM ratemeter to assess contamination for compliance wipe tests and exposure rate measurements for daily closeout surveys and patient release measurements for a standard volume ion chamber and a GM ratemeter.

Contamination Assessment:

Removable radioactive contamination assessment is a radioactive materials license condition and must be completed on a weekly basis. Wipe tests are the mechanism to assess removable contamination in the case of veterinary nuclear medicine with unsealed radioactivity. Wipe tests are conducted by wiping an area with a dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of a known efficiency for the isotope in question. Typically, a radioactive materials licensee will wipe test an area of 100 cm^2 or 300 cm^2 dependent on their own internal procedures. The units for wipe tests are disintegrations per minute per unit area (dpm/cm^2)

Empirical data using a Ludlum model 3 ratemeter and 44-9 GM probe show the efficiency for ^{117m}Sn detection to be approximately 20% under 2D geometry. With a background rate of 100 counts per minute (cpm), this radiation detection system has a minimum detectable activity (MDA) of approximately 400 dpm. The standard regulatory threshold for removable contamination of a beta and or gamma emitting radionuclide, such as ^{117m}Sn, in an unrestricted area is 1000 dpm/100 cm^2 [1]. ^{117m}Sn has 159 keV gamma and several low energy conversion electron outputs. Note, the same probe geometry is used in the Ludlum 44-88 and Ludlum 26-1 Dose meter.

The empirical data can be readily recreated in a lab setting using:

1. Liquid Scintillation Analyzer (LSA)
2. Calibrated Pipettes
3. Known concentration of isotope (mCi/mL)
4. Cardboard Paper
5. Paraffin paper

The known activity concentration of the ^{117m}Sn is pipetted into an acceptable concentration to be added to an LSA vial – typically less than 1M counts. Then, the now diluted concentration is used to pipette into LSA vials to establish a known activity from the dilution. Once the known activity is established, the same volume is pipetted onto a dimpled paraffin paper to simulate removable contamination in a standard geometry. The GM probe (44-9) connected to the Ludlum model 3 ratemeter is then used to establish an efficiency. The 20% efficiency quoted above was established with triplicate measurements for both the LSA activity establishment and the paraffin paper standards.

The MDA was established with the below data:

1. Time of the sample count: T_{s+b} = 0.367min on the slow setting for the Ludlum 3
2. Time of the background count: T_b = 0.367min on the slow setting for the Ludlum 3
3. Confidence interval: k = 1.645 for 95% confidence
4. Efficiency: eff = 20% for ^{117m}Sn
5. Background rate: R_b = 100 cpm
6. Lower critical level: L_c = 38.4 cpm — $L_c = k[((R_b/ T_{s+b})+(R_b/ T_b))]^{0.5}$
7. Lower limit of detection: L_d = 84.1 cpm — $L_d = (k^2/ T_{s+b})+2L_c$
8. Minimum Detectable Activity/Wipe: MDA = 422.4 cpm — $MDA = L_d/eff$

Since the minimum detectable activity is much less than the contamination limit for an uncontrolled area, the Ludlum model 3 ratemeter with 44-9 or 44-88 GM probe combination (or other comparable instrument such as the Ludlum 26-1 Dose) is an adequate instrument to measure removable contamination for ^{117m}Sn.

Note, ^{117m}Sn has a similar gamma emission as the commonly used medical radioisotope ^{99m}Tc along with several low energy conversion electron emissions which only aid in the detection efficiency of contamination.

Exposure Rate Measurements:

Radioactive materials licenses require daily closeout surveys of all areas where unsealed radioactive material is used. Further, license conditions require that release exposure rate measurements be completed prior to releasing animals who have been administered unsealed radioactivity. The below information provides guidance to radioactive materials licensees for instrument selection for daily closeout survey and release exposure rate measurements [2][3][4].

Daily closeout surveys are completed by surveying all areas of unsealed radioactive materials use. The goal of the daily closeout survey is to determine if exposure rate license conditions are met. Typically, uncontrolled areas have an exposure rate limit of 0.2 milliRoentgen per hour (mR/h) and controlled areas (such as the Hot Lab) will have an exposure rate limit of 5 mR/h. Daily closeouts help identify contamination, if radioactive waste is appropriately contained, and if sealed sources are properly stored. These surveys can be completed with either a standard volume ion chamber such as the Ludlum 9DP and Victoreen 451P, or they can be completed with an appropriate Ludlum ratemeter and GM probe (44-88, 44-9, or Ludlum 26-1 Dose). The GM option is more practical as this detection instrument can also be used for contamination assessment. Using the same instrument routinely allows for the user to have familiarity with the radiation detector and its properties.

Each animal treated with ^{117m}Sn is required to have a release exposure rate measurement prior to leaving the licensed facility. Most license conditions require the measurement taken not exceed 0.5 mR/h at 1 meter from the treatment site as the mechanism to validate that public dose requirements are met [5]. While the ion chamber is the gold standard for exposure rate measurements, the Ludlum 26-1 Dose with energy flattening filter is more practical. Exposure rate measurement data was compiled with multiple instruments over multiple distances with different activities. The unshielded gamma exposure constant of 0.169 mR m^2 h^{-1} mCi^{-1} was used as the benchmark for expectation values [6]. The ionization chamber response tends to slightly under respond while the Ludlum 26-1 Dose with energy flattening filter tends to slight over respond from theoretical values. Since each instrument is very close to the expectation values, either would be sufficient to use without the need to correct for energy response.

The Ludlum 26-1 Dose without the energy flattening filter can be used for contamination assessment and daily closeout surveys. The Ludlum 26-1 Dose with the energy flattening filter can be used for Synovetin OA release measurements. Therefore the Ludlum 26-1 Dose is the recommended radiation detector for licensees using ^{117m}Sn.

References:

1. 10 CFR Part 835 Appendix D. Surface Contamination Values in dpm/100 cm^2
2. NUREG 1556 Vol 7 Appendix O.
3. Smith and Stabin, Exposure Rate Constants and Lead Shielding Values for over 1,100 Radionuclides, Health Physics Society. https://www.doseinfo-radar.com/Exposure_Rate_Constants_and_Lead_Shielding_Values%204.pdf

PROCEDURE FOR WASTE DISPOSAL

Overview

There are four commonly used methods of waste disposal: release to the environment through the sanitary sewer or by evaporative release; decay-in-storage (DIS); transfer to a burial site or back to the manufacturer; and release to in-house waste. With the exception of the patient excreta and generally licensed in vitro kit exemptions, nothing in these guidelines relieves the licensee from maintaining records of the disposal of licensed material.

General Guidance

1. All radioactivity labels must be defaced or removed from containers and packages prior to disposal in in-house waste. If waste is compacted, all labels that are visible in the compacted mass must be defaced or removed.

2. Remind employees that nonradioactive waste such as leftover reagents, boxes, and packing material should not be mixed with radioactive waste.

3. Occasionally monitor all procedures to ensure that radioactive waste is not created unnecessarily. Review all new procedures to ensure that waste is handled in a manner consistent with established procedures.

4. In all cases, consider the entire impact of various available disposal routes. Consider occupational and public exposure to radiation, other hazards associated with the material and routes of disposal (e.g., toxicity, carcinogenicity, pathogenicity, flammability), and expense.

Procedure for Disposal of Liquids and Gases

Liquids may be disposed of by release to the sanitary sewer or evaporative release to the atmosphere. This does not relieve licensees from complying with other regulations regarding toxic or hazardous properties of these materials.

1. Regulations for disposal in the sanitary sewer appear in either federal regulations for non-agreement states or your State's local regulations. Federal guidance may be found in 10 CFR 10.2003. Material must be readily soluble or dispersible in the water. There are monthly and annual limits based on the total sanitary sewerage release of your facility. Make a record of the date, radionuclide, estimated activity that was released (in millicuries or microcuries), and of the sink or toilet at which the material was released.

2. Limits on permissible concentrations in effluents to uncontrolled areas are enumerated in either federal regulations for non-agreement states or your State's local regulations. Federal guidance may be found in 10 CFR 10.2003. These limits apply at boundary of the controlled area. Make a record of the date, radionuclide, estimated activity that was released (in millicuries or microcuries) and estimated concentration at the point at which the material was released.

3. Liquid scintillation-counting media containing 0.05 microcuries per gram of H-3 or C-14 may be disposed of without regard to its radioactivity. Make a record of the date, radionuclide, estimated activity (in millicuries or microcuries), calculated concentration in microcuries per gram, and how the material was disposed of.

Procedures for Disposal of Decay-In-Storage (DIS)

Short-lived material (physical half life less than 120 days) may be disposed of by DIS. Keep material separated according to half-life.

1. Use separate containers for different types of waste, e.g., capped needles and syringes in one container, other injection paraphernalia such as swabs and gauze in another, and unused dosages in a third container. Smaller departments may find it easier to use just one container for all DIS waste. Because the waste must be surveyed with all shielding removed, the containers in which waste will be disposed must not provide any radiation shielding for the material.

2. When the container is full, seal it with string or tape and attach an identification tag that includes the date sealed, the longest-lived radioisotope in the container, and the initials of the person sealing the container. The container may then be transferred to the DIS area.

3. Decay the material until not distinguishable from background.

4. Prior to disposal as in-house waste, monitor each container as follows:

    a. Check your radiation detection survey meter for proper operation;

    b. Plan to monitor a low-level (less than 0.05 millirem per hour) area;

    c. Remove any shielding from around the container;

    d. Monitor all surfaces of each individual container;

e. Discard as in-house waste only those containers that cannot be distinguished from background. Record the date on which the container was sealed, the disposal date, and type of material (e.g., paraphernalia, unused dosages). Check to be sure no radiation labels are visible.

f. Containers that can be distinguished from background radiation levels must be returned to the storage area for further decay or transferred for burial.

Procedures for Transfer for Burial

Except for material suitable for DIS and some animal carcasses, solids must be transferred to a burial site. Follow the packaging instructions you received from the transfer agent and the burial site operator. For your record of disposal, keep the consignment sheet that the transfer agent gave you.

Procedure for Release to In-House Waste

Waste from in vitro kits that are generally licensed are exempt from waste disposal regulations when these kits are used in a laboratory physically and administratively isolated from Nuclear Medicine. Radioactive labels should be defaced or removed. There is no need to keep any record of release or make any measurement.

SPILL PROCEDURES

Minor Spills of Liquids and Solids (<1 mCi in controlled areas not involving personnel)

1. Notify persons in the area that a spill has occurred.

2. Prevent the spread of contamination by covering the spill with absorbent paper.

3. Clean up the spill using disposable gloves and absorbent paper. Carefully fold the absorbent paper with the clean side out and place in a plastic bag for transfer to a radioactive waste container. Also put contaminated gloves and any other contaminated disposable material in the bag.

4. Survey the area with a low-range radiation detector survey meter. Check the area around the spill. Also check your hands, clothing, and shoes for contamination.

5. Report the incident to the Radiation Safety Officer (RSO).

6. The RSO or his designee will follow up on the cleanup of the spill and will complete the Radioactive Spill Report and the Radioactive Spill Contamination Survey.

Major Spills of Liquids and Solids (>1 mCi in controlled area, all spills in uncontrolled areas and spills involving personnel contamination)

1. Clear the area. Notify all persons not involved in the spill to vacate the room.

2. Prevent the spread of contamination by covering the spill with absorbent paper, but do not attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.

3. Shield the source if possible. This should be done only if it can be done without further contamination or a significant increase in radiation exposure.

4. Close the room and lock or otherwise secure the area to prevent entry.

5. Notify the RSO immediately.

6. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and then washing with mild soap. If contamination remains, induce perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.

7. The RSO or designee will supervise cleanup of the spill and will complete the Radioactive Spill Report and the Radioactive Spill Contamination Survey.