HIGHLIGHTS OF PRESCRIBING INFORMATION

These highlights do not include all the information needed to use RADIOGENIX® SYSTEM safely and effectively. See full prescribing information for RADIOGENIX SYSTEM .

RADIOGENIX SYSTEM (technetium Tc 99m generator)
For the production of Sodium Pertechnetate Tc 99m Injection, USP for intravenous, intravesicular, and ophthalmic use.
Initial U.S. Approval: 1973

----------RECENT MAJOR CHANGES----------

Dosage and Administration,	
Directions for Eluting RadioGenix System (2.6)	04/2020
Warnings and Precautions, Unintended Re-186 Exposure (5.3)	04/2020

----------INDICATIONS AND USAGE----------

The RadioGenix System is a technetium Tc-99m generator used to produce Sodium Pertechnetate Tc 99m Injection, USP. Sodium Pertechnetate Tc 99m Injection is a radioactive diagnostic agent and can be used in the preparation of FDA-approved diagnostic radiopharmaceuticals.

Sodium Pertechnetate Tc 99m Injection is also indicated in

- Adults for: salivary gland imaging and nasolacrimal drainage system imaging (dacryoscintigraphy).
- Adults and pediatric patients for: thyroid imaging and vesicoureteral imaging (direct isotopic cystography) for detection of vesicoureteral reflux. (1)

----------DOSAGE AND ADMINISTRATION----------

- Follow step-by-step directions for use provided in the RadioGenix System Operator Guide Version 1.0a and 1.1 (94S05058).

Dose ranges for ADULT patients are:

Indication	**Megabecquerels (MBq)**	**Millicuries (mCi)**
Vesicoureteral imaging:	18.5 to 37	0.5 to 1
Thyroid gland imaging:	37 to 370	1 to 10
Salivary gland imaging:	37 to 185	1 to 5
Nasolacrimal drainage system:	3.70 (maximum)	0.100 (maximum)

Dose ranges in PEDIATRIC patients are:

Indication	**MBq**	**mCi**
Vesicoureteral imaging:	18.5 to 37	0.5 to 1
Thyroid gland imaging:	2.2 to 2.96 MBq /kg	0.06 to 0.08 mCi/kg

- Sodium Pertechnetate Tc 99m Injection may be administered by intravenous injection; it may also be instilled into the urinary bladder (for vesicoureteral imaging) or eye (for nasolacrimal imaging). (2.3, 2.4)
- Discard the first eluate from every new Potassium Molybdate Mo-99 Source Vessel (2.6)

----------DOSAGE FORMS AND STRENGTHS----------

The RadioGenix System provides Sodium Pertechnetate Tc 99m Injection, USP from a non-highly enriched uranium (non-HEU) source of potassium molybdate Mo-99, as a clear, colorless solution containing 25 mCi/mL to 1,015 mCi/mL (925 to 37,555 MBq/mL) of technetium Tc-99m radioactivity in approximately 5 mL of volume. The amount of Tc-99m radioactivity depends on the radioactivity in the potassium molybdate Mo-99 source. The source is supplied in containers with 6 Ci (222 GBq) activity at the time of calibration. (3)

----------CONTRAINDICATIONS----------

None. (4)

----------WARNINGS AND PRECAUTIONS----------

- Radiation Exposure Risk: Sodium Pertechnetate Tc 99m Injection contributes to a patient's long-term cumulative radiation exposure. Ensure safe handling to protect patients and healthcare workers from unintentional radiation exposure. (5.1)
- Unintended Mo-99 Exposure: Only use potassium molybdate Mo-99, processing reagent, saline, and other supplies, including packs, provided by NorthStar Medical Radioisotopes. Do not administer Sodium Pertechnetate Tc 99m Injection after the 0.15 microCi of Mo-99/mCi of Tc-99m limit has been reached and discard the Sodium Pertechnetate Tc 99m Injection when the 12-hour expiration time is reached; whichever occurs earlier. (5.2)
- Unintended Re-186 Exposure: Discard the first eluate from every new Potassium Molybdate Mo-99 Source Vessel to minimize the risk of unintended radiation exposure from Rhenium Re-186. (5.3)
- Hypersensitivity Reactions: Monitor all patients for hypersensitivity reactions. (5.4).

----------ADVERSE REACTIONS----------

Allergic reactions, including anaphylaxis, have been reported infrequently following the administration of Sodium Pertechnetate Tc 99m Injection. (6)

To report SUSPECTED ADVERSE REACTIONS, contact NorthStar Medical Radioisotopes, LLC at 1-844-438-6659; or FDA at 1-800-332-1088 or www.fda.gov/medwatch.

----------USE IN SPECIFIC POPULATIONS----------

- Lactation: Temporarily discontinue breastfeeding. A lactating woman should pump and discard breast milk for 12 to 24 hours after Sodium Pertechnetate Tc-99m administration. (8.2)

Revised: 08/2020

FULL PRESCRIBING INFORMATION: CONTENTS*

*Sections or subsections omitted from the full prescribing information are not listed.

FULL PRESCRIBING INFORMATION

1 INDICATION AND USAGE

The RadioGenix System is a technetium Tc-99m generator used to produce sterile, non-pyrogenic Sodium Pertechnetate Tc 99m Injection. Sodium Pertechnetate Tc 99m Injection is indicated for use in the preparation of FDA-approved diagnostic radiopharmaceuticals.

Sodium Pertechnetate Tc 99m Injection is also indicated in:
Adults for:

- Thyroid Imaging
- Salivary Gland Imaging
- Urinary Bladder Imaging (direct isotopic cystography) for detection of vesicoureteral reflux
- Nasolacrimal Drainage System Imaging (dacryoscintigraphy)

Pediatric Patients for:

- Thyroid Imaging
- Urinary Bladder Imaging (direct isotopic cystography) for the detection of vesicoureteral reflux

2 DOSAGE AND ADMINISTRATION

2.1 Radiation Safety – Drug Handling

- The potassium molybdate Mo-99 source solution and Sodium Pertechnetate Tc 99m Injection are radioactive and should be handled with appropriate safety measures to minimize radiation exposure to patients and healthcare providers. Use waterproof gloves and effective shielding, including syringe shields, throughout the entire preparation and handling for the RadioGenix System and technetium Tc-99m injection *[see Warnings and Precautions (5.1)]*.

2.2 Important Administration Instructions

- Use aseptic technique in eluting generator and in all drug preparation and handling.
- Inspect the Sodium Pertechnetate Tc 99m Injection for particulate matter and discoloration prior to administration. Do not administer Sodium Pertechnetate Tc 99m Injection if there is any evidence of particulate matter and discoloration.
- Measure patient dose with a suitable radioactivity calibration system immediately prior to administration.
- Instruct patients to hydrate after intravenous or intravesicular administration. Encourage the patient to void as soon as the imaging study is completed and frequently for the next 12 hours to minimize the radiation absorbed dose to the bladder.
- Instruct patients to blow their nose and/or wash their eyes with sterile distilled water or an isotonic sodium chloride solution after ophthalmic administration to minimize the radiation absorbed dose.

2.3 Recommended Dose for Adults

The recommended doses for adult patients are shown in Table 1.

Table 1 Recommended Dose of Sodium Pertechnetate for Adult Patients

Indication	Megabecquerels (MBq)	Millicuries (mCi)	Administration Technique
Vesicoureteral imaging:	18.5 to 37	0.5 to 1	• Intravesicular via a urethral catheter • Flush the catheter with approximately 200 mL of sterile saline directly into the bladder
Thyroid gland imaging:	37 to 370	1 to 10	• Intravenous
Salivary gland imaging:	37 to 185	1 to 5	• Intravenous
Nasolacrimal drainage system imaging:	3.7 (maximum)	0.1 (maximum)	• Ophthalmic instillation with micropipette or similar method

2.4 Recommended Dose for Pediatric Patients

The recommended doses for pediatric patients are shown in Table 2 *[see Use in Specific Populations (8.4)]*.

Table 2 Recommended Dose of Sodium Pertechnetate for Pediatric Patients

Indication	Megabecquerels (MBq)	Millicuries (mCi)	Administration Technique
Vesicoureteral imaging:	18.5 to 37	0.5 to 1	Intravesicular via urethral catheter
Thyroid gland imaging:	2.2 to 2.96 per kg of body weight (370 MBq maximum)	0.06 to 0.08 per kg of body weight (10 mCi maximum)	Intravenous

2.5 RadioGenix System Maintenance

- **For complete system maintenance and use follow the RadioGenix System Operator Guide Version 1.0a and 1.1 (94S05058).**
- Install the RadioGenix System in an operating environment which complies with local and national requirements for production of radiopharmaceutical products (ISO Class 8 or better environment as described in USP General Chapter 797 Pharmaceutical Compounding – Sterile Preparations).
- The RadioGenix Systemis only for use by trained personnel.
- Only use potassium molybdate Mo-99, processing reagents, saline and other components, including kits [Sterilization Kit for RadioGenix System , Reagent Kit for RadioGenix System, Tc-99m Product Kit for RadioGenix System, Discarded Material Kit for RadioGenix System, and Source Vessel Kit for RadioGenix System], supplied by NorthStar Medical Radioisotopes, LLC.
- Table 3 is a summary of RadioGenix System scheduled maintenance and protocol actions. Perform all protocols according to the illustrated directions provided in the RadioGenix System Operator Guide Version 1.0a and 1.1 (94S05058).

Table 3 RadioGenix System Scheduled Maintenance

Protocol Frequency	**Action**
Initialize System When prompted or as needed (host computer screen will prompt the operator to perform initialization)	• Perform an initialization cycle when prompted or when RadioGenix System is returned to service after a scheduled or unscheduled downtime, such as an interrupted cycle due to equipment or power failure.
Produce Tc-99m Every elution	• Replace the technetium Tc-99m product cartridge, technetium Tc-99m product vial, 0.9% normal saline syringe and the product port caps.
Add/Change Reagents Every 10 elutions or after sterilization	• Replace the primary separation cartridge (PSC), the reagent assembly consisting of 3% hydrogen peroxide, 5M potassium hydroxide and 1.5M sodium acetate along with their port caps.
Add/Remove Source Vessel No later than expiration date indicated on Source Vessel label	• Replace each potassium molybdate Mo-99 Source Vesselwith a new Mo-99 source. • Use each potassium molybdate Mo-99 source solution by the indicated expiration date on the label.
Sterilization Weekly	• Perform the software-driven ozonated water system sterilization process. • Replace the 0.1 micrometer RGX air filter.
Exchange Discarded Material Every 200 elutions or earlier	• Remove the radioactive waste (discarded material container holds 3.5 liters) using appropriate safety measures. Replace with a fresh container.

2.6 Directions for Eluting RadioGenix System

- The Sodium Pertechnetate Tc 99m Injection solution is produced using the “Produce Tc-99m” protocol through the

RadioGenix System home screen. **Follow step-by-step directions for use provided in the RadioGenix System Operator Guide Version 1.0a and 1.1 (94S05058).**

- The elution process to produce Sodium Pertechnetate Tc 99m Injection involves the initial installation and set-up of the equipment, reagents, sterilizing filters, and sterile final product collection vials provided by NorthStar Medical Radioisotopes, LLC *[see Table 3]*.
- Implement the following prerequisites before the "Produce Tc-99m" protocol is initiated:
  1. Connect the potassium molybdate Mo-99 source container using the Source Vessel Kit for RadioGenix System.
  2. Aseptically install the Reagent Kit for RadioGenix System consisting of three reagent solutions (3% Hydrogen Peroxide, 5M Potassium Hydroxide, and 1.5M Sodium Acetate) and the primary separation cartridge (PSC).
  3. Aseptically assemble and install the Tc-99m Product Kit for RadioGenix System consisting of an alumina column, 0.22 micron filter, and a 20 mL sterile collection vial.
  4. Attach the supplied pre-filled syringe containing 0.9% sodium chloride injection, USP to the saline port.
  5. Initiate the computer controlled elution process to prepare Sodium Pertechnetate Tc 99m Injection.
  6. After delivery of the Sodium Pertechnetate Tc 99m Injection to the collection vial is complete, remove the collection vial and perform the quality control procedures *[see Dosage and Administration (2.7)]*.
  7. Discard the first eluate from every new Potassium Molybdate Mo-99 Source Vessel to minimize the risk of unintended radiation exposure from Rhenium Re-186 *[see Warnings and Precautions (5.3)]*.

2.7 Quality Control of Sodium Pertechnetate Tc 99m Injection

Perform the following quality control procedures on each Sodium Pertechnetate Tc 99m Injection prior to its release for clinical use or for reconstitution with Tc-99m radiopharmaceutical kits.

Mo-99 Breakthrough Test

- Using a suitable radioactivity calibrator, determine the activity of technetium Tc-99m eluted.
- Place the Sodium Pertechnetate Tc 99m Injection eluate in a calibrated Mo-99 assay shield. Place the lid on the container and put the entire container in the dose calibrator chamber.
- Record the activity of molybdenum Mo-99 on the most sensitive scale.
- Divide the activity of molybdenum Mo-99 by the activity of technetium Tc-99m. Correct for decay and shielding effect, if necessary.
- Determine the molybdenum Mo-99/technetium Tc-99m ratio at the time of elution and from that ratio, determine the expiration time of the eluate. Each Sodium Pertechnetate Tc 99m Injection eluate must meet or exceed the purity requirement of 0.15 microCi of Mo-99 per mCi of Tc-99m.
- The expiry time for each eluate of Sodium Pertechnetate Tc 99m Injection must be no later than **12 hours** post-elution or the time where the Mo-99 to Tc-99m ratio reaches **0.15 microCi/mCi,** whichever occurs earlier.

Colorimetric Aluminum Ion Test Procedure

- Using an aluminum ion indicator kit, determine the aluminum ion concentration of the eluate per the manufacturer's instructions.
- The eluate concentration must not exceed 10 micrograms/mL.

Determination of pH

- Place a small drop of Sodium Pertechnetate Tc 99m Injection on a colorimetric pH strip.
- Examine and compare the coloration of the test strip with the colors displayed on the pH cartridge.
- The pH range must be between 4.5 and 7.5.

2.8 Radiolabeling (Reconstitution) of Kits

- In general, use no more than 3 mL volume for radiolabeling kits with RadioGenix System produced Sodium Pertechnetate Tc 99m Injection, USP. For radiolabeling certain kits (such as the Product Kit for the preparation of technetium Tc-99m exametazime), use no more than 1 mL of volume.
- Perform quality control of a radiolabeled kit per the directions in the kit package insert and only use the product if it meets the kit manufacturer's quality control requirements.
- The radiolabeled product shall have an expiry no more than **12 hours** from the time of sodium pertechnetate elution or the expiry time stated by the kit manufacturer, whichever occurs earlier.

2.9 Radiation Dosimetry

Intravenous Injection

Estimates of radiation absorbed dose per unit activity of Sodium Pertechnetate Tc 99m Injection administered to an adult of average size and weight and to pediatric patients of sizes and weights typical of representative ages are shown in Table 4.

Table 4 Radiation Absorbed Dose from Intravenous Injection

Age	Adult	15 years	10 years	5 years	1 year
Organ	**Absorbed dose per unit activity Sodium Pertechnetate Tc 99m Injection administered intravenously with no thyroid-blocking agent (microGy/MBq)***				
Adrenals	3.7	4.6	7.1	11	19
Bone Surfaces	5.4	6.5	9.6	14	25
Brain	2.0	2.5	4.1	6.5	11
Breasts	1.8	2.3	3.4	5.6	11
Gallbladder Wall	7.4	9.8	16	23	35
GI Tract					
Esophagus	2.5	3.2	4.8	7.5	14
Stomach Wall	26	34	48	78	160
Small Intestine	16	20	31	47	82
Colon Wall	41	53	89	140	270
ULI Wall	56	73	120	200	370
LLI Wall	21	27	45	71	130
Heart Wall	3.1	4.0	6.0	9.1	16
Kidneys	5.0	6.0	8.6	13	21
Liver**	4.8	6.0	10	15	28
Lungs	2.6	3.4	5.1	7.9	14
Muscles	3.2	4.0	6.0	9.1	16
Ovaries	9.9	13	18	27	44
Pancreas	5.6	7.2	11	16	27
Red Marrow	3.7	4.4	6.5	9.0	15
Salivary Glands	8.5	10	14	18	26
Skin	1.8	2.2	3.5	5.6	10
Spleen	4.3	5.3	8.0	12	20
Testes	2.8	3.7	5.9	9.1	16
Thymus	2.5	3.2	4.8	7.5	14
Thyroid	22	36	54	120	220
Urinary Bladder Wall	18	23	34	45	66
Uterus	8.1	10	16	23	37
Remaining Tissues	3.7	4.7	7.1	11	19
	Effective dose* per administered activity (microSv/MBq)				
	13	17	26	42	79

*To obtain radiation absorbed dose per unit activity in mrad/mCi from the preceding table, multiply individual values by a factor of 3.7. For effective dose per administered activity, the resulting unit is mrem/mCi.

**For the liver, 20% of the absorbed dose per unit activity is derived from a presumed maximum concentration of 0.015% MBq Mo-99 per MBq Tc-99m.

Dacryoscintigraphy

Estimates of radiation absorbed dose to an adult patient from the nasolacrimal imaging procedure using a maximum dose

of 3.7 megabecquerels (0.1 millicurie) of Sodium Pertechnetate Tc-99m are shown in Table 5.

Table 5 Radiation Absorbed Dose in the Eye Lens from Dacryoscintigraphy of Adults		
	3.7 MBq (0.1 mCi) of Sodium Pertechnetate Tc-99m	
	(mGy)	(rad)
If lacrimal fluid turnover is 16% per min	0.140	0.014
If lacrimal fluid turnover is 100% per min	0.022	0.002

Cystography

Estimates of radiation absorbed dose per unit activity of Sodium Pertechnetate Tc 99m Injection administered through direct urinary-bladder infusion with no voiding over 30 minutes to an adult of average size and weight and to pediatric patients of sizes and weights typical of representative ages are shown in Table 6.

Table 6 Radiation Absorbed Dose* from Cystography						
Age	**Adult**	**15 years**	**10 years**	**5 years**	**1 year**	**Newborn**
Organ	**Absorbed dose per unit activity Sodium Pertechnetate Tc 99m Injection administered through direct urinary-bladder infusion with no voiding over 30 minutes (microGy/MBq)**					
Bone Surfaces	0.19	0.24	0.35	0.51	0.95	1.8
Kidneys	0.035	0.051	0.11	0.22	0.37	0.83
Ovaries	0.97	1.2	1.8	2.6	3.9	7.1
Red Marrow	0.14	0.19	0.28	0.34	0.41	0.67
Testes	0.67	0.95	1.7	2.6	4.7	8.5
Urinary Bladder Wall	20	26	37	55	101	237
	Effective dose equivalent per administered activity (microSv/MBq)					
	1.7	2.2	3.2	4.7	8.3	19
*To obtain radiation absorbed dose per unit activity in mrad/mCi from the preceding table, multiply individual values by a factor of 3.7. For effective dose equivalent per administered activity, the resulting unit is mrem/mCi.						

3 DOSAGE FORMS AND STRENGTHS

The RadioGenix System provides Sodium Pertechnetate Tc 99m Injection, USP from a non-highly enriched uranium source of potassium molybdate Mo-99, as a clear, colorless solution containing 30 mCi/mL to 1,153 mCi/mL (1,110 to 42,661 MBq/mL) of technetium Tc-99m radioactivity in approximately 5 mL of volume. The amount of Tc-99m radioactivity depends on the radioactivity in the potassium molybdate Mo-99 source. The source is supplied in vessels containing 6 Ci (222 GBq) at the date and time of calibration.

4 CONTRAINDICATIONS

None.

5 WARNINGS AND PRECAUTIONS

5.1 Radiation Exposure Risk

Sodium Pertechnetate Tc-99m contributes to a patient's overall long-term cumulative radiation exposure. Long-term cumulative radiation exposure is associated with an increased risk of cancer. Use the lowest dose of Sodium Pertechnetate Tc-99m necessary for imaging and ensure safe handling and preparation to protect the patient and healthcare worker from unintentional radiation exposure. Encourage patients to drink fluids and void as frequently as possible after intravenous or intravesicular administration. Advise patients to blow their nose and wash their eyes with water after ophthalmic

administration *[see Dosage and Administration (2.1)]*.

Radiation risks associated with the use of Sodium Pertechnetate Tc-99m are greater in pediatric patients than in adults due to greater absorbed radiation doses and longer life expectancy. Ensure the diagnostic benefit of Sodium Pertechnetate Tc-99m outweighs these greater risks prior to administration in pediatric patients.

5.2 Unintended Mo-99 Exposure

Unintended exposure to Mo-99 radiation contributes to a patient's overall cumulative radiation dose. To minimize the risk of unintended radiation exposure, strict adherence to the eluate testing protocol is required. Use only potassium molybdate Mo-99, processing reagents, saline, and other supplies, including kits, provided by NorthStar Medical Radioisotopes, LLC. Do not administer Sodium Pertechnetate Tc 99m Injection after the 0.15 microCi of Mo-99/mCi of Tc-99m limit has been reached and discard the Sodium Pertechnetate Tc 99m Injection when the 12 hour expiration time is reached; whichever occurs earlier *[see Dosage and Administration (2.7)]*.

5.3 Unintended Re-186 Exposure

Sodium Pertechnetate Tc 99m Injection from the first elution of Potassium Molybdate Mo-99 Source Vessel on the RadioGenix System may contain Rhenium Re-186, and may exceed USP limits for unspecified beta and gamma-emitting radionuclide impurities. Unintended exposure to Re-186 radiation contributes to a patient's overall cumulative radiation dose. To minimize the risk of unintended radiation exposure from Re-186, discard the first eluate from every new Potassium Molybdate Mo-99 Source Vessel *[See Dosage and Administration (2.6)]*.

5.4 Hypersensitivity Reactions

Hypersensitivity reactions, including serious signs and symptoms of anaphylaxis, following administration of Sodium Pertechnetate Tc 99m Injection have been reported. Always have cardiopulmonary resuscitation equipment and personnel available and monitor all patients for hypersensitivity reactions.

6 ADVERSE REACTIONS

The following adverse reactions are described elsewhere in the labeling:

- Radiation Exposure Risk (5.1)
- Unintended Mo-99 Exposure (5.2)

6.1 Postmarketing Experience

The following adverse reactions associated with the use of Sodium Pertechnetate Tc 99m Injection have been identified in postmarketing experience. Because these reactions are reported voluntarily from a population of uncertain size, it is not always possible to reliably estimate their frequency or establish a causal relationship to drug exposure.

Allergic reactions (skin rash, hives, or itching) including anaphylaxis has been reported following the administration of Sodium Pertechnetate Tc-99m.

8 USE IN SPECIFIC POPULATIONS

8.1 Pregnancy

Risk Summary

There are no available data with Sodium Pertechnetate Tc-99m use in pregnant women to inform any drug-associated risks of developmental outcomes. Animal reproductive studies have not been conducted with Sodium Pertechnetate Tc-99m. All radiopharmaceuticals, including Sodium Pertechnetate Tc-99m, have the potential to cause fetal harm depending on the fetal stage of development and the magnitude of the radiation dose. If considering Sodium Pertechnetate Tc-99m administration to a pregnant woman, inform the patient about the potential for adverse pregnancy outcomes based on the radiation dose from Sodium Pertechnetate Tc-99m and the gestational timing of exposure.

The estimated background risk of major birth defects and miscarriage for the indicated population is unknown. All pregnancies have a background risk of birth defects, loss, or other adverse outcomes. In the U.S. general population, the estimated background risk of major birth defects and miscarriage in clinically recognized pregnancies is 2-4% and 15-20%, respectively.

8.2 Lactation

Risk Summary

There are limited data available in the published literature on the presence of technetium Tc-99m in human milk. There are no data available on the effects of Sodium Pertechnetate Tc-99m on the breast fed infant or the effects on milk production. Exposure of Sodium Pertechnetate Tc-99m to a breastfed infant can be minimized by temporary discontinuation of breast feeding *(see Clinical Considerations).* The developmental and health benefits of breastfeeding should be considered along with the mother's clinical need for Sodium Pertechnetate Tc-99m, any potential adverse effects on the breastfed child from Sodium Pertechnetate Tc-99m or from the underlying maternal condition.

Clinical Considerations

To decrease radiation exposure to the breastfed infant, advise a lactating woman to pump and discard breastmilk after the administration of Sodium Pertechnetate Tc-99m for 12 to 24 hours, where the duration corresponds to the typical range of administrated activity, 259 MBq to 925 MBq (7 mCi to 25 mCi).

8.4 Pediatric Use

Safety and effectiveness have been established for Sodium Pertechnetate Tc-99m in pediatric patients from birth (term neonates) to 17 years of age of age for thyroid imaging and for urinary bladder imaging via direct isotopic cystography for the detection of vesicoureteral reflux based on clinical experience. Safety and effectiveness have not been established in pediatric patients for salivary gland imaging or nasolacrimal drainage system imaging. Although dose adjustment based on body size or weight is generally recommended, the administered dose should be adequate to obtain acceptable quality diagnostic information *[see Dosage and Administration 2.4]*. Radiation risks of Sodium Pertechnetate Tc 99m Injection are greater in pediatric patients than adults *[see Warnings and Precautions (5.1)]*.

8.5 Geriatric Use

Studies on the relationship of age to the effects of Sodium Pertechnetate Tc 99m Injection have not been performed in the geriatric population. Other reported clinical experience has not identified differences in responses between the elderly and younger patients. In general, dose selection for an elderly patient should be cautious, usually starting at the low end of the dosing range, reflecting the greater frequency of decreased hepatic, renal, or cardiac function, and of concomitant disease or other drug therapy.

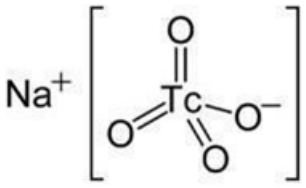
11 DESCRIPTION

11.1 Chemical Characteristics

The RadioGenix System provides Sodium Pertechnetate Tc 99m Injection, USP for intravenous use, intravesicular use, ophthalmic use, or for preparing radiopharmaceutical kits. The RadioGenix System uses a non-uranium potassium molybdate Mo-99 source solution to produce Sodium Pertechnetate Tc 99m Injection, USP. The RadioGenix System uses potassium molybdate Mo-99 sources at an activity of 6 Ci/29 mL (222 GBq) at the date and time of calibration.

Elution of RadioGenix System produces Sodium Pertechnetate Tc-99m ($Na^{99m}TcO_4$) in approximately 5 mL of sterile 0.9% sodium chloride injection solution. The activity of Sodium Pertechnetate Tc-99m produced varies (30 mCi/mL to 1,153 mCi/mL of technetium Tc-99m) and depends on the activity of potassium molybdate Mo-99 present in the source container originally, the decay time since the calibration time, and the elapsed time since the previous Sodium Pertechnetate Tc-99m elution.

Sodium Pertechnetate Tc-99m is an inorganic compound with the formula $Na^{99m}TcO_4$. In solution, Sodium Pertechnetate exists as dissociated Na^+ cations and pertechnetate TcO_4^- anions with the following molecular structure:



The eluted Sodium Pertechnetate Tc 99m Injection, USP is a sterile, non-pyrogenic, clear, and colorless solution. The pH of the solution is between 4.5 and 7.5.

11.2 Physical Characteristics

Technetium Tc-99m

Technetium Tc-99m decays by isomeric transition with a physical half-life of 6.01 hours. The principal photon that is useful for detection and imaging studies is shown in Table 8.

Table 8 Principal Radiation Emission Data technetium Tc-99m		
Radiation	Mean Percent Per Disintegration	Energy (keV)
Gamma-2	88.5	140.5

The air-kerma-rate (exposure-rate) constant for technetium Tc-99m is 5.23 $m^2 \cdot pGy \cdot (MBq)^{-1} \cdot s^{-1}$ [0.795 $cm^2 \cdot R \cdot (mCi)^{-1} \cdot h^{-1}$]. A range of values for the relative radiation attenuation by the various thicknesses of Pb is shown in Table 9. For example, the use of 3 mm thickness of Pb will attenuate the radiation exposure by a factor of about 1,000.

Table 9 Radiation Attenuation by Lead Shielding	
Shield Thickness (Pb) mm	**Coefficient of Attenuation**
0.25	0.5
1	10^{-1}
2	10^{-2}
3	10^{-3}
4	10^{-4}

Molybdenum Mo-99

Molybdenum Mo-99 decays to technetium Tc-99m with a molybdenum Mo-99 half-life of 66 hours. This means that 77.7% of the activity remains after 24 hours; 60.4% remains after 48 hours (see Table 10).

Table 10 Molybdenum Mo-99 Decay Chart half- life 66.0 hours			
Days	Percent Remaining	Days	Percent Remaining
0*****	100	10	8
1	77.7	11	6.3
2	60.4	12	4.9
3	46.9	13	3.8
4	36.5	14	2.9
5	28.4	15	2.3
6	22.0	20	0.6
7	17.1	25	0.2
8	13.3	30	0.1
9	10.3		
***** calibration time			

The physical decay characteristics of molybdenum Mo-99 are such that 88.6% of the decaying molybdenum Mo-99 atoms form Technetium Tc-99m. RadioGenix System elutions may be made at any time, but the amount of technetium Tc-99m available will depend on the time interval measured from the last elution cycle. Eluting the RadioGenix System every 24 hours will provide the maximal yield of Sodium Pertechnetate Tc-99m.

To correct for physical decay of technetium Tc-99m, the fractions that remain at selected intervals of time are shown in Table 11.

Table 11 Physical Decay Chart. Technetium Tc-99m, half-life 6.01 Hours

Hours	Percent Remaining	Hours	Percent Remaining
0*	100	7	44.7
1	89.1	8	39.8
2	79.4	9	35.5
3	70.8	10	31.6
4	63.1	11	28.2
5	56.2	12	25.1
6	50.1		

* calibration time

12 CLINICAL PHARMACOLOGY

12.1 Mechanism of Action

The pertechnetate ion distributes in the body similarly to the iodide ion, but is not organified. In contrast to the iodide ion, the pertechnetate is released unchanged from the thyroid gland.

12.2 Pharmacodynamics

Pertechnetate concentrates in the thyroid gland, salivary glands, gastric mucosa and choroid plexus. After intravenous administration, it equilibrates with the extracellular space.

Following the administration of Sodium Pertechnetate Tc-99m as an eye drop, the drug mixes with tears within the conjunctival space. Within seconds to minutes it leaves the conjunctival space and escapes into the inferior meatus of the nose through the nasolacrimal drainage system. During this process the pertechnetate ions pass through the canaliculi, the lacrimal sac, and the nasolacrimal duct. In the event of any anatomical or functional blockage of the drainage system there will be a backflow resulting in tearing (epiphora). Thus, the pertechnetate escapes the conjunctival space in the tears. The majority of the pertechnetate escapes within a few minutes of normal drainage and tearing.

12.3 Pharmacokinetics

Times to peak concentrations of pertechnetate following intravenous administration are 3.5 hours for cerebral spinal fluid (CSF) and 0.25 to 2 hours for thyroid (euthyroid patients).

The disappearance of pertechnetate from plasma is biexponential with an initial phase of 10 minutes and a terminal phase of 3 hours. The corresponding phases in CSF are less than 1 hour and 11-12 hours, respectively.

Distribution: Pertechnetate distributes throughout the body concentrating in the gastric mucosa, thyroid gland, salivary glands, and urinary bladder.

Elimination:
Excretion: Elimination by urinary route is 27% in 1 day, 31% in 4 days, and 34% in 8 days based on rate of excretion.

13 NONCLINICAL TOXICOLOGY

13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

No long-term studies have been performed to evaluate carcinogenic potential, mutagenicity potential, or to determine whether Sodium Pertechnetate Tc 99m Injection may affect fertility in males or females.

16 HOW SUPPLIED/STORAGE AND HANDLING

16.1 How Supplied

The RadioGenix System is a technetium tc-99m generator supplied and installed by NorthStar Medical Radioisotopes, LLC. It produces Sodium Pertechnetate Tc 99m Injection from a non-uranium potassium molybdate Mo-99 source solution. The potassium molybdate Mo-99 source solution is shielded within a source container which completely encases a vial that contains 29 mL of solution. NorthStar supplies potassium molybdate Mo-99 solution with the referenced calibration date and time specified on the container label (Table 12).

Table 12 Potassium Molybdate Mo-99 Solution Containers

Mo-99 Activity at Time of Calibration		Product Number	NDC Number
FCuries	Gigabecquerels		
6.0	222	40P03246	71612-006-01

The following kits (Tables 13-17) are used in the operation of the RadioGenix System as described in the RadioGenix System Operator Guide Version 1.0a and 1.1(94S05058).

Table 13 Materials Supplied in Source Vessel Kit for RadioGenix System, p/n 40P07954

Component Description	Component Part Number	Qty.
Catheter	77P07937	1
Air Filter	77C01237	1
Manifold	12D09657	1
Absorbent Cloth	73C05400	1
Black Cap	77C01489	1
Cap	77C05450	1
Luer Cap	77C05449	1

Table 14 Materials Supplied in Reagent Kit for RadioGenix System, p/n 40P05044

Component Description	Component Part Number	Qty.
Reagents	16P04143	1
Primary Separation Cartridge (PSC)	40P03354	1
Hydrogen Peroxide Wipe	16C07455	5

Table 15 Materials Supplied in Tc-99m Product Kit for RadioGenix System, p/n 40P05045

Component Description	Component Part Number	Qty.
Tc-99m Product Cartridge (TPC)	40P04600	1
Tc-99m Collection Vial	77C01318	1
Saline Syringe	16C05227	1
Product Port Cap	16C05212	1
Cap	16C04989	1
Hydrogen Peroxide Wipe	16C07455	3

Table 16 Materials Supplied in Sterilization Kit for RadioGenix System, p/n 40P05043		
Component Description	**Component Part Number**	**Qty.**
Blank Primary Separation Cartridge (PSC)	40P04578	1
Blank Tc-99m Product Cartridge (TPC)	40P05377	1
Spike	NA	1
Air Filter	77C01237	1
Cap	16C04989	7
Product Port Cap	16C05212	1
Purge Water Container	77C05585	1
Sterile Water for Injection (SWFI)	16C04488	1
Hydrogen Peroxide Wipe	16C07455	13
Product Vial	NA	1

Table 17 Materials Supplied in Discarded Material Kit for RadioGenix System, p/n 40P05046		
Component Description	**Component Part Number**	**Qty.**
Discarded Material Container	12D05146	1
Silicone Tubing	77C05431	1
Luer Cap	77C05449	1

16.2 Storage and Handling

Storage

- Receipt, transfer, storage, handling, possession, or use of the potassium molybdate Mo-99 source solution, Sodium Pertechnetate Tc 99m Injection, and radioactive components of the RadioGenix System are subject to the radioactive material regulations and licensing requirements of the U.S. Nuclear Regulatory Commission, Agreement States, or Licensing States.
- Install and operate RadioGenix System, and store the potassium molybdate Mo-99 source solutions and kits [Sterilization Kit for RadioGenix System Reagent Kit for RadioGenix System, Tc-99m Product Kit for RadioGenix System, Discarded Material Kit for RadioGenix System, and Source Vessel Kit for RadioGenix System] at 20°C-25°C (68°F-77°F); excursions permitted to 15°C-30°C (59°F-86°F).

Disposal

- The maximum use period of a RadioGenix System is one year from the date of installation. After expiry, have NorthStar perform annual preventative maintenance and recertify the RadioGenix System.
- The maximum use period of the ozone generator is 6 months. After expiry, have NorthStar replace the ozone generator.
- When the potassium molybdate Mo-99 source has reached the end of its useful life or expiration date, remove the source vessel from the RadioGenix System and return it to NorthStar for processing.
- Dispose of the radioactive waste (discarded material) container in accordance with applicable regulations.

17 PATIENT COUNSELING INFORMATION

Administration Instructions:

Intravenous or Intravesicular Administration

Advise patients to hydrate before (4 hours) and after administration and to void as soon as the imaging study is completed and as often as possible thereafter for the next 12 hours to minimize radiation exposure *[see Dosage and Administration (2.2) and Warnings and Precautions (5.1)]*.

Ophthalmic Administration

After the termination of the nasolacrimal imaging procedure, advise patient to blow their nose and/or wash their eyes with sterile distilled water to further minimize the radiation dose *[see Dosage and Administration (2.2) and Warnings and Precautions (5.1)]*.

Pregnancy:

Advise pregnant women of the risk of fetal exposure to radiation dose if they undergo a radionuclide procedure *[see Use in Specific Populations (8.1)]*.

Lactation:

Advise a lactating woman that exposure of the infant to technetium Tc-99m through breast milk can be minimized if breastfeeding is interrupted when technetium Tc-99m is administered. Advise a lactating woman to pump and discard breast milk for 12 to 24 hours based on the injected dose *[see Use in Specific Populations (8.2)]*.

Manufactured and Distributed by:
NorthStar Medical Radioisotopes, LLC
1800 Gateway Blvd
Beloit, Wisconsin 53511

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