JUNE 2023

A REVIEW OF Mo 99/Tc 99m generators

Ultra-Technekow™ V4 (technetium Tc 99m generator) Indication and Important Risk Information

Indication & Usage

The Ultra-Technekow™ V4 generator is a source of sodium pertechnetate Tc 99m for use in the preparation of FDA-approved diagnostic radiopharmaceuticals, as described in the labeling of these diagnostic radiopharmaceutical kits.

Sodium Pertechnetate Tc 99m is used IN ADULTS as an agent for:

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

Sodium Pertechnetate Tc 99m is used IN PEDIATRIC PATIENTS as an agent for:

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

Important risk information

Warnings and precautions

- Radiation risks associated with the use of Sodium Pertechnetate Tc 99m are greater in pediatric patients than in adults and, in general, the younger the patient the greater the risk owing to greater absorbed radiation doses and longer life expectancy. These greater risks should be taken firmly into account in all benefit risk assessments involving pediatric patients.

Please see additional Important Risk Information on page 14 and accompanying full Prescribing Information.

curium™
LIFE FORWARD

Introduction

Radioisotope generators serve as a convenient system for production of medical radioisotopes, including technetium 99m (Tc 99m), within nuclear pharmacies.[1] Tc 99m is an essential diagnostic radioisotope that is widely used in approximately 80% of all nuclear medicine procedures worldwide. In the United States alone, 40,000 to 50,000 Tc 99m-based scans are performed daily.[2]

Sodium Pertechnetate Tc 99m can be used alone or chemically incorporated into diagnostic radiopharmaceuticals using cold kits for single photon emission computed tomography (SPECT) imaging studies, including[3,4]:

- Thyroid imaging*
- Urinary bladder imaging for detection of vesico-ureteral reflux*
- Salivary gland imaging†
- Nasolacrimal drainage system imaging†
- Cardiac imaging‡
- Bone imaging‡

*Sodium Pertechnetate Tc 99m indications for both adult and pediatric patients.

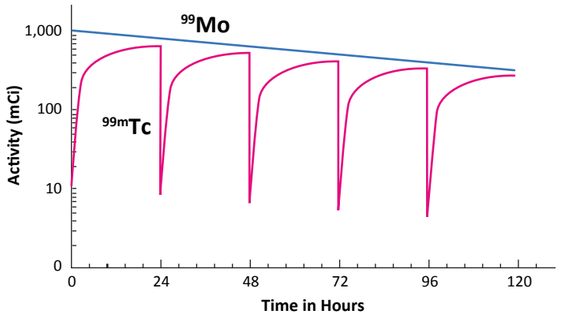
†Sodium Pertechnetate Tc 99m indications for adult patients only.

‡Sodium Pertechnetate Tc 99m for cold kit labeling; see product labels for more information.

Tc 99m is the daughter nuclide of molybdenum 99 (Mo 99) beta decay. Mo 99/Tc 99m generators are used to obtain Tc 99m for SPECT imaging or radiopharmaceutical labeling through an elution process.

Mo 99 has a half-life of 66 hours, and over ~24 hours, the Mo 99/Tc 99m reaches transient equilibrium. Over time, the total amount of Mo 99 in the Mo 99/Tc 99m generator decays until it is no longer useful (**see Figure 1**). Due to the short 6-hour half-life of Tc 99m and its importance to North America, it is imperative to maintain a reliable Mo 99 supply.[1-3,5,6]

FIGURE 1: Plot of typical Mo 99 and Tc 99m activity on a logarithmic scale over time. Adapted from National Academy of Sciences NRC Committee 2009.[5]*



*Assumes elution occurs every 24 hours.

In the US, there are 3 main Tc 99m generator manufacturers that use 2 primary production methods for starting materials for the current FDA-approved Mo 99/Tc 99m generators (**see Table 1**).[7-12] Other generators in the pipeline include one from BWXT Medical Ltd that will use Mo 98 as a starting material for the production of Mo 99 and another from NorthStar Medical Radioisotopes that will use Mo 100-produced Mo 99.[13,14]

TABLE 1: FDA-approved Mo 99/Tc 99m generators[7-12,15]

Company	Generator	Starting Material	Reaction
Curium	Ultra-Technekow™ V4 (technetium Tc 99m generator)	100% HALEU[a]	Fission
Lantheus Medical Imaging	TechneLite® (technetium Tc 99m generator)	100% HALEU[a]	Fission
NorthStar Medical Radioisotopes	RadioGenix® System (technetium Tc 99m generator)	Mo 98	Neutron capture

[a]High-assay low-enriched uranium (HALEU) is enriched 5% to <20% U 235.[16]

Important Risk Information for Ultra-Technekow™ V4 (technetium Tc 99m generator)

Warnings and precautions

- Only use generator eluant specified for use with the Ultra-Technekow™ V4 generator. Do not use any other generator eluant or saline from any other source.

Please see additional Important Risk Information on page 14 and accompanying full Prescribing Information.

General process

The Mo 99 production process begins with an enriched target material that is irradiated with neutrons at research reactors.[6,8,9,12,17] Six global research reactors are used to irradiate U 235 targets, and 1 domestic research reactor is used to irradiate Mo 98 targets.[2,12] The irradiated targets are then processed into Mo 99 bulk liquid at a Mo 99 processing facility. This liquid Mo 99 is incorporated into the final Mo 99/Tc 99m generators at manufacturing facilities. To satisfy the demand for Tc 99m-based scans, every stage of the process must be continuous and efficient, preserving as much radioactivity as possible for the Mo 99/Tc 99m generators.[6,12] Disruptions in workflow can have significant downstream implications and cause widespread outages.

Supply of target material

Uranium 235 (U 235) and molybdenum 98 (Mo 98) are the 2 main target materials for the production of Mo 99.[7-12] Both isotopes have a modest natural abundance (~0.7% and 24%, respectively) and undergo enrichment to help improve the efficiency of the irradiation process.[8,9,12,17,18] U 235 is enriched to between 5% and <20%, at which point it is classified as high-assay low-enriched uranium (HALEU).[16] The U 235 used by Curium and Lantheus Medical Imaging is enriched to 19.75%.[12] The US Department of Energy (US DOE) manages the supply of HALEU, which is preferred over high-enriched uranium (HEU; ≥20% U 235) for medical isotope production due to diversion concerns.[6,19] Mo 98 is enriched to >95% and is mainly available from a supplier in the Russian Federation.[6,17]

Fission vs neutron capture

Targets are irradiated using 2 different methods: U 235 undergoes fission, and Mo 98 undergoes neutron capture.[5,6] Fission is the bombardment of the U 235 nucleus with neutrons to cause the nucleus to fission or break apart (**see Figure 2a**). This results in a reaction that produces high amounts of energy and many byproducts. Mo 99 makes up approximately 6% of the total byproduct of a U 235 fission reaction.[5,6,18,20] Other byproducts of U 235 fission include I 131 and Xe 133, which are used in other nuclear medicine procedures.[6] Xenon Xe 133 Gas is used in pulmonary function evaluations, lung imaging, and cerebral blood flow assessments.[21]

Neutron capture occurs when neutrons bombard the Mo 98 nucleus and one of the neutrons merges with the atomic nucleus to produce Mo 99 (**see Figure 2b**). Even though Mo 99 is produced in this process, a significant number of Mo 98 atoms are still present.[5,6,18]

Neutron capture yields Low Specific Activity Mo 99, while the fission method yields High Specific Activity Mo 99. Low Specific Activity Mo 99 cannot be efficiently used in Mo 99/Tc 99m generators designed for Mo 99 derived from fission of U 235. Specific activity is the radioactivity per unit mass of a material. This means that at the same

FIGURE 2a: Production of Mo 99 from U 235 fission. Adapted from National Academy of Sciences NRC Committee 2009.[5,6]

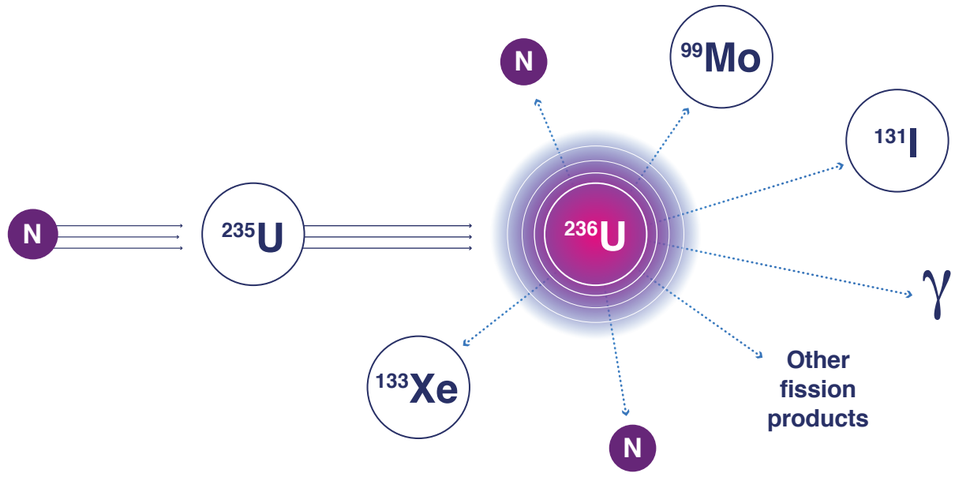


FIGURE 2b: Production of Mo 99 from Mo 98 neutron capture. Adapted from National Academy of Sciences NRC Committee 2009.[5]

Important Risk Information for Xenon Xe 133 Gas

Warnings and precautions

- Xenon Xe 133 Gas delivery systems, i.e., respirators or spirometers, and associated tubing assemblies must be leakproof to avoid loss of radioactivity into the laboratory environs not specifically protected by exhaust systems.

Please see additional Important Risk Information on page 15 for Xenon Xe 133 Gas and accompanying full Prescribing Information.

Important Risk Information for Ultra-Technekow™ V4 (technetium Tc 99m generator)

Warnings and precautions

- Radiopharmaceuticals should be used only by physicians who are qualified by training and experience in the safe use and handling of radionuclides and whose experience and training have been approved by the appropriate government agency authorized to license the use of radionuclides.

Please see additional Important Risk Information on page 14 for Ultra-Technekow™ V4 generator and accompanying full Prescribing Information.

TABLE 2a: U 235 Research Reactors[12,22-35]

Mo 99 Research Reactor	Location	Year of Commission
HFR	The Netherlands	1961
BR2	Belgium	1961
SAFARI-1	South Africa	1965
OPAL	Australia	2007
Maria	Poland	1974
LVR-15	Czech Republic	1957
FRM II[a]	Germany	2005
PALLAS[b]	The Netherlands	After 2030[c]
JHR[d]	France	After 2030[c]

[a]€5.4 million investment; scheduled to have Mo 99 production in 2025.
[b]€497 million investment; scheduled to replace the HFR reactor.
[c]Anticipated year of commission.
[d]€500 million investment; scheduled to replace the OSIRIS reactor.

TABLE 2b: Non-Uranium Mo 99 Production Facilities[36-39]

Facility	Location	Process	Year Commissioned
MURR	United States	Neutron capture (Mo 98)	1966
NorthStar Medical Radioisotopes Accelerator Production Facility[a]	United States	Electron accelerator (Mo 100)	2023
OPG Darlington Nuclear Generating Station[a]	Canada	Neutron capture (Mo 98)	1990

[a]Not currently FDA approved for use in a technetium Tc 99m generator.

mass, fission-produced Mo 99 has more available radioactivity than neutron capture-produced Mo 99. As a result, fission of U 235 is the most widely used process for Mo 99 production. High Specific Activity Mo 99 takes up less mass; therefore, it leads to space efficiencies within the pharmacy.[2,5,6,18]

Reactor investments

Six global research reactors supply the majority of U 235-derived Mo 99 and are supported by 4 global Mo 99 processing facilities. Alternatively, the Mo 98-based Mo 99 supply chain relies on 1 reactor and 1 processing facility.[2,12,37]

It is important to invest in routine maintenance and upgrades to preserve the supply chain. Approximately €400 million has been invested in recent years into upgrades for research reactors.[40] When a Mo 99-producing reactor nears the end of its life cycle, it is decommissioned and replaced with a new reactor. New reactors are either recently constructed or established by expanding the capabilities of an existing reactor. Over €1 billion has been invested in new Mo 99 reactors, ensuring the security and longevity of the Mo 99 supply (**see Tables 2a and 2b**).[29-35]

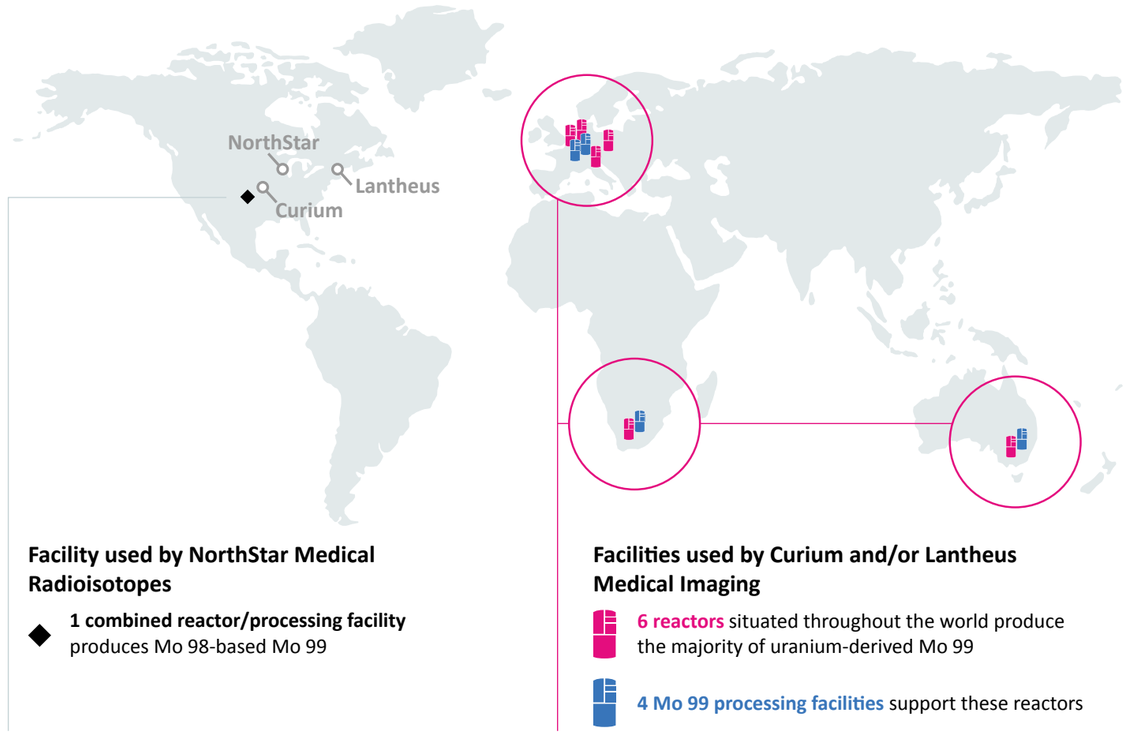
Redundancies

As Mo 99 has a 66-hour half-life, Mo 99/Tc 99m generators can only be used for 2 to 3 weeks.[1,8,10,41] To meet the high demand for Tc 99m generators and withstand the possibility of outages, the workflow must include redundancies that protect the integrity of the supply chain. In addition, numerous research reactors used to produce Mo 99 and processing facilities help to maintain the workflow.[2,6,12,37]

The reactors within the U 235 workstream are run by governments, and routine maintenance is coordinated between the facilities to allow for proactive planning for Mo 99 producers.[12,42] The Mo 98-based production chain is currently limited to the Missouri University Research Reactor (MURR) (**see Figure 3**).[2,12,37]

Mo 99 producers must buy reactor slot time for routine Mo 99 production, so it is important to protect the supply chain in case of an outage.[6,12] Outage reserve capacity is a strategy used by Mo 99 producers to proactively purchase extra reactor capacity, so targets can be irradiated in the event of an unexpected outage.[2,6,43] A diversified and redundant network is more adaptable during scheduled maintenance and flexible during unexpected outages.

FIGURE 3: Map of Mo 99 Production Facilities[2,12,37]



Facility used by NorthStar Medical Radioisotopes

◆ **1 combined reactor/processing facility** produces Mo 98-based Mo 99

Facilities used by Curium and/or Lantheus Medical Imaging

6 reactors situated throughout the world produce the majority of uranium-derived Mo 99

4 Mo 99 processing facilities support these reactors

Important Risk Information for Ultra-Technekow™ V4 (technetium Tc 99m generator)

Warnings and precautions

- After the termination of the nasolacrimal imaging procedure, blowing the nose and washing the eyes with sterile distilled water or an isotonic sodium chloride solution will further minimize the radiation dose.

Please see additional Important Risk Information on page 14 and accompanying full Prescribing Information.

TABLE 3: Features of Mo 99/Tc 99m generators[1,3,8-12,41,44-47]

	Ultra-Technekow™ V4 (technetium Tc 99m generator)	TechneLite® (technetium Tc 99m generator)	RadioGenix® System (technetium Tc 99m generator)
Mo 99 source	U 235; 100% HALEU	U 235; 100% HALEU	Mo 98
System type	Dry system	Dry system	Isotope separation platform with liquid Mo 99 source vessel
Activity options	13	13	4
Shielding options	Lead, depleted uranium	Lead	Lead, tungsten
Expiration	14 days after manufacturing	14 days after manufacturing	21 days after manufacturing[a]
Dimensions	~5 in D x 12 in H	~5 in D x 12 in H	48 in L x 29 in D x 75 in H
Weight	55 to 70 lb (generator and packaging); full auxiliary shield adds 280 lb	Contact manufacturer for weight of generator, packaging, and full auxiliary shield	~90 lb (source vessel); 3011 lb (generator system)

[a]Source vessel.

Generator overview

The current FDA-approved Mo 99/Tc 99m generators derived from HALEU are dry, solid systems with an alumina column that has Mo 99 adsorbed onto it (**see Table 3**). These are 2-port systems: 1 port is for the saline generator eluant and the other is for the evacuated collection vial. During elution, saline that is passed through the system collects the Tc 99m from the column into the evacuated vial (**see Figure 4a**).[1,3,7,44]

The RadioGenix® System is a more complex radioisotope separation platform that relies on a liquid Mo 99 source vessel and a dual-separation cartridge pathway (**see Figure 4b and Table 3**). The liquid Mo 99 source vessel is used to contain the Mo 99. Once the computer-driven system initiates the elution process, the Mo 99 is drawn across the first column, which is the primary separation cartridge that retains the Tc 99m. The Mo 99 is then returned to the source vessel. The system is eluted again to remove the Tc 99m from the first column. The user must perform significant assembly and maintenance on the RadioGenix® System before and after elution. Additional shielding for the system may be required by the end user to mitigate exposure during the elution process.[10,45-47]

Elution process

The elution process for dry generators is a convenient procedure that takes approximately 5 minutes after the initial generator setup. For the Ultra-Technekow™ V4 generator, this includes initially setting the generator into the auxiliary shield, setting up generator accessories, and seating a Technestat™ vial on the elution needles to help maintain sterility.[3,12,48]

Ultra-Technekow™ V4 and TechneLite® elution process

- Using aseptic technique and the appropriate accessories[3,12]:
  - Puncture eluant vial with eluant needles
  - Remove Technestat vial
  - Pierce evacuated vial with elution needle to begin elution (~5 minutes)
  - Replace Technestat vial
- Perform quality control procedures[3]
  - Tc 99m and Mo 99 content
  - Aluminum ion concentration

This procedure uses only 2 consumables: the generator eluant vial and the evacuated collection vial, as detailed in **Table 4**.[48]

RadioGenix® System elution process

The elution process for the RadioGenix® System involves the initial installation and setup of the equipment, reagent, sterilizing filters, and sterile collection vials. The elution protocol is controlled by the computer system and takes approximately 45 minutes after the initial setup.[45,47]

FIGURE 4:

Side-by-side images of Figures 4a and 4b to scale

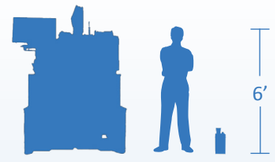


FIGURE 4a:

Image of Ultra-Technekow™ V4

Dimensions of generator[12]
~5 in D x 12 in H

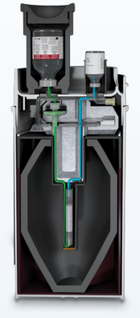


FIGURE 4b:

Image of RadioGenix® System

Dimensions of system[46]
48 in L x 29 in D x 75 in H

Images not to scale.

Important Risk Information for Ultra-Technekow™ V4 (technetium Tc 99m generator)

Warnings and precautions

- Since the eluate does not contain an antimicrobial agent, it should not be used after 12 hours from time of generator elution.

Please see additional Important Risk Information on page 14 and accompanying full Prescribing Information.

Important Risk Information for Ultra-Technekow™ V4 (technetium Tc 99m generator)

Adverse reactions

- Allergic reactions including anaphylaxis have been reported infrequently following the administration of Sodium Pertechnetate Tc 99m.

Please see additional Important Risk Information on page 14 and accompanying full Prescribing Information.

- Prior to elution protocol, users must[45]:
  - Connect Mo 99 source vessel using the source vessel kit, consisting of a catheter, air filter, and manifold
  - Aseptically install the primary separation cartridge (PSC) pack, consisting of the PSC, hydrogen peroxide wipe, and tubing assembly
  - Aseptically assemble and install the Tc 99m elution pack, consisting of the Tc 99m product cartridge, Tc 99m collection vial, product port cap, alcohol wipe, Tc 99m collection vial shield label, and Tc 99m collection vial label
  - Attach the saline tubing pack, consisting of a hydrogen peroxide wipe and saline tubing
  - Attach a sterile 0.9% saline bag
- Initiate computer-controlled elution process (~45 minutes)[45,47]
- Perform multistep quality control procedures[45]
  - Mo 99 breakthrough test
  - Colorimetric aluminum ion test procedure
  - Determination of pH

This procedure uses a collection of consumables for eluting the system, detailed in **Table 4**.[45]

Maintenance

Dry generators, like the Ultra-Technekow™ V4, require a daily inspection to ensure parts and tools are functioning properly and lead is not exposed.[48] The RadioGenix® System has 7 user-based maintenance protocols that operate on varying schedules and are in addition to annual preventative maintenance performed by a technician from NorthStar Medical Radioisotopes (**see Table 5**).[45]

TABLE 4: Consumables for generator elution[12,44,45,48]

Ultra-Technekow™ V4 (technetium Tc 99m generator)	TechneLite® (technetium Tc 99m generator)	RadioGenix® System (technetium Tc 99m generator)
1. Evacuated vial **2.** 0.9% saline vial (generator eluant)	**1.** Evacuated vial **2.** 0.9% saline vial (generator eluant)	**1.** Source vessel kit **2.** PSC pack **3.** Elution pack **4.** Saline tubing pack **5.** NaOH reagent solution **6.** 0.9% saline bag **7.** Discarded radioactive waste collection container

TABLE 5: Maintenance schedule for Mo 99/Tc 99m generators[45,48]

Ultra-Technekow™ V4	TechneLite®	RadioGenix® System
1. Daily inspection to ensure parts and tools are functioning properly and lead is not exposed	Contact manufacturer for maintenance schedule.	**1.** Initialization cycle when prompted or as needed **2.** Replace 0.9% sodium chloride injection, USP every 10 elutions or 24 hours **3.** Replace Tc 99m product cartridge, vial, and port caps every elution **4.** Replace NaOH and PSC every 10 elutions or after sterilization **5.** Replace or remove source vessel no later than expiration date (21 days from production) **6.** Sterilize with ozonated water weekly **7.** Exchange radioactive waste container (3.5 L) every 200 elutions or earlier **8**. Requires annual preventative maintenance from NorthStar technician

New generator

BWXT Medical has submitted a new drug application to the US Food and Drug Administration proposing approval for a new Mo 99/Tc 99m generator. This generator will use Mo 98 irradiated at a commercial power reactor or MURR as a Mo 99 source, rather than U 235. Additionally, there is a proprietary process for converting the low-specific activity Mo 99 into the Tc 99m generator that BWXT reports will "perform exactly the same as other generators on the market (i.e., offering the same activity, quality, and method of elution)."[13,49]

Historically, there have been safety and efficacy concerns around neutron capture-derived Mo 99 within Mo 99/Tc 99m generators. Breakthrough Mo 99 is a significant concern that can be related to the low-specific activity Mo 99 from neutron capture and the small size of the alumina column in the traditional Mo 99/Tc 99m dry generators.

The neutron capture method of production has a risk of half-life impurities, including radionuclidic, radiochemical, and biologic. The currently designed traditional Mo 99/Tc 99m generators are designed to support fission-derived Mo 99 and do not lend themselves as favorably to neutron capture–derived Mo 99.[18,50]

Solid vs liquid radioactive material

Liquid Mo 99 radioactive material has a potential to spill; therefore, it carries a higher level of risk compared to solid radioactive material. Spills or releases of radioactive material are considered a radiation emergency by the Occupational Safety and Health Administration (OSHA) and the US Nuclear Regulatory Commission (NRC). The NRC was created as an independent agency to ensure safe use of radioactive materials for beneficial civilian purposes while protecting people and the environment. There are strict regulations for radioactive materials, and

Important Risk Information for Ultra-Technekow™ V4 (technetium Tc 99m generator)

Use in specific populations

- Breastfeeding: Technetium Tc-99m is excreted in human milk during lactation, therefore, formula-feedings should be substituted for breast-feedings.

Please see additional Important Risk Information on page 14 and accompanying full Prescribing Information.

FIGURE 5: Radioactive waste by production method[3,12,45,51]

the NRC maintains an incident response program to provide expert consultation, support, and assistance for emergency events.[52-54] The NRC also partners with the US Department of Transportation to establish shipping rules for radioactive material.[55]

Radioactive waste

Radioactive waste disposal is highly regulated by governments and organizations around the world.[56,57] The U 235-based manufacturing process generates more radioactive waste than Mo 98-based production, although the total amount remains limited.

The manufacturing process for Curium's U 235-derived Mo 99 produces <20 L total of liquid and solid radioactive waste per batch.[12] This waste is disposed of at the Central Organization for Radioactive Waste (COVRA) in the Netherlands, a facility whose sole responsibility is to process and store radioactive waste in a professional and safe manner.[58] At COVRA, liquid and solid radioactive waste is solidified in concrete and stored in dedicated buildings at the facility.[59] The manufacturing process for U 235-derived Mo 99/Tc 99m generator produces domestic radioactive waste, which is disposed of at a licensed low-level waste disposal facility. Domestic radioactive waste created from these generators within nuclear pharmacies is limited. Curium offers a return program for spent generators to reuse viable components.[3,12]

The manufacturing process for the Mo 98-derived Mo 99/Tc 99m generator produces domestic radioactive waste. Radioactive waste is generated with the use of neutron capture Tc 99m generators within the nuclear pharmacies and has to be disposed of at a licensed low-level waste disposal facility. NorthStar Medical Radioisotopes also has a return and reuse program for spent liquid Mo 99 source vessels.[45,51]

Although radioactive waste is produced throughout the production of Mo 99/Tc 99m generators, regulations establish responsible disposal practices.[60,61] Due to the nature of the manufacturing process, production of Mo 99/Tc 99m generators derived from U 235 places responsibility for radioactive waste disposal onto the manufacturer, whereas Mo 98-based generators require the user to store and dispose of radioactive waste (**see Figure 5**).[3,12,45,51]

Conclusion

There are many factors for maintaining a secure Mo 99 supply chain that will ensure patients can get the scans they need. Redundant global networks offer additional stability to the supply chain over single-stream domestic production. Intuitive Mo 99/Tc 99m generator systems that require less time and user intervention lead to procedural efficiencies for the pharmacies. Mitigating risks and responsibilities of radioactive waste and proper disposal helps to alleviate workflow burden in the nuclear pharmacy. Finally, as a fundamental part of nuclear pharmacies, Mo 99/Tc 99m generators must consistently prioritize the end-user experience.

Important Risk Information for Ultra-Technekow™ V4 (technetium Tc 99m generator)

Warnings and precautions

- Long-term cumulative radiation exposure may be associated with an increased risk of cancer.

Please see additional Important Risk Information on page 14 and accompanying full Prescribing Information.

Ultra-Technekow™ V4 (technetium Tc 99m generator) Indication and Important Risk Information

Indication & Usage

The Ultra-Technekow™ V4 generator is a source of sodium pertechnetate Tc 99m for use in the preparation of FDA-approved diagnostic radiopharmaceuticals, as described in the labelling of these diagnostic radiopharmaceutical kits.

Sodium Pertechnetate Tc 99m is used IN ADULTS as an agent for:

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

Sodium Pertechnetate Tc 99m is used IN PEDIATRIC PATIENTS as an agent for:

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

Important risk information

Warnings and precautions

- Radiation risks associated with the use of Sodium Pertechnetate Tc 99m are greater in pediatric patients than in adults and, in general, the younger the patient the greater the risk owing to greater absorbed radiation doses and longer life expectancy. These greater risks should be taken firmly into account in all benefit risk assessments involving pediatric patients.
- Long-term cumulative radiation exposure may be associated with an increased risk of cancer.
- Only use generator eluant specified for use with the Ultra-Technekow™ V4 generator. Do not use any other generator eluant or saline from any other source.
- Radiopharmaceuticals should be used only by physicians who are qualified by training and experience in the safe use and handling of radionuclides and whose experience and training have been approved by the appropriate government agency authorized to license the use of radionuclides.
- As in the use of any radioactive material, care should be taken to minimize radiation exposure to the patient consistent with proper patient management and to ensure minimum radiation exposure to occupational workers.
- After the termination of the nasolacrimal imaging procedure, blowing the nose and washing the eyes with sterile distilled water or an isotonic sodium chloride solution will further minimize the radiation dose.
- Since the eluate does not contain an antimicrobial agent, it should not be used after 12 hours from time of generator elution.

Adverse reactions

- Allergic reactions including anaphylaxis have been reported infrequently following the administration of Sodium Pertechnetate Tc 99m.

Use in specific populations

- Pregnancy: Sodium Pertechnetate Tc 99m should be given to pregnant women only if the expected benefits to be gained clearly outweigh the potential hazards.
- Breastfeeding: Technetium Tc-99m is excreted in human milk during lactation, therefore, formula-feedings should be substituted for breast-feedings.

Please see accompanying full Prescribing Information or at https://www.curiumpharma.com/product/us-ultra-technekow-v4/.

Xenon Xe 133 Gas Indication and Important Risk Information

Indication & Usage

Xenon Xe 133 Gas has been shown to be valuable for diagnostic inhalation studies for the evaluation of pulmonary function, for imaging the lungs and may also be applied to assessment of cerebral blood flow.

Important risk information

Warnings and precautions

- Xenon Xe 133 Gas delivery systems, i.e., respirators or spirometers, and associated tubing assemblies must be leakproof to avoid loss of radioactivity into the laboratory environs not specifically protected by exhaust systems.
- Xenon Xe 133 Gas adheres to some plastics and rubber and should not be allowed to stand in tubing or respirator containers. Loss of radioactivity due to such adherence may render the study nondiagnostic.
- Xenon Xe 133 Gas as well as other radioactive drugs, must be handled with care and appropriate safety measures should be used to minimize radiation exposure to clinical personnel. Also, care should be taken to minimize radiation exposure to the patients consistent with proper patient management.
- Exhaled Xenon Xe 133 Gas should be controlled in a manner that is in compliance with the appropriate regulations of the government agency authorized to license the use of radionuclides.
- Radiopharmaceuticals should be used only by physicians who are qualified by training and experience in the safe use and handling of radionuclides.
- Transfer the appropriate Xenon Xe 133 Gas dose from the Xenon Xe 133 Gas unit dose vial(s) to a breathing device or spirometer utilizing the Xenotron™ I Xenon Gas Dispenser. Follow the directions for use that are provided with the Xenotron I Xenon Gas Dispenser.

Adverse reactions

- Adverse reactions specifically attributable to Xenon Xe 133 Gas have not been reported.

Use in specific populations

- Pregnancy Category C. Xenon Xe 133 Gas should be given to a pregnant woman only if clearly needed.
- Breastfeeding: It is not known whether this drug is excreted in human milk. Because many drugs are excreted in human milk, caution should be exercised when Xenon Xe 133 Gas is administered to a nursing woman.
- Pediatric Use: Safety and effectiveness in pediatric patients have not been established.

Please see accompanying full Prescribing Information or at https://www.curiumpharma.com/product/xenon-xe-133-gas/.

References:

1. Gupta R, Hashmi MF. Mo99 - Tc99m Generator. In: *StatPearls.* Treasure Island (FL): StatPearls Publishing; July 25, 2022. https://www.ncbi.nlm.nih.gov/books/NBK565854/
2. National Academies of Sciences, Engineering, and Medicine; Division on Earth and Life Studies; Nuclear and Radiation Studies Board. *Opportunities and Approaches for Supplying Molybdenum-99 and Associated Medical Isotopes to Global Markets: Proceedings of a Symposium.* National Academies Press (US); 2018. Accessed February 15, 2023. https://www.ncbi.nlm.nih.gov/books/NBK487238/
3. Ultra-Technekow™ V4. Package insert. Curium US LLC; May 2022.
4. Kane SM, Davis DD. Technetium-99m. [Updated 2022 Sep 19]. In: *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK559013/
5. National Research Council (US) Committee on Medical Isotope Production Without Highly Enriched Uranium. *Medical Isotope Production without Highly Enriched Uranium*. Washington (DC): National Academies Press (US); 2009.
6. Committee on State of Molybdenum-99 Production and Utilization and Progress Toward Eliminating Use of Highly Enriched Uranium; Nuclear and Radiation Studies Board; Division on Earth and Life Studies; National Academies of Sciences, Engineering, and Medicine. *Molybdenum-99 for Medical Imaging*. National Academies Press (US); 2016. Accessed February 1, 2023. https://www.ncbi.nlm.nih.gov/books/NBK396175/
7. US Food and Drug Administration. *Orange Book: Approved Drug Products With Therapeutic Equivalence and Evaluations.* Technetium Tc 99m sodium pertechnetate generator. Published February 10, 2023. Accessed February 14, 2023. https://www.accessdata.fda.gov/scripts/cder/ob/search_product.cfm
8. Ultra-Technekow™ V4 (technetium Tc 99m generator). Curium. Published 2021. Accessed February 14, 2023. https://www.curiumpharma.com/product/us-ultra-technekow-v4/
9. TechneLite® (Technetium Tc 99m Generator). Lantheus. Published 2022. Accessed February 14, 2023. https://technelite.com/about_technelite.html
10. RadioGenix® System (technetium Tc 99m generator). NorthStar Medical Radioisotopes. Published 2021. Accessed February 14, 2023. https://www.northstarnm.com/our-products/radiogenix/
11. Innovative Mo 99 production. NorthStar Medical Radioisotopes. Published 2021. Accessed February 16, 2023. https://www.northstarnm.com/our-products/mo-99/
12. Data on file. Curium US LLC.
13. Product Pipeline. BWXT Medical Ltd. Accessed April 24, 2023. https://www.bwxt.com/bwxt-medical/products-and-pipeline/product-pipeline
14. Accelerator Mo-99 Production. NorthStar Medical Radioisotopes. Accessed April 24, 2023. https://www.northstarnm.com/development/accelerator-mo-99/
15. HALEU Consortium Members. Office of Nuclear Energy. Accessed April 24, 2023. https://www.energy.gov/ne/haleu-consortium-members
16. What is High-Assay Low-Enriched Uranium (HALEU)? Office of Nuclear Energy. Published April 7, 2020. Accessed April 24, 2023. https://www.energy.gov/ne/articles/what-high-assay-low-enriched-uranium-haleu
17. NorthStar Medical Radioisotopes announces FDA approval for enhanced U.S. Mo 99 radioisotope production capacity. NorthStar Medical Radioisotopes. January 6, 2021. Accessed February 15, 2023. https://www.northstarnm.com/northstar-medical-radioisotopes-announces-fda-approval-for-enhanced-u-s-mo-99-radioisotope-production-capacity/
18. Hasan, S., Prelas, M.A. Molybdenum-99 production pathways and the sorbents for 99Mo/99mTc generator systems using (n, γ) 99Mo: a review. *SN Appl.* Sci. 2, 1782 (2020). https://doi.org/10.1007/s42452-020-03524-1
19. U.S. Department of Energy HALEU Consortium. Office of Nuclear Energy. Accessed April 25, 2023. https://www.energy.gov/ne/us-department-energy-haleu-consortium
20. Nuclear Explained. US Energy Administration. Accessed April 25, 2023. https://www.eia.gov/energyexplained/nuclear/#:~:text=In%20nuclear%20fission%2C%20atoms%20are,form%20of%20heat%20and%20radiation.
21. Xenon Xe 133 Gas. Package insert. Curium US LLC; December 2018.
22. Nuclear research facilities. NRG. Accessed April 26, 2023. https://www.nrg.eu/en/about/nuclear-research-facilities
23. Joppen F, Kopnen E, Van Dijck S. Periodic safety review of the BR2 reactor. International Atomic Energy Agency.
24. SAFARI-1. NTP Radioisotopes SOC Ltd. Accessed April 26, 2023. https://www.ntp.co.za/safari-1/
25. OPAL multi-purpose reactor. ANSTO. Accessed April 26, 2023. https://www.ansto.gov.au/facilities/opal-multi-purpose-reactor
26. The MARIA research reactor. National Centre for Nuclear Research. Accessed April 26, 2023. https://www.ncbj.gov.pl/en/o-nas/maria-research-reactor
27. Research reactor LVR-15. Centrum výzkumu Řež s.r.o. Accessed April 26, 2023. http://reaktory.cvrez.cz/en/research-reactor-lvr-15/
28. About us. Research Neutron Source Heinz Maier-Leibnitz (FRM II). Accessed April 26, 2023. https://www.frm2.tum.de/en/frm2/about-us/
29. Construction of the Mo 99 irradiation facility. Research Neutron Source Heinz Maier-Leibnitz (FRM II). Accessed February 15, 2023. https://www.frm2.tum.de/en/frm2/mo-99/construction-of-the-mo-99-irradiation-facility/
30. Approval of the molybdenum-99-producing irradiation facility. Research Neutron Source Heinz Maier-Leibnitz (FRM II). Published August 18, 2022. Accessed February 16, 2023. https://www.frm2.tum.de/en/frm2/news-single-view-en/article/genehmigung-der-bestrahlungsanlage-zur-produktion-von-molybdaen-99/
31. Groothengel P; PALLAS. Focus on PALLAS: The transformation of the Energy & Health Campus. September 2021. Accessed February 16, 2023. https://www.pallasreactor.com/focus-on-pallas/4/
32. Financing. PALLAS. Accessed February 15, 2023. https://www.pallasreactor.com/en/financing/
33. About the JHR. RJH. Accessed February 15, 2023. https://jhrreactor.com/en/about/
34. Ligtvoet A, Scholten C, Davé A, et al. Study on sustainable and resilient supply of medical radioisotopes in the EU. Goulart De Medeiros M, Joerger A, eds. EUR 30690 EN; Publications Office of the European Union, Luxembourg; 2021. ISBN 978-92-76-37422-0. doi:10.2760/642561, JRC124565
35. World Nuclear News. Heat exchangers in place at Jules Horowitz. Published January 27, 2020. Accessed February 15, 2023. https://world-nuclear-news.org/Articles/Heat-exchangers-in-place-at-Jules-Horowitz
36. History. Research reactor University of Missouri. Accessed April 26, 2023. https://www.murr.missouri.edu/about/history/
37. Our facilities. NorthStar Medical Radioisotopes. Accessed March 15, 2023. https://www.northstarnm.com/company/facilities/#apf
38. Darlington nuclear generating station. Ontario Power Generation. Accessed March 15, 2023. https://www.opg.com/powering-ontario/our-generation/nuclear/darlington-nuclear/
39. BWXT Medical and Laurentis complete key Tc-99m generator program milestone. BWX Technologies, Inc. Published February 1, 2023. Accessed March 15, 2023. https://www.bwxt.com/news/2023/02/01/BWXT-Medical-and-Laurentis-Complete-Key-Tc-99m-Generator-Program-Milestone
40. Curium's customers to benefit from Mo 99 production restart. Curium US LLC. November 23, 2022. Accessed February 16, 2023. https://www.curiumpharma.com/2022/11/24/curium-customers-mo-99/
41. TechneLite® Yield Chart Mon thru Friday. 2013. Lantheus Medical Imaging.
42. Security of supply. Nuclear Medicine Europe. Accessed April 26, 2023. https://nuclearmedicineeurope.eu/security-of-supply/#:~:text=The%20Security%20of%20Supply%20Workgroup,for%20medical%20isotope%20production%20purposes.
43. Peykov P, Cameron R. Provision of outage reserve capacity for molybdenum-99 irradiation services: methodology and economic analysis. Nuclear Development NEA/SEN/HLGMR(2013)2. Accessed February 15, 2023. https://www.oecd-nea.org/jcms/pl_36048/provision-of-outage-reserve-capacity-for-molybdenum-99-irradiationservices-methodology-and-economic-analysis?details=true
44. TechneLite®. Package insert. Lantheus Medical Imaging; July 2019.
45. RadioGenix® System. Package insert. NorthStar Medical Radioisotopes, LLC; February 2022.
46. Howe DB; US Nuclear Regulatory Commission. NorthStar Medical Radioisotopes, LLC RadioGenix® Molybdenum-99/Technetium-99m Generator System. Licensing Guidance for Medical Use Licensees, Medical Use Permittees, and Commercial Nuclear Pharmacies. Published January 15, 2020. https://www.nrc.gov/docs/ML1733/ML17338A449.pdf
47. Weatherman K. Understanding the RadioGenix radionuclide generator system. Purdue University. Nuclear Pharmacy Programs.
48. Generator Accessories Ultra-Technekow™ V4 (technetium Tc 99m generator). User manual for installation, service & parts. Curium US LLC; November 2022.
49. BWXT Medical submits Tc-99m generator new drug application to FDA. BWX Technologies, Inc. Published September 13, 2022. Accessed April 26, 2023. https://www.bwxt.com/bwxt-medical/news/2022/09/13/BWXT-Medical-Submits-Tc-99m-Generator-New-Drug-Application-to-FDA
50. Koblitz SW, Karst KR. Citizen Petition. Washington, DC: Hyman, Phelps & McNamara, PC. January 20, 2023.
51. Environmental benefits of NorthStar Medical Radioisotopes' non-uranium-based production method for molybdenum-99/technetium-99m. NorthStar Medical Radioisotopes. Published August 2022. Accessed February 15, 2023. https://www.northstarnm.com/wp-content/uploads/2022/09/NorthStar-Environmental-Benefits-White-Paper-Aug-2022-WP-Z001.pdf
52. Radiation emergency preparedness and response. Occupational Safety and Health Administration. Accessed February 16, 2023. https://www.osha.gov/emergency-preparedness/radiation
53. About NRC Emergency Response. United States Nuclear Regulatory Commission. Published March 26, 2021. Accessed April 24, 2023. https://www.nrc.gov/about-nrc/emerg-preparedness/respond-to-emergency.html
54. About NRC. United States Nuclear Regulatory Commission. Published January 25, 2022. https://www.nrc.gov/about-nrc.html
55. US Department of Energy. Office of Environmental Management. Packaging and Transportation Safeguards for Shipment of Liquid Low-Level Radioactive Waste. Published August 2020. Accessed February 16, 2023. https://www.energy.gov/em/articles/fact-sheet-packaging-and-transportation-safeguards-shipment-liquid-low-level
56. International organizations. United States Nuclear Regulatory Commission. Published September 30, 2021. February 17, 2023. https://www.nrc.gov/about-nrc/ip/intl-organizations.html
57. World Nuclear Association. International Nuclear Waste Disposal Concepts. Published April 2020. Accessed February 17, 2023. https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-wastes/international-nuclear-waste-disposal-concepts.aspx
58. About COVRA. COVRA NV. Accessed February 16, 2023. https://www.covra.nl/nl/veelgestelde-vragen/over-covra/
59. Processing. COVRA NV. Accessed February 16, 2023. https://www.covra.nl/nl/radioactief-afval/verwerking/
60. Low-level waste disposal. United States Nuclear Regulatory Commission. Published December 14, 2020. Accessed February 16, 2023. https://www.nrc.gov/waste/llw-disposal.html
61. Radioactive waste. United States Nuclear Regulatory Commission. Published June 5, 2020. Accessed February 16, 2023. https://www.nrc.gov/waste.html

111 Westport Plaza, Suite 800, St. Louis, MO 63146.

GN0039 0423

CURIUM™
LIFE FORWARD

A9011S R5/2022

Ultra-Technekow™ V4 (Technetium Tc 99m Generator)

9010/9190

Ultra-Technekow™ V4 (Technetium Tc 99m Generator)

Ultra-Technekow™ V4 (Technetium Tc 99m Generator)

9010/9190

A9011S R5/2022

A9011S R5/2022

Ultra-Technekow™ V4 (Technetium Tc 99m Generator)

9010/9190

Ultra-Technekow™ V4 (Technetium Tc 99m Generator)

Rx only

For the Production of Sodium Pertechnetate Tc 99m Injection

DESCRIPTION

The Ultra-Technekow™ V4 Generator is prepared with fission-produced molybdenum Mo-99 adsorbed onto alumina in a column shielded by lead, tungsten, or depleted uranium. The column assembly and shielding are encased in a plastic container that is covered with a plastic elution hood. The elution hood has an opening for the column assembly double inlet needles and an opening for the single outlet needle. The needles accommodate the sterile eluant vials that contain 0.9% Sodium Chloride Injection and sterile evacuated collection vials. A sterile vial containing a bacteriostat is supplied with the generator for the customer to aseptically seal the outlet needle after each elution.

This terminally sterilized generator provides a closed system for the production of sterile metastable technetium Tc-99m, which is produced by the decay of molybdenum Mo-99. Incorporated between the column outlet and the collection vial is a sterile 0.22 micrometer filter. Sterile, non-pyrogenic isotonic solutions of Sodium Pertechnetate Tc 99m Injection in 0.9% Sodium Chloride Injection can be obtained conveniently by periodic aseptic elution of the generator. These solutions should be clear, colorless, and free from any particulate matter. The Sodium Pertechnetate Tc 99m Injection is suitable for intravenous injection and direct instillation.

The carrier-free solution may be used as is, or diluted to the proper concentration. Over the life of the generator, an elution will contain an amount of technetium Tc-99m in direct proportion to the quantity of Mo-99 decay since the previous elution of the generator. The quantity of Tc-99m in the eluate is determined by quantity of Mo-99 on the column, and the elapsed time between elutions.

Each eluate of the generator should not contain more than the USP limit of 0.15 kilobecquerel molybdenum Mo-99 per megabecquerel technetium Tc-99m (0.15 microcurie Mo-99 per millicurie Tc-99m) per administered dose at the time of administration and an aluminum ion concentration of not more than 10 micrograms per milliliter of the generator eluate, both of which must be determined by the user before administration.

Since the eluate does not contain an antimicrobial agent, it should not be used after 12 hours from the time of generator elution.

Physical Characteristics

Technetium Tc-99m decays by isomeric transition with a physical half-life of 6 hours. The principal photon that is useful for detection and imaging studies is listed in Table 1.

Table 1. Principal Radiation Emission Data

Radiation	Mean Percent Per Disintegration	Energy (keV)
Gamma-2	89.07	140.5

External Radiation

The specific gamma ray constant for technetium Tc-99m is 0.795 R/hr-mCi at 1 cm. The first half-value layer is 0.023 cm of lead (Pb). A range of values for the relative attenuation of the radiation emitted by this radionuclide that results from interposition of various thicknesses of Pb is shown in Table 2. For example, the use of 0.27 cm thickness of Pb will attenuate the radiation emitted by a factor of about 1000.

Table 2. Radiation Attenuation by Lead Shielding

Shield Thickness (Pb) cm	Coefficient of Attenuation
0.023	0.5
0.09	10^{-1}
0.18	10^{-2}
0.27	10^{-3}

Molybdenum Mo-99 decays to technetium Tc-99m with a molybdenum Mo-99 half-life of 2.75 days, or 66 hours (see Table 3). The physical decay characteristics of molybdenum Mo-99 are such that only 88.6% of the decaying molybdenum Mo-99 atoms form technetium Tc-99m. Generator elutions may be made at any time, but the amount of technetium Tc-99m available will depend on the interval measured from the last elution. Approximately 47% of the maximum available technetium Tc-99m is reached after 6 hours and 95% after 23 hours. To correct for physical decay of molybdenum Mo-99 and technetium Tc-99m, the fractions that remain at selected intervals of time are shown in Tables 3 and 4.

Table 3. Physical Decay Chart; Molybdenum Mo-99, Half-Life 66 Hours

Days	Percent Remaining	Days	Percent Remaining
0	100	10	8
1	78	11	6
2	60	12	5
3	47	13	4
4	37	14	3
5	28	15	2
6	22	20	0.6
7	17	25	0.2
8	13	30	0.05
9	10		

Table 4. Physical Decay Chart; Technetium Tc-99m, Half-Life 6 Hours

Hours	Percent Remaining	Hours	Percent Remaining
0*	100	9	35
1	89	10	32
2	79	11	28
3	71	12	25
4	63	14	20
5	56	16	16
6	50	18	13
7	45	24	6
8	40		

*Calibration Time

CLINICAL PHARMACOLOGY

The pertechnetate ion distributes in the body similarly to the iodide ion but is not organified when trapped in the thyroid gland. Pertechnetate concentrates in the thyroid gland, salivary glands, stomach and choroid plexus. After intravenous administration it gradually equilibrates with the extracellular space. A fraction is promptly excreted via the kidneys.

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 ion passes 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.

While the major part of the pertechnetate escapes within a few minutes of normal drainage and tearing, it has been documented that there is some degree of transconjunctival absorption with turnover of 1.5% per minute in normal individuals, 2.1% per minute in patients without any sac and 2.7% per minute in patients with inflamed conjunctiva due to chronic dacryocystitis. Individual values may vary but these rates are probably representative and indicate that the maximum possible pertechnetate absorbed will remain below one thousandth of that used in other routine diagnostic procedures.

INDICATIONS AND USAGE

The Ultra-Technekow™ V4 generator is a source of sodium pertechnetate Tc 99m for use in the preparation of FDA-approved diagnostic radiopharmaceuticals, as described in the labeling of these diagnostic radiopharmaceutical kits.

Sodium Pertechnetate Tc 99m is used **IN ADULTS** as an agent for:

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

Sodium Pertechnetate Tc 99m is used **IN PEDIATRIC PATIENTS** as an agent for:

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

CONTRAINDICATIONS

None.

WARNINGS

Radiation risks associated with the use of Sodium Pertechnetate Tc 99m are greater in pediatric patients than in adults and, in general, the younger the patient the greater the risk owing to greater absorbed radiation doses and longer life expectancy. These greater risks should be taken firmly into account in all benefit risk assessments involving pediatric patients.

Long-term cumulative radiation exposure may be associated with an increased risk of cancer.

Only use generator eluant specified for use with the Ultra-Technekow™ V4 Generator. Do not use any other generator eluant or saline from any other source.

PRECAUTIONS

Radiopharmaceuticals should be used only by physicians who are qualified by training and experience in the safe use and handling of radionuclides and whose experience and training have been approved by the appropriate government agency authorized to license the use of radionuclides.

As in the use of any radioactive material, care should be taken to minimize radiation exposure to the patient consistent with proper patient management and to ensure minimum radiation exposure to occupational workers.

After the termination of the nasolacrimal imaging procedure, blowing the nose and washing the eyes with sterile distilled water or an isotonic sodium chloride solution will further minimize the radiation dose.

Since the eluate does not contain an antimicrobial agent, it should not be used after 12 hours from time of generator elution.

Carcinogenesis, Mutagenesis, Impairment of Fertility

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

Pregnancy

In animal reproductive studies, Sodium Pertechnetate Tc 99m (as free pertechnetate) has been shown to cross the placental barrier. It is not known whether Sodium Pertechnetate Tc 99m can cause fetal harm when administered to a pregnant woman or can affect reproductive capacity.

Sodium Pertechnetate Tc 99m should be given to pregnant women only if the expected benefits to be gained clearly outweigh the potential hazards.

Ideally, examinations using radiopharmaceutical drug products - especially those elective in nature - of women of childbearing capability should be performed during the first ten days following the onset of menses.

Nursing Mothers

Technetium Tc-99m is excreted in human milk during lactation, therefore, formula-feedings should be substituted for breast-feedings.

Pediatric Use

See **INDICATIONS AND USAGE** and **DOSAGE AND ADMINISTRATION** sections. Also see the description of additional risk under **WARNINGS**.

ADVERSE REACTIONS

Allergic reactions including anaphylaxis have been reported infrequently following the administration of Sodium Pertechnetate Tc 99m.

DOSAGE AND ADMINISTRATION

Sodium Pertechnetate Tc 99m is administered by intravenous injection. When imaging the nasolacrimal drainage system, instill the Sodium Pertechnetate Tc 99m by the use of a device such as a micropipette or similar method which will ensure the accuracy of the dose.

For imaging the urinary bladder and ureters (direct isotopic cystography), the Sodium Pertechnetate Tc 99m is administered by direct instillation aseptically into the bladder via a urethral catheter, following which the catheter is flushed with approximately 200 mL of sterile saline directly into the bladder.

The suggested dose ranges employed for various diagnostic indications in the average ADULT PATIENT (70 kg) are as follows:

Vesico-ureteral imaging: 18.5 to 37 MBq (0.5 to 1 mCi)
Thyroid gland imaging: 37 to 370 MBq (1 to 10 mCi)
Salivary gland imaging: 37 to 185 MBq (1 to 5 mCi)
Nasolacrimal drainage system: Maximum dose of 3.7 MBq (100 µCi)

The recommended dosages in PEDIATRIC PATIENTS are:

Vesico-ureteral imaging: 18.5 to 37 MBq (0.5 to 1 mCi)
Thyroid gland imaging: 2.22 to 2.96 MBq (60 to 80 µCi) per kg body weight

The patient dose should be measured by a suitable radioactivity calibration system immediately prior to administration.

Parenteral drug products should be inspected visually for particulate matter and discoloration prior to administration whenever solution and container permit. If the solution is discolored, discontinue use of the generator immediately. The solution to be administered as the patient dose should be clear, colorless, and contain no particulate matter.

Radiation Dosimetry

The estimated absorbed radiation doses to an average **ADULT** and **PEDIATRIC** patient from an intravenous injection of various doses of Sodium Pertechnetate Tc 99m distributed uniformly in the total body are shown in Tables 5 and 6.

Table 5. Absorbed Radiation Doses from Intravenous Injection

Organ	Absorbed Radiation Dose (mGy) for a 1110 MBq (30mCi) dose
Adrenals	4.1
Urinary Bladder Wall	20
Bone Surfaces	6.2
Brain	2.2
Breasts	2
Gallbladder Wall	8.3
Stomach Wall	29
Small Intestine	18
ULI Wall	63
LLI Wall	23
Heart Wall	3.5
Kidneys	6
Liver	4.7
Lungs	2.9
Muscle	3.6
Ovaries	11
Pancreas	6.3
Red Marrow	4.1
Skin	2
Spleen	4.8
Testes	3.1
Thymus	2.7
Thyroid	24
Uterus	9
Remaining Tissues	3.9
Effective Dose (mSv)	14

To obtain radiation absorbed dose in rads (30 mCi dose) from the above table, divide individual organ values by a factor of 10 (does not apply for effective dose).

Table 6. Pediatric Absorbed Radiation Doses (mGy) from Intravenous Injection

Age	15 years	10 years	5 years	1 year
Administered activity in MBq (mCi)	**1110 (30)**	**740 (20)**	**555 (15)**	**370 (10)**
Organ				
Adrenals	5.3	5.4	6.2	7.1
Urinary Bladder Wall	26	22	18	22
Bone Surfaces	7.6	7.5	8.1	10
Brain	2.8	3.1	3.7	4.5
Breasts	2.6	2.6	3.2	4.1
Gallbladder Wall	11	12	13	13
Stomach Wall	38	36	43	59
Small Intestine	22	23	26	30
ULI Wall	81	89	110	140
LLI Wall	31	33	40	48
Heart Wall	4.5	4.6	5.2	6.4
Kidneys	7.2	6.9	7.8	8.5
Liver	6	6.7	8	9.1
Lungs	3.8	3.8	4.4	5.3
Muscle	4.5	4.5	5	6
Ovaries	14	13	14	17
Pancreas	8.1	8.2	8.9	10
Red Marrow	5.1	5	5.2	6
Skin	2.5	2.6	3.2	3.8
Spleen	6	6	6.7	7.8
Testes	4.1	4.3	4.9	6
Thymus	3.6	3.5	4.2	5.3
Thyroid	40	41	67	81
Uterus	11	11	12	14
Remaining Tissues	4.8	4.8	5.4	6.4
Effective Dose (mSv)	19	19	23	29

To obtain radiation absorbed dose in rads (30 mCi dose) from the above table, divide individual organ values by a factor of 10 (does not apply for effective dose).

The estimated absorbed radiation doses to an ADULT patient from the nasolacrimal imaging procedure using a maximum dose of 3.7 megabecquerels (100 microcuries) of Sodium Pertechnetate Tc 99m are shown in Table 7.

Table 7. Absorbed Radiation Doses from Dacryoscintigraphy

Tissue	3.7 MBq (100 µCi) Dose of Sodium Pertechnetate Tc 99m	
	mGy	rad
Eye Lens:		
If lacrimal fluid turnover is 16%/min	0.140	0.014
If lacrimal fluid turnover is 100%/min	0.022	0.002
If drainage system is blocked	4.020	0.402
Total Body*	0.011	0.001
Ovaries*	0.030	0.003
Testes*	0.009	0.001
Thyroid*	0.130	0.013

*Assuming no blockage of draining system.

In pediatric patients, an average 30 minute exposure to 37 MBq (1 mCi) of Tc-99m pertechnetate following instillation for direct cystography, will result in the following estimated radiation doses:

Table 8. Absorbed Radiation Doses from Cystography (PEDIATRIC)

Age	Bladder wall dose, mGy (rad)	Gonadal dose, mGy (rad)
1 year	3.6 (0.36)	0.15 (0.015)
5 years	2.0 (0.2)	0.095 (0.0095)
10 years	1.3 (0.13)	0.066 (0.0066)
15 years	0.92 (0.092)	0.046 (0.0046)

HOW SUPPLIED

The Ultra-Technekow™V4 (Technetium Tc 99m) Generators contain the following amount of molybdenum Mo-99 at the date and time of calibration stated on the label.

Catalog No.		
9010 NDC 69945-010-03	37 gigabecquerels	(1.0 curie)
9015 NDC 69945-015-04	55.5 gigabecquerels	(1.5 curies)
9020 NDC 69945-020-05	74 gigabecquerels	(2.0 curies)
9025 NDC 69945-025-06	92.5 gigabecquerels	(2.5 curies)
9030 NDC 69945-030-07	111 gigabecquerels	(3.0 curies)
9035 NDC 69945-035-08	129.5 gigabecquerels	(3.5 curies)
9051 NDC 69945-051-09	185 gigabecquerels	(5.0 curies)
9060 NDC 69945-060-10	222 gigabecquerels	(6.0 curies)
9075 NDC 69945-075-11	277.5 gigabecquerels	(7.5 curies)
9110 NDC 69945-110-12	407 gigabecquerels	(11.0 curies)
9140 NDC 69945-140-13	518 gigabecquerels	(14.0 curies)
9160 NDC 69945-160-14	592 gigabecquerels	(16.0 curies)
9190 NDC 69945-190-15	703 gigabecquerels	(19.0 curies)

Each generator is supplied with the following components for the elution of the generator:

1 - Technestat™ Vial, 5 mL, containing 0.5 mL of 1.5 mg/mL methylparaben and 0.2 mg/mL propylparaben, sterile, non-pyrogenic

1 - Package Insert

SUPPLIED SEPARATELY

30 - Evacuated Collecting Vials, 30 mL, sterile, non-pyrogenic, supplied with:

90 - Radioactive Materials Labels – Collection Vial (30 en, 30 fr, 30 es)

90 - Radioactive Materials Labels – Elution Shield (30 en, 30 fr, 30 es)

1 - Package Insert

30 - Generator Eluant, 0.9% Sodium Chloride Injection, sterile, non-pyrogenic, available in 5 mL, 10 mL, or 20 mL volumes, with 1 package insert. The eluant does not contain an antimicrobial agent. Each milliliter of Generator Eluant contains 9 milligrams of Sodium Chloride.

Storage

Store generator and Sodium Pertechnetate Tc 99m solution at controlled room temperature 20° to 25°C (68° to 77°F) [see USP Controlled Room Temperature].

Expiration Date

The generator should not be used after the expiration date stated on the label.

The expiration time of the Sodium Pertechnetate Tc 99m solution is not later than 12 hours after time of elution. If the eluate is used to reconstitute a kit, the radiolabeled kit should not be used after 12 hours from the time of generator elution or after the expiration time stated on the labeling for the prepared drug, whichever is earlier.

Directions for Use of the Technetium Tc 99m Generator

NOTE 1: Immediately upon delivery, the generator should be placed within a minimum of one-inch of lead shielding in such a manner so as to minimize radiation exposure to attending personnel.

NOTE 2: Wear waterproof gloves during the elution procedure and during subsequent reconstitution of kits with the eluate.

NOTE 3: Use a shielded syringe to withdraw patient dose or to transfer Sodium Pertechnetate Tc 99m into mixing vials during kit reconstitution.

NOTE 4: The needles in the generator are sterile beneath their covers, and the generator has been cleaned underneath the top cover. Additional disinfection of these areas with agents containing alcohol may unfavorably influence the Tc-99m yield.

Eluting the generator every 24 hours will provide optimal amounts of Sodium Pertechnetate Tc 99m. However, the generator may be eluted whenever sufficient amounts of technetium Tc-99m have accumulated within the column.

For Example

Time After First Elution (hrs.)	Approximate Yield (% of First Elution)
1	10
2	19
3	27
4	35
5	41
6	47

Elution

1. Lift the generator by its handle and place it inside the auxiliary shield. Move the handle so that it is not covering the generator top by pushing it off to the side in between the generator and the auxiliary shield.
2. Remove and store the elution hood cover. Place the auxiliary shield top onto the top of the generator and align it with the elution hood.
3. Remove and store the tip cap plugs from the needles.
4. Remove the flip-top cap of the eluant vial; disinfect the stopper with a bacteriocide such as 70% isopropyl alcohol, allowing the stopper to dry before use. Invert the eluant vial and place stopper first into the saline vial alignment insert. Place the saline vial alignment insert and vial into the saline port of the auxiliary shield top and firmly push down the eluant vial until the stopper is punctured and seated at the base of the eluant needles.
5. Place the saline shield on top of the auxiliary shield top to cover the eluant vial.
6. Remove the flip-top cap of an evacuated vial; disinfect the stopper, allowing the stopper to dry before use. Place the evacuated vial into the elution tool.
7. Position the shielded evacuated vial by carefully lowering the elution tool into place on the elution needle. Piercing the septum of the evacuated vial with the elution needle will begin the elution process.
8. Wait until the evacuated vial has completely filled itself. This may take a few minutes. **Never interrupt the elution by lifting the elution tool!**
9. **NOTE: Do not use generator eluate if its appearance is discolored, and discontinue use of the generator.**
10. Remove the flip-top cap of the Technestat vial; disinfect the stopper, allowing the stopper to dry before use. Secure the Technestat vial into the Technestat vial holder.
11. Carefully remove the elution tool and replace with the shielded Technestat vial.
12. Determine the technetium Tc-99m concentration and molybdenum Mo-99 content for dispensing purposes. The generator eluate may be assayed using an appropriate detection system. The manufacturer's instructions for operation of the instrument/equipment should be followed for measurement of Technetium Tc-99m and Molybdenum Mo-99 activity. **NOTE: Molybdenum Mo-99 Breakthrough Limit** - The acceptable limit is 0.15 kilobecquerel molybdenum Mo-99 per megabecquerel technetium Tc-99m (0.15 microcurie Mo-99 per millicurie Tc-99m) per administered dose in the Injection, at the time of administration (see USP, Sodium Pertechnetate Tc 99m Injection).
13. Determine the aluminum ion concentration of the eluate. **NOTE: Aluminum Ion Breakthrough Limit** - The acceptable limit is not more than 10 micrograms per milliliter of eluate (see USP, Sodium Pertechnetate Tc 99m Injection).

Subsequent Elutions

1. Remove the saline shield and then remove saline vial alignment insert from the saline port to remove the eluant vial from the eluant needles. Remove the vial from the saline vial alignment insert and reuse the saline vial alignment insert for subsequent elutions.
2. Remove the shielded Technestat vial by carefully lifting the Technestat vial shield from the elution needle.
3. Repeat steps 4 through 12 of the Elution procedure above.

Vacuum Loss

If the vacuum in the collecting vial is lost, do not attempt to re-evacuate the vial, but discard and use a new collecting vial.

Expired Generator Disposal

1. Following the life of the generator, remove and dispose of the used Technestat vial and the eluant vial.
2. Cover the elution and eluant needles with the stored tip cap plugs.
3. Place the stored elution hood cover onto the top of the generator.
4. The intact generator assembly should be either returned to Curium US LLC or disposed of in accordance with applicable regulations.

This generator may be received, used and administered only by authorized persons in designated clinical settings. Its receipt, storage, use, transfer and disposal are subject to the regulations and/or appropriate licenses of local competent official organizations.

Manufactured by:
Curium US LLC
Maryland Heights, MO 63043 USA
Made in USA

A9011S

Revised 5/2022

STERILE

CURIUM™

Ultra-Technekow™ V4
(Generador de Tecnecio Tc 99m)

Solamente Rx
Solo por prescripción médica

Para la Producción de Inyección de Pertecnetato de Sodio Tc 99m

DESCRIPCIÓN

El Generador Ultra-Technekow™ V4 se prepara con molibdeno Mo-99 producido por fisión, adsorbido en alúmina en una columna blindada con plomo, tungsteno o uranio empobrecido. El ensamblaje de la columna y el blindaje están contenidos en un recipiente de plástico cubierto con un campana de elución de plástico. La campana de elución posee una abertura para las agujas de doble entrada del ensamblaje de la columna y una abertura para la aguja de salida simple. Las agujas se adaptan a los viales estériles de eluyente que contienen 0.9% de cloruro de sodio inyectable y viales estériles de recolección evacuados. Un vial estéril con un bacteriostático se suministra junto con el generador para que el cliente selle de manera aséptica la salida de la aguja luego de cada elución.

Este generador sometido a esterilización terminal, proporciona un sistema cerrado para la producción de tecnecio Tc 99m metaestable, estéril, el cual se produce por la desintegración del molibdeno Mo-99. Entre la columna de salida y el vial de recolección se encuentra un filtro estéril de 0,22 micrómetros. Las inyecciones de soluciones isotónicas, no pirógenas y esterilizadas de pertecnetato de sodio Tc 99m, en inyección de cloruro de sodio al 0.9% pueden ser obtenidas fácilmente mediante elución aséptica periódica del generador. Estas soluciones deben ser transparentes, incoloras, y libres de cualquier partícula. La Inyección de Pertecnetato de Sodio Tc 99m es adecuada para inyección intravenosa e instilación directa.

La solución libre de vehículo puede ser usada como viene, o diluida a la concentración adecuada. Durante la vida del generador, una elución contendrá una cantidad de tecnecio Tc 99m en proporción directa a la cantidad de desintegración de Mo-99 desde la elución previa del generador. La cantidad de Tc 99m en el eluato es determinada por la cantidad de Mo-99 en la columna, y el tiempo transcurrido entre las eluciones.

Cada eluato del generador no debe contener más del límite USP de 0,15 kilobecquereles de molibdeno Mo-99 por megabecquerel de tecnecio Tc 99m (0,15 microcurios Mo-99 por milicurio Tc 99m) por dosis administrada en el momento de la administración y una concentración de ion aluminio no mayor a 10 microgramos por mililitro del eluato del generador, debiendo ser determinados ambos por el usuario antes de la administración.

Puesto que el eluato no contiene un agente antimicrobiano, no debe ser usado después de 12 horas desde el momento de elución del generador.

Características físicas

El Tecnecio Tc 99m se desintegra por transición isomérica con una vida media física de 6 horas. El fotón principal, útil para estudios de detección e imágenes, se muestra en la Tabla 1.

Tabla 1. Datos de Emisión de Radiación Principal

Radiación	Porcentaje promedio por desintegración	Energía (keV)
Gamma-2	89,07	140,5

Radiación externa

La constante de rayos gamma específica para el tecnecio Tc 99m es 0,795 R/hr-mCi a 1 cm. La primera capa de valor medio es 0,023 cm de plomo (Pb). En la Tabla 2 se muestra un rango de valores para la atenuación relativa de la radiación emitida por este radionúclido que resulta de interposición de varios grosores de Pb. Por ejemplo, el uso de un grosor de 0,27 cm de Pb atenuará la radiación emitida en aproximadamente 1000 veces.

Tabla 2. Atenuación de Radiación por Protección con Plomo

Grosor del Blindaje (Pb) cm	Coeficiente de Atenuación
0,023	0,5
0,09	10^{-1}
0,18	10^{-2}
0,27	10^{-3}

El molibdeno Mo-99 se desintegra hasta tecnecio Tc 99m con una vida media de molibdeno Mo-99 de 2,75 días, o 66 horas (véase la Tabla 3). Las características de desintegración física de molibdeno Mo-99 son tales que sólo 88,6% de los átomos de molibdeno Mo-99 que se desintegran forman tecnecio Tc 99m. Pueden hacerse eluciones del generador en cualquier momento, pero la cantidad de tecnecio Tc 99m disponible dependerá del intervalo medido desde la última elución. Aproximadamente 47% del tecnecio Tc 99m máximo disponible se alcanza después de 6 horas y 95% después de 23 horas. Para corregir la desintegración física del molibdeno Mo-99 y del tecnecio Tc 99m, las fracciones restantes a intervalos seleccionados de tiempo se muestran en la Tablas 3 y 4.

Tabla 3. Tabla de Desintegración Física; Molibdeno Mo-99, Vida Media 66 Horas

Días	Porcentaje Restante	Días	Porcentaje Restante
0	100	10	8
1	78	11	6
2	60	12	5
3	47	13	4
4	37	14	3
5	28	15	2
6	22	20	0,6
7	17	25	0,2
8	13	30	0,05
9	10		

Tabla 4. Tabla de Desintegración Física; Tecnecio Tc 99m, Vida Media 6 Horas

Horas	Porcentaje Restante	Horas	Porcentaje Restante
0*	100	9	35
1	89	10	32
2	79	11	28
3	71	12	25
4	63	14	20
5	56	16	16
6	50	18	13
7	45	24	6
8	40		

*Tiempo de calibración

FARMACOLOGÍA CLÍNICA

El ion pertecnetato se distribuye en el cuerpo de manera similar al ion yoduro pero no es organificado cuando es atrapado en la glándula tiroides. El pertecnetato se concentra en la glándula tiroides, glándulas salivales, estómago y plexo coroide. Después de la administración intravenosa gradualmente se equilibra con el espacio extracelular. Una fracción es excretada prontamente a través de los riñones.

Luego de la administración de Pertecnetato de Sodio Tc 99m en forma de colirio, el fármaco se mezcla con las lágrimas dentro del espacio conjuntival. En cuestión de segundos a minutos sale del espacio conjuntival y escapa hacia el meato inferior de la nariz a través del sistema de drenaje nasolagrimal. Durante este proceso el ion pertecnetato pasa a través de los canalículos, el saco lagrimal y el conducto nasolagrimal. En caso de cualquier bloqueo anatómico o funcional del sistema de drenaje, habrá un flujo retrógrado que resultará en lagrimeo (epífora). En consecuencia, el pertecnetato escapa del espacio conjuntival en las lágrimas.

A pesar de que la mayor parte del pertecnetato escapa en unos pocos minutos de drenaje normal y lagrimeo, se ha documentado que hay cierto grado de absorción transconjuntival con recambio de 1,5% por minuto en individuos normales, 2,1% por minuto en pacientes sin ningún saco y 2,7% por minuto en pacientes con conjuntiva inflamada debido a dacriocistitis crónica. Los valores individuales pueden variar pero estas tasas son probablemente representativas e indican que el máximo posible de pertecnetato absorbido permanecerá debajo de una milésima del usado en otros procedimientos diagnósticos de rutina.

INDICACIONES Y USO

El generador Ultra-Technekow™ V4 es una fuente de pertecnetato de sodio Tc 99m para ser usado en la preparación de radiofármacos para diagnóstico aprobados por la FDA, como se describe en la etiqueta de estos kits de radiofármacos para diagnóstico.

El Pertecnetato de Sodio Tc 99m se usa **EN ADULTOS** como agente para:

- Imágenes Tiroideas
- Imágenes de la Glándula Salival
- Imágenes de la Vejiga Urinaria (cistografía isotópica directa) para detección de reflujo vesicoureteral
- Imágenes del Sistema de Drenaje Nasolagrimal (dacriocentellografía)

El Pertecnetato de Sodio Tc 99m se usa **EN PACIENTES PEDIÁTRICOS** como agente para:

- Imágenes Tiroideas
- Imágenes de la Vejiga Urinaria (cistografía isotópica directa) para detección de reflujo vesicoureteral

CONTRAINDICACIONES

Ninguna.

ADVERTENCIAS

Los riesgos de radiación asociados con el uso de Pertecnetato de Sodio Tc 99m son mayores en pacientes pediátricos que en adultos y, en general, a medida que el paciente es más joven, mayor es el riesgo debido a mayores dosis de radiación absorbidas y mayor expectativa de vida. Estos riesgos mayores deben ser tomados firmemente en cuenta en todas las evaluaciones riesgo-beneficio que involucran pacientes pediátricos.

La exposición acumulada a la radiación a largo plazo puede asociarse con un mayor riesgo de cáncer.

Utilice solamente el eluyente de generador especificado para uso con el Generador Ultra-Technekow™ V4. No use ningún otro eluyente de generador o solución salina de cualquier otra fuente.

PRECAUCIONES

Como con cualquier otro material radioactivo, se debe tener cuidado para minimizar la exposición del paciente a la radiación, de manera consistente con un manejo adecuado del paciente y para asegurar una mínima exposicion del personal a la radiación.

Los radiofármacos solo deben ser usados por médicos calificados mediante el entrenamiento específico y la experiencia en el uso y manejo seguros de radionúclidos y cuya experiencia y entrenamiento han sido aprobados por el organismo gubernamental autorizado para otorgar licencia para el uso de radionúclidos.

Después de terminar el procedimiento de imágenes nasolagrimales, sonar la nariz y lavar los ojos con agua destilada estéril o una solución de cloruro de sodio isotónica minimizará adicionalmente la dosis de radiación.

Puesto que el eluato no contiene un agente antimicrobiano, no debe ser usado después de 12 horas a partir de la elución del generador.

Carcinogénesis, mutagénesis, deterioro de la fertilidad

No se han realizado estudios a largo plazo en animales para evaluar el potencial carcinogénico o mutagénico, o si el Pertecnetato de Sodio Tc 99m puede afectar la fertilidad en machos o hembras.

Embarazo

Se ha demostrado en estudios de reproducción en animales que el Pertecnetato de Sodio Tc 99m (en forma de pertecnetato libre) cruza la barrera placentaria. No se sabe si el Pertecnetato de Sodio Tc 99m puede causar daño fetal cuando se administra a una mujer embarazada o si puede afectar la capacidad de reproducción.

El Pertecnetato de Sodio Tc 99m sólo debe ser administrado a mujeres embarazadas si los beneficios esperados claramente superan los peligros potenciales.

Idealmente, los exámenes que utilizan radiofármacos - especialmente aquellos de naturaleza electiva - en mujeres con capacidad reproductiva, deben realizarse durante los primeros diez días luego del inicio de la menstruación.

Lactancia

El tecnecio Tc 99m es excretado en la leche humana durante la lactancia, por lo tanto la lactancia artificial debe sustituir a la materna.

Uso pediátrico

Ver las secciones **INDICACIONES Y USO** y **DOSIFICACIÓN Y ADMINISTRACIÓN**. Ver también la descripción de riesgo adicional en **ADVERTENCIAS**.

REACCIONES ADVERSAS

Se han reportado reacciones alérgicas, incluyendo anafilaxia, de manera infrecuente luego de la administración de Pertecnetato de Sodio Tc 99m.

DOSIFICACIÓN Y ADMINISTRACIÓN

El Pertecnetato de Sodio Tc 99m se administra por inyección intravenosa. Cuando se obtienen imágenes del sistema de drenaje nasolagrimal, instile el Pertecnetato de Sodio Tc 99m usando un instrumento como una micropipeta o un método similar que asegure la precisión de la dosis.

Para imágenes de la vejiga urinaria y uréteres (cistografía isotópica directa), el Pertecnetato de Sodio Tc 99m se administra por instilación directa asépticamente en la vejiga a través de un catéter uretral, luego de lo cual el catéter se lava con aproximadamente 200 ml de solución salina estéril directamente en la vejiga.

Los rangos de dosis sugeridos empleados para varias indicaciones diagnósticas en el PACIENTE ADULTO promedio (70 kg) son los siguientes:

Imágenes Vesicoureteral:	18,5 a 37 MBq (0,5 a 1 mCi)
Imágenes de la glándula Tiroides:	37 a 370 MBq (1 a 10 mCi)
Imágenes de la glándula Salival:	37 a 185 MBq (1 a 5 mCi)
Sistema de drenaje Nasolagrimal:	Dosis máxima de 3,7 MBq (100 µCi)

Las posologías recomendadas en PACIENTES PEDIÁTRICOS son:

Imágenes Vesicoureteral:	18,5 a 37 MBq (0,5 a 1 mCi)
Imágenes de la glándula Tiroides:	2,22 a 2,96 MBq (60 a 80 µCi) por kg peso corporal

La dosis del paciente debe ser medida por un sistema de calibración de radioactividad adecuado inmediatamente antes de la administración.

Los fármacos parenterales deben ser inspeccionados visualmente para detectar partículas en suspensión y decoloración antes de la administración, siempre que la solución y el recipiente lo permitan. Si la solución está decolorada, suspenda de inmediato el uso del generador. La solución a ser administrada como dosis para el paciente debe ser transparente, incolora, y no debe contener partículas en suspensión.

Dosimetría de radiación

En las Tablas 5 y 6 se muestran las dosis de radiación absorbida estimadas para un paciente **ADULTO** y **PEDIATRICO** promedio provenientes de una inyección intravenosa de varias dosis de Pertecnetato de Sodio Tc 99m, distribuida uniformemente en todo el cuerpo.

Tabla 5. Dosis de radiación absorbidas en Adultos proveniente de inyección intravenosa

Órgano	Dosis de radiación absorbidas (mGy) for a 1110 MBq (30mCi) Dosis
Suprarrenales	4,1
Pared de la vejiga urinaria	20
Superficies óseas	6,2
Cerebro	2,2
Senos	2
Pared de la vesícula biliar	8,3
Pared estomacal	29
Intestino delgado	18
Pared del intestino grueso superior	63
Pared del intestino grueso inferior	23
Pared del corazón	3,5
Riñones	6
Hígado	4,7
Pulmones	2,9
Músculo	3,6
Ovarios	11
Páncreas	6,3
Médula roja	4,1
Piel	2
Bazo	4,8
Testículos	3,1
Timo	2,7
Tiroides	24
Útero	9
Tejidos restantes	3,9
Dosis efectiva (mSv)	14

Para obtener la dosis absorbida de radiación en rads (dosis de 30 mCi) a partir de la tabla arriba indicada, divida los valores de los órganos individuales por un factor de 10 (no aplica para la dosis efectiva).

Tabla 6. Dosis de radiación absorbidas (mGy) en pacientes Pediátricos proveniente de inyección intravenosa

Edad	15 años	10 años	5 años	1 año
Actividad administrada en MBq (mCi)	**1110 (30)**	**740 (20)**	**555 (15)**	**370 (10)**
Órgano				
Suprarrenales	5,3	5,4	6,2	7,1
Pared de la vejiga urinaria	26	22	18	22
Superficies óseas	7,6	7,5	8,1	10
Cerebro	2,8	3,1	3,7	4,5
Senos	2,6	2,6	3,2	4,1
Pared de la vesícula biliar	11	12	13	13
Pared estomacal	38	36	43	59
Intestino delgado	22	23	26	30
Pared del intestino grueso superior	81	89	110	140
Pared del intestino grueso inferior	31	33	40	48
Pared del corazón	4,5	4,6	5,2	6,4
Riñones	7,2	6,9	7,8	8,5
Hígado	6	6,7	8	9,1
Pulmones	3,8	3,8	4,4	5,3
Músculo	4,5	4,5	5	6
Ovarios	14	13	14	17
Páncreas	8,1	8,2	8,9	10
Médula roja	5,1	5	5,2	6
Piel	2,5	2,6	3,2	3,8
Bazo	6	6	6,7	7,8
Testículos	4,1	4,3	4,9	6
Timo	3,6	3,5	4,2	5,3
Tiroides	40	41	67	81
Útero	11	11	12	14
Tejidos restantes	4,8	4,8	5,4	6,4
Dosis efectiva (mSv)	19	19	23	29

Para obtener la dosis absorbida de radiación en rads (dosis de 30 mCi) a partir de la tabla arriba indicada, divida los valores de los órganos individuales por un factor de 10 (no aplica para la dosis efectiva).

Las dosis estimadas de radiación absorbida para un paciente ADULTO en el procedimiento de imágenes del conducto nasolagrimal usando una dosis máxima de 3,7 megabecquereles (100 microcurios) de Pertecnetato de Sodio Tc 99m se muestran en la Tabla 7.

Tabla 7. Dosis de radiación absorbida proveniente de Dacriocentellografía

Tejido	Dosis de 3,7 MBq (100 µCi) de Pertecnetato de Sodio Tc 99m	
	mGy	rad
Cristalino:		
Si el recambio del líquido lagrimal es 16%/min	0,140	0,014
Si el recambio del líquido lagrimal es 100%/min	0,022	0,002
Si el sistema de drenaje está bloqueado	4,020	0,402
Cuerpo total*	0,011	0,001
Ovarios*	0,030	0,003
Testículos*	0,009	0,001
Tiroides*	0,130	0,013

*Asumiendo que no hay bloqueo del sistema de drenaje.

En pacientes pediátricos, una exposición promedio de 30 minutos a 37 MBq (1 mCi) de pertecnetato Tc-99m luego de instilación para cistografía directa, resultará en las siguientes dosis de radiación estimadas:

Tabla 8. Dosis de Radiación Absorbidas a partir de Cistografía (PEDIÁTRICA)

Edad	Dosis de la pared vesical, mGy (rad)	Dosis gonadal, mGy (rad)
1 año	3,6 (0,36)	0,15 (0,015)
5 años	2,0 (0,2)	0,095 (0,0095)
10 años	1,3 (0,13)	0,066 (0,0066)
15 años	0,92 (0,092)	0,046 (0,0046)

PRESENTACIÓN

Los generadores Ultra-Technekow™ V4 (Tecnecio Tc 99m) contienen la siguiente cantidad de molibdeno Mo-99 en la fecha y hora de calibración mencionada en la etiqueta.

No. de Catálogo

9010 NDC 69945-010-03	37 gigabecquereles	(1,0 curio)
9015 NDC 69945-015-04	55,5 gigabecquereles	(1,5 curios)
9020 NDC 69945-020-05	74 gigabecquereles	(2,0 curios)
9025 NDC 69945-025-06	92,5 gigabecquereles	(2,5 curios)
9030 NDC 69945-030-07	111 gigabecquereles	(3,0 curios)
9035 NDC 69945-035-08	129,5 gigabecquereles	(3,5 curios)
9051 NDC 69945-051-09	185 gigabecquereles	(5,0 curios)
9060 NDC 69945-060-10	222 gigabecquereles	(6,0 curios)
9075 NDC 69945-075-11	277,5 gigabecquereles	(7,5 curios)
9110 NDC 69945-110-12	407 gigabecquereles	(11,0 curios)
9140 NDC 69945-140-13	518 gigabecquereles	(14,0 curios)
9160 NDC 69945-160-14	592 gigabecquereles	(16,0 curios)
9190 NDC 69945-190-15	703 gigabecquereles	(19,0 curios)

Cada generador viene con los siguientes componentes para su elución:

1 - Vial de Technestat™, 5 ml, que contiene 0,5 ml de metilparabeno 1,5 mg/ml y propilparabeno 0,2 mg/ml, estériles, no pirogénicos

1 - Prospecto adjunto

POR SEPARADO SE SUMINISTRAN

30 - Viales de recolección evacuados, 30 ml, estériles, no pirogénicos, suministrados con:

90 - Etiquetas de Material Radiactivo –Vial de recolección (30 en, 30 fr, 30 es)

90 - Etiquetas de Material Radiactivo – Blindaje de elución (30 en, 30 fr, 30 es)

1 - Prospecto adjunto

30 - Eluyente de generador, Inyección de Cloruro de Sodio 0,9%, estéril, no pirogénicos, disponible en volúmenes de 5 ml, 10 ml, o 20 ml, con 1 prospecto adjunto. El eluyente no contiene un agente antimicrobiano. Cada mililitro de eluyente del generador contiene 9 miligramos de cloruro de sodio.

Almacenamiento

Almacene el generador y la solución de Pertecnetato de Sodio Tc 99m a temperatura controlada de 20° a 25°C (68° a 77°F) [vea Temperatura Ambiente Controlada USP].

Fecha de caducidad

El generador no debe ser usado después de la fecha de caducidad que aparece en la etiqueta.

El tiempo de caducidad de la solución de Pertecnetato de Sodio Tc 99m no es mayor a 12 horas después del momento de la elución. Si se usa el eluato para reconstituir un kit, el kit radiomarcado no debe ser usado después de 12 horas a partir del momento de elución del generador o después del tiempo de caducidad especificado en la etiqueta para el fármaco preparado, lo que ocurra primero.

Indicaciones para el uso del generador de tecnecio Tc 99m

NOTA 1: Inmediatamente después de ser entregado, el generador debe ser colocado dentro de un mínimo de una pulgada de blindaje de plomo de una manera tal que se minimice la exposición a la radiación por parte del personal asistente.

NOTA 2: Use guantes a prueba de agua durante el procedimiento de elución y durante la subsiguiente reconstitución de kits con el eluato.

NOTA 3: Use una jeringa blindada para extraer la dosis del paciente o para transferir Pertecnetato de Sodio Tc 99m a los viales de mezcla durante la reconstitución del kit.

NOTA 4: Las agujas en el generador están estériles debajo de sus cubiertas, y el generador ha sido limpiado debajo de la cubierta superior. La desinfección adicional de estas áreas con agentes que contengan alcohol pueden influenciar de manera desfavorable el rendimiento de Tc 99m.

Eluir el generador cada 24 horas proporcionará cantidades óptimas de Pertecnetato de Sodio Tc 99m. Sin embargo, el generador puede ser eluido siempre que se hayan acumulado cantidades suficientes de tecnecio Tc 99m dentro de la columna.

Por ejemplo

Tiempo Después de la Primera Elución (hrs.)	Rendimiento Aproximado (% de Primera Elución)
1	10
2	19
3	27
4	35
5	41
6	47

Elución

1. Levante el generador por su asa y colóquelo dentro del blindaje auxiliar. Mueva el asa para que no cubra la parte superior del generador, empujándola a un lado entre el generador y el blindaje auxiliar.
2. Retire y guarde la tapa de la campana de elución. Coloque la cubierta del blindaje auxiliar sobre la parte superior del generador y alinéelo con la campana de elución.
3. Retire y guarde los tapones de las cubiertas de las agujas.
4. Remueva la tapa abatible de la ámpula de eluyente; desinfecte el émbolo con un bactericida, como el alcohol de isopropilo al 70%, permitiendo el secado del émbolo antes de su uso. Invierta el ámpula de eluyente y coloque el émbolo primero en el inserto de alineación del ámpula de solución salina. Coloque el inserto de alineación del ámpula de solución salina y el ámpula en el puerto de solución salina del capuchón de blindaje auxiliar y empujar el ámpula de eluyente firmemente hacia abajo hasta perforar el émbolo y que esté asentada en la base de las agujas de eluyente.
5. Coloque la protección de solución salina sobre el blindaje auxiliar superior para tapar el vial de eluyente.
6. Retire la tapa abatible de un vial de evacuación; desinfecte el tapón, permitiendo que el tapón se seque antes de su uso. Coloque el vial de evacuación en el instrumento de elución.
7. Coloque en posición el vial de evacuación blindado bajando cuidadosamente el instrumento de elución hasta que quede en lugar en la aguja de elución. Perforar el septum del vial de evacuación con la aguja de elución, hará que comience el proceso de elución.
8. Espere hasta que el vial de evacuación se haya llenado completamente. Esto tomará unos pocos minutos. **Nunca interrumpa la elución levantando el instrumento de elución!**
9. **NOTA: No utilice el eluato del generador si su apariencia está decolorada, y descontinúe el uso del generador.**
10. Retire la tapa abatible del vial Technestat; desinfecte el tapón permitiendo que el mismo se seque antes de su uso. Asegure el vial Technestat en su soporte.
11. Retire cuidadosamente el instrumento de elución y reemplácelo con el vial Technestat blindado.
12. Determine la concentración de tecnecio Tc 99m y el contenido de molibdeno Mo-99 para propósitos de preparación. El eluato del generador puede ser sometido a análisis usando un calibrador de dosis con cámara de ionización, detector de centelleo u otro sistema de detección apropiado. Se deben seguir las instrucciones del fabricante para el funcionamiento del instrumento/equipo para medir la actividad del Tecnecio Tc-99m y Molibdeno Mo-99. **NOTA: Límite de Irrupción de Molibdeno Mo-99** - El límite aceptable es 0,15 kilobecquereles de molibdeno Mo-99 por megabecquerel de tecnecio Tc 99m (0,15 microcurio Mo-99 por milicurio Tc 99m) por dosis administrada en la inyección, en el momento de la administración. (Vea USP, Inyección de Pertecnetato de Sodio Tc 99m).
13. Determine la concentración del ion aluminio del eluato. **NOTA: Límite de Irrupción del Ion Aluminio** - El límite aceptable no es mayor a 10 microgramos por mililitro de eluato (Vea USP, Inyección de Pertecnetato de Sodio Tc 99m).

No se garantiza la esterilidad del producto en caso de que el empaque primario tenga señales de haber sufrido ruptura previa.

Eluciones subsiguientes

1. Remueva el blindaje salino y luego remueva el inserto de alineación del ámpula de solución salina para remover el ámpula de eluyente de las agujas de eluyente. Remueva el ámpula del inserto de alineación del ámpula de solución salina y reutilice el inserto de alineación del ámpula de solución salina para posteriores eluciones.
2. Retire el vial blindado de Technestat levantando cuidadosamente su blindaje de la aguja de elución.
3. Repita los pasos del 4 al 12 del procedimiento de Elución arriba mencionado.

Pérdida de vacío

Si se pierde el vacío en el vial de recolección, no intente volver a evacuar el vial, sino que descarte y use un nuevo vial de recolección.

Eliminación del generador expirado

1. Luego de la vida del generador, retire y elimine el vial Technestat usado y el vial del eluyente.
2. Cubra las agujas de elución y de eluyente con los tapones de las cubiertas de aguja almacenadas.
3. Coloque la cubierta de la campana de elución guardada en la parte superior del generador.
4. El ensamblaje intacto del generador debe ser devuelto a Curium US LLC, o desechado de acuerdo con regulaciones aplicables.

Este generador puede ser recibido, usado y administrado solamente por personas autorizadas en ambientes clínicos designados. Su recepción, almacenamiento, uso, transferencia y descarte están sujetos a las regulaciones y/o licencias apropiadas de organizaciones oficiales locales competentes.

Fabricado por:
Curium US LLC
Maryland Heights, MO 63043 E.U.A
Hecho en E.U.A

A901IS
Revisado 5/2022

STERILE

CURIUM™

A901IS R5/2022

Ultra-Technekow™ V4
(Generador de Tecnecio Tc 99m)

9010/9190

Ultra-Technekow™ V4
(Generador de Tecnecio Tc 99m)

Xenon Xe 133 Gas

Rx only

Diagnostic

DESCRIPTION

Xenon Xe 133 Gas is for diagnostic inhalation use only. It is supplied in vials containing either 370 or 740 megabecquerels (10 or 20 millicuries) of Xenon Xe 133 Gas in 2 milliliters of carrier xenon and atmospheric air.

Xenon Xe 133 Gas is chemically and physiologically similar to elemental xenon, a non-radioactive gas which is physiologically inert except for anesthetic properties at high doses.

Xenon Xe 133 is produced by fission of Uranium U 235. At the time of calibration, it contains no more than 0.3% Xenon Xe 133m, no more than 1.5% Xenon Xe 131m, no more than 0.06% Krypton Kr 85 and no more than 0.01% Iodine I 131, with no less than 99.9% total radioactivity as radioxenon. Table 1 shows the effect of time on radionuclidic composition.

Table 1. Radionuclidic Composition

Percent of Total Radioactivity					
Days	% Xe-133	% Xe-133m	% Xe-131m	% Kr-85	% I-131
-5	>98.3	<0.6	<1.0	<0.03	<0.01
0*	>98.1	<0.3	<1.5	<0.06	<0.01
7	>97.2	<0.08	<2.5	<0.15	<0.02
14**	>95.7	<0.02	<4.1	<0.37	<0.02

*Calibration Date
**Expiration Date

PHYSICAL CHARACTERISTICS

Xenon Xe 133 decays by beta and gamma emissions with a physical half-life of 5.245 days.[1] Photons that are useful for detection and imaging studies as well as the principal beta emission are listed in Table 2.

Table 2. Principal Radiation Emission Data

Radiation	Mean % Per Disintegration	Energy (keV)
Beta-2	99.3	100.6 Avg.
Gamma-2	36.5	81.0
K alpha x-rays	38.9	30.8 Avg.
K beta x-rays	9.1	35.0 Avg.

EXTERNAL RADIATION

The specific gamma ray constant for Xenon Xe 133 is 0.51 R/hr-mCi at 1 cm. The first half-value thickness is 0.0035 cm of Pb.

A range of values for the relative attenuation of the radiation emitted by this radionuclide that results from interposition of various thicknesses of Pb is shown in Table 3. For example, the use of 0.2 cm of Pb will decrease the external radiation exposure by a factor of about 1000.

Table 3. Radiation Attenuation by Lead Shielding

Shield Thickness (Pb), cm	Coefficient of Attenuation
0.0035	0.5
0.037	10^{-1}
0.12	10^{-2}
0.20	10^{-3}
0.29	10^{-4}

To correct for physical decay of this radionuclide, the fractions that remain at selected time intervals after the date of calibration are shown in Table 4.

[1] Kocher, David C., "Radioactive Decay Data Tables," DOE/TIC-11026, 138 (1981).

Table 4. Physical Decay Chart; Xenon Xe 133, Half-life 5.245 Days

Days	Fraction Remaining	Days	Fraction Remaining
0*	1.000	8	0.347
1	0.876	9	0.304
2	0.768	10	0.267
3	0.673	11	0.234
4	0.589	12	0.205
5	0.516	13	0.179
6	0.453	14	0.157
7	0.397		

*Calibration Day

CLINICAL PHARMACOLOGY

Xenon Xe 133 is a readily diffusible gas which is neither utilized nor produced by the body. It passes through cell membranes, freely exchanges between blood and tissue, and tends to concentrate more in body fat than in blood, plasma, water or protein solutions. In the concentrations recommended for diagnostic studies, it is physiologically inactive. Inhaled Xenon Xe 133 Gas will enter the alveolar wall and the pulmonary venous circulation via capillaries. Most of the Xenon Xe 133 Gas that enters the circulation from a single breath is returned to the lungs and exhaled after a single pass through the peripheral circulation.

INDICATIONS AND USAGE

Xenon Xe 133 Gas has been shown to be valuable for diagnostic inhalation studies for the evaluation of pulmonary function, for imaging the lungs and may also be applied to assessment of cerebral blood flow.

CONTRAINDICATIONS

None known.

WARNINGS

Xenon Xe 133 Gas delivery systems, i.e., respirators or spirometers, and associated tubing assemblies must be leakproof to avoid loss of radioactivity into the laboratory environs not specifically protected by exhaust systems.

Xenon Xe 133 Gas adheres to some plastics and rubber and should not be allowed to stand in tubing or respirator containers. Loss of radioactivity due to such adherence may render the study nondiagnostic.

PRECAUTIONS

General

Xenon Xe 133 Gas as well as other radioactive drugs, must be handled with care and appropriate safety measures should be used to minimize radiation exposure to clinical personnel. Also, care should be taken to minimize radiation exposure to the patients consistent with proper patient management.

Exhaled Xenon Xe 133 Gas should be controlled in a manner that is in compliance with the appropriate regulations of the government agency authorized to license the use of radionuclides.

Radiopharmaceuticals should be used only by physicians who are qualified by training and experience in the safe use and handling of radionuclides and whose experience and training have been approved by the appropriate government agency authorized to license the use of radionuclides.

Carcinogenesis, Mutagenesis, Impairment of Fertility

No long-term animal studies have been performed to evaluate carcinogenic potential, mutagenic potential or whether this drug affects fertility in males or females.

Pregnancy Category C

Animal reproduction studies have not been conducted with Xenon Xe 133 Gas. It is also not known whether Xenon Xe 133 Gas can cause fetal harm when administered to a pregnant woman or can affect reproduction capacity. Xenon Xe 133 Gas should be given to a pregnant woman only if clearly needed.

Ideally, all examinations that use radiopharmaceuticals, especially those elective in nature, of a woman of childbearing capability should be performed during the first few (approximately 10) days following the onset of menses.

Nursing Mothers

It is not known whether this drug is excreted in human milk. Because many drugs are excreted in human milk, caution should be exercised when Xenon Xe 133 Gas is administered to a nursing woman.

Pediatric Use

Safety and effectiveness in pediatric patients have not been established.

ADVERSE REACTIONS

Adverse reactions specifically attributable to Xenon Xe 133 Gas have not been reported.

DOSAGE AND ADMINISTRATION

Xenon Xe 133 Gas is administered by inhalation from a closed respirator system or spirometer. The final patient dose should be measured by a suitable radioactivity calibration system immediately prior to administration.

The recommended activity range employed for inhalation by the average patient (70 kg) is:

Pulmonary function including imaging: 74 to 1110 megabecquerels (2 to 30 millicuries)

Cerebral blood flow: 370 to 1110 megabecquerels (10 to 30 millicuries)

This may be administered as a bolus into the tubing near the patient's mouthpiece or mask after the completion of a tidal exhalation, or by rebreathing for a period of approximately 5 minutes of the Xenon Xe 133 gas in equilibrium with the air contained in the closed system at concentrations of the radionuclide that may vary from 37 to 222 megabecquerels (1.0 to 6.0 millicuries) per liter.

RADIATION DOSIMETRY

The estimated absorbed radiation doses to an average patient (70 kg) for inhalation studies from a maximum dose of Xenon Xe 133 gas in 5, 7.5 and 10 liters are shown in Table 5. The values are the maximum absorbed dose that could be anticipated under the given conditions.

Table 5. Radiation Dose Estimates of Xenon Xe 133[2]: Absorbed Dose per 1110 megabecquerels (30 millicuries) of Xenon Xe 133 Gas Administered by Inhalation

Tissue	Spirometer Volume (liters)					
	5		7.5		10	
	Absorbed Radiation Doses					
	mGy	Rad	mGy	Rad	mGy	Rad
Lung	3.3	0.33	2.46	0.246	1.95	0.195
Red Marrow	0.45	0.045	0.36	0.036	0.27	0.027
Ovaries	0.39	0.039	0.30	0.030	0.24	0.024
Testes	0.36	0.036	0.27	0.027	0.21	0.021
Total Body	0.42	0.042	0.33	0.033	0.27	0.027

DIRECTIONS FOR DISPENSING

Transfer the appropriate Xenon Xe 133 Gas dose from the Xenon Xe 133 Gas unit dose vial(s) to a breathing device or spirometer utilizing the Xenotron™ I Xenon Gas Dispenser. Follow the directions for use that are provided with the Xenotron™ I Xenon Gas Dispenser.

Xenon Xe 133 Gas should not be used after 14 days from the date of calibration stated on the label.

ACTIVITY MEASUREMENTS

Calibrate a suitable commercial ionization chamber dose calibrator according to the

[2] Atkins, Harold L., et al., Estimates of Radiation Absorbed Doses from Radioxenons in Lung Imaging. Task Group of the Medical Internal Radiation Dose Committee, Society of Nuclear Medicine, J. Nucl. Med., 21:459-465,1980.

Xenon Xe 133 Gas

manufacturer's instructions for that particular instrument. An instrument that gives direct radioactivity readouts is recommended.

Use a National Institute of Standards and Technology (NIST) Xenon Xe 133 standard for the initial calibration. Also establish a secondary standard, such as Americium Am 241, at that time for subsequent routine use. Other suitable radionuclides may also be used. Determine the effective readout of the secondary standard compared to the Xenon Xe 133 standard over the range of activities expected for routine measurements. Determine the radioactivities of the dose for administration as follows:

1. Check the dose calibrator for proper response with the secondary standard.
2. Insert the Xenon Xe 133 Gas unit dose vial in the dose calibrator and measure the apparent radioactivity of the Xenon Xe 133.
3. Correct for decay as necessary.

The radioactivity determined by this method is within 25% of the true value. This degree of accuracy includes variations attributed to small differences in geometry and radiation attenuation between the NIST standard ampule and the Xenon Xe 133 Gas unit dose vial.

HOW SUPPLIED

Xenon Xe 133 Gas is available in 2 milliliter vials with color-coded labels in 370 megabecquerel (10 millicurie; Catalog No. 097) and 740 megabecquerel (20 millicurie; Catalog No. 098) sizes. Both sizes are available in packages of 1, 3 and 5 vials, each with individual lead shielding.

STORAGE

Xenon Xe 133 Gas should be stored at controlled room temperature 20° to 25°C (68° to 77°F). [See USP Controlled Room Temperature.]

The U.S. Nuclear Regulatory Commission has approved distribution of this radiopharmaceutical to persons licensed to use byproduct material listed in Sections 35.200 and to persons who hold an equivalent license issued by an Agreement State.

Curium US LLC
Maryland Heights, MO 63043 USA

A097I0

R12/2018

CURIUM™

Xenon Xe 133 Gas

097, 098