2025 Industry Report for

Nuclear Medicine

SHINE

There's a sea change in nuclear medicine.

Fueled by medical innovation and investments by key players, nuclear medicine is booming, creating a boon for patients and drug developers alike.

But how will rapidly evolving medical innovations and the shifting geo-political landscape impact the industry in 2025—and beyond?

Read on as we shine a light on the opportunities, transformations, and challenges ahead.

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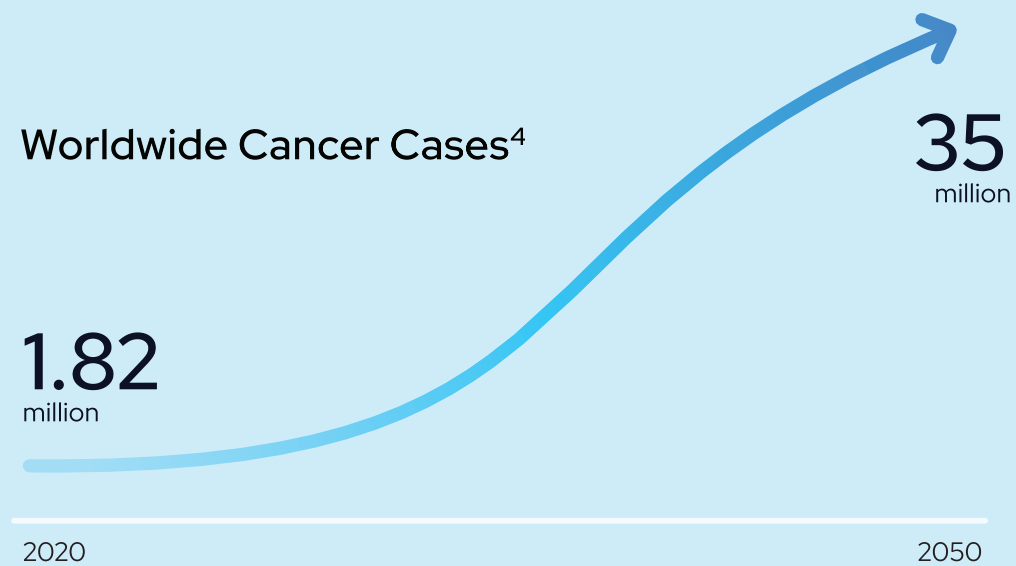
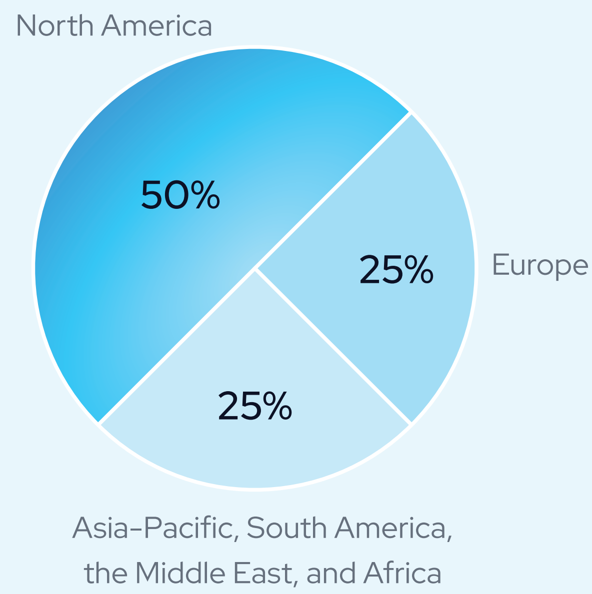
Growing use for a growing need

Global cancer cases are on the rise and projected to increase dramatically, with new cases expected to reach 35 million by 2050. Additionally, the global population of those ages 60+ will double to 2.1 billion by 2050. These factors have increased the need for nuclear medicine, including radioisotopes, for the diagnosis and treatment of diseases such as cancer.



Nuclear medicine in the U.S. and around the world.

The top consumers of nuclear medicine[2]:



Each year:

50 million
medical procedures use radioisotopes worldwide

20+ million
nuclear medicine procedures in the U.S.

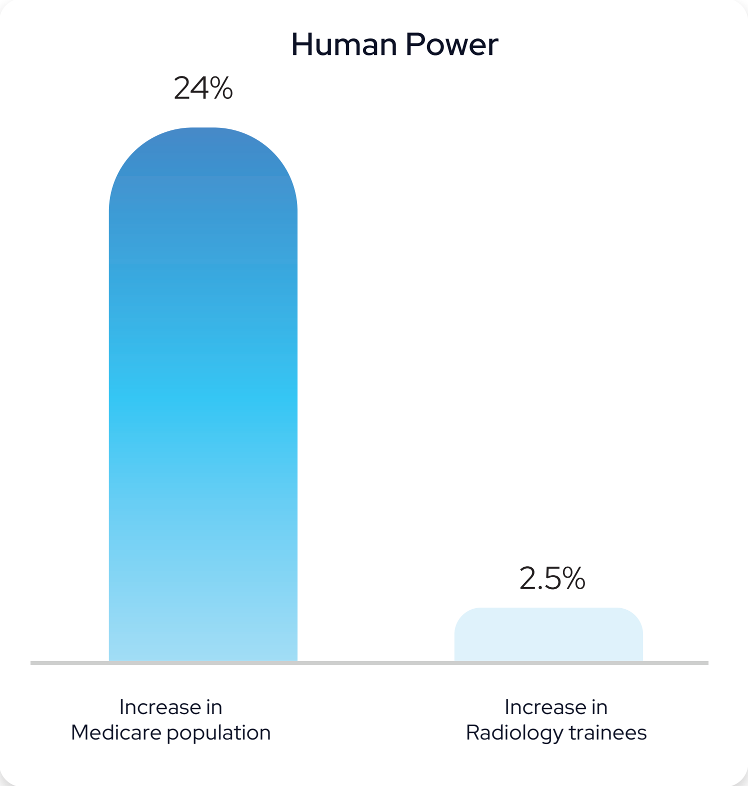
1 in 50
people use diagnostic nuclear medicine in developed countries

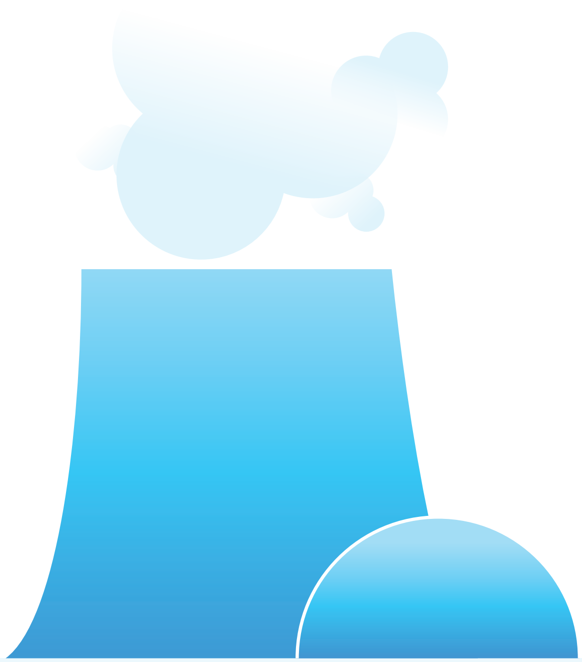
Technetium-99
(Tc-99m) is used in approximately 80% of nuclear medicine procedures and 85% of diagnostic scans in nuclear medicine worldwide

The demands of growing demand

The other side of the growth coin for nuclear medicine is the challenge of shortages.

There is a shortage of nuclear medicine technologists, with growing demand due to the aging population and a dearth in new radiology graduates. In fact, as the Medicare population increased 24% from 2010 to 2020, the number of diagnostic radiology trainees increased just 2.5%. Moreover, by 2050 the proportion of the world's population over 65 is projected to nearly double that of 2015.





Access to high-quality, reliably sourced medical isotopes has also been limited.

Most nuclear reactors, which have historically been necessary for the production of medical isotopes, are located outside of the U.S.

Additionally, there are planned shutdowns in Australia and The Netherlands, further diminishing capacity, and the lead time to build new reactors is too lengthy to meet growing demand in time.

Other factors affect reliable medical isotope supply.

Post-COVID disruptions in the supply chain

International conflicts

Political instability

Supply chain fragility

Long shipping times

These factors negatively impact program timelines and availability of drugs when patients need them

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Radioisotopes: A critical component of nuclear medicine.

Now more than ever the nuclear medicine market relies on radioisotopes for diagnosis and treatment of diseases such as cancer. Although available for more than three decades, radioisotopes are growing in use, not only because of their ability to see inside the body and precisely target diseases, but also due to increasing cancer rates, an aging population, and new treatment breakthroughs.

Medical isotopes: a comparison

Medical isotopes have transformed medicine in their abilities to serve as both diagnostic and treatment tools. As usage of medical isotopes expands, so too do the considerations for their merits and drawbacks.

> ***Nuclear medicine is at an inflection point, with new therapeutic isotopes and molecular targeting agents poised to revolutionize cancer care.***
>
> Dr. Rock Mackie, Professor Emeritus of medical physics at the UW-Madison

	Lutetium-177 (Lu-177)	**Terbium-161 (Tb-161)**	**Actinium-225 (Ac-225)**	**Iodine-131 (I-131)**	**Yttrium-90 (Y-90)**	**Lead-212 (Pb-212)**	**Copper-67 (Cu-67)**
Use	Diagnostic imaging and Targeted Radionuclide Therapy (TRT)	TRT substitution for Lu-177	Targeted Alpha-Radiation Therapy (TAT)	Thyroid cancer and hyperthyroidism treatment	Radioembolization for liver cancer	In vivo generator of alpha-emitting radionuclides for TAT	Ideal theranostic isotope
Benefits	Effective treatment of neuroendocrine tumors and prostate cancer	Increased efficacy in small metastases	Effective for high-dose to tumors with minimal damage to surrounding tissue	Effectively destroys thyroid tissue; straightforward protocols	Helps target and destroy cancer cells	High energy alpha-emitting isotope for high linear energy transfer (LET) to tumor cells	Decays via beta and gamma emission
Starting Materials	Highly enriched Yb-176; can be produced by SHINE for accessible, scalable domestic supply.	Highly enriched Gd-160; SHINE engaged in R&D for production	Radium-226 (radioactive with 1600 year half-life)	Produced via uranium fission or direct irradiation of a natural tellurium target	Strontium-90	Neutron irradiation of Rad-226 to produce Th-228	Highly enriched Zn-68
Production	High-flux research reactors; SHINE uses low to medium flux reactors without impacting product quality	Soon to be produced by SHINE via high-flux reactors	Most commonly proton bombardment of a Radium-226 target	Byproduct of nuclear reactors or irradiation; SHINE can produce without a nuclear reactor	Typically produced in a reactor; SHINE can produce without a nuclear reactor	Separation from Ra-224 or directly from Th-228	Gamma ray irradiation of Zn-68 targets
Half-life & Transport	6.65 days half-life; closer transport beneficial	6.96 day half-life; closer transport beneficial	9.92 day half-life; closer transport beneficial	8-day half-life; constrained but manageable for transport	Relatively short half-life of 64.1 hours, necessitating efficient transport	10.64 hour half-life; closer transport beneficial	2.58 day half life; longest lived isotope of copper
Waste Generation	Liquid isotope waste streams reduced by 100x with SHINE	Similar to standard Lu-177 processing if bulk separation not utilized	Radioactive liquid waste; need for waste recycling	Beta and gamma emissions; requires careful handling of radioactive waste	Beta emitter requires careful waste management	Purification streams contain alpha-emitters, strict control needed	Highly enriched zinc can be recycled and reused for irradiation
Radiation Concerns	Storage of radioactive liquid waste dramatically reduced via SHINE's bulk separation technology	Storage of radioactive liquid waste from processing and Gd recycling	Storage of radioactive liquid waste from processing and radioactive Ra-226 recycling; radiological safety concerns	Store radioactive liquid waste or separate from long-lived fission product stream and its radioactive raffinate	Limited flexibility due to need for nuclear reactor or generator system	High energy but easily shielded alpha emissions	After separation of Zn, waste can be further processed for disposal

A bright new future

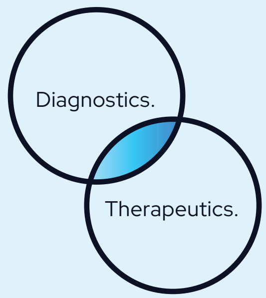
As innovations and challenges unfold, emerging trends become more evident:

Greater reliance on precision oncology.

Artificial Intelligence, especially to shorten image acquisition, decrease the dose of tracers, and enhance image quality.

Advancements in biomarker identification.

Expansion in theranostics, which integrates therapeutics and diagnostics for personalized, targeted treatment.

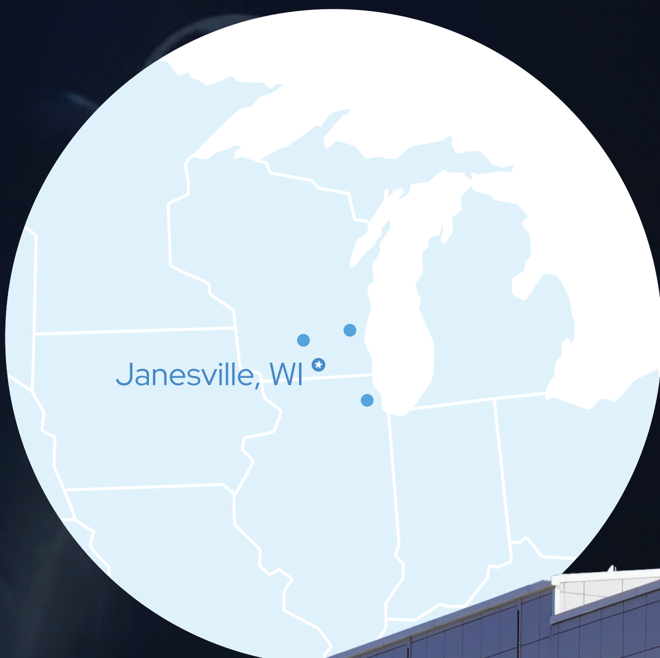


Increased investment in R&D in both the public and private sectors.

Regulatory support of new theranostic solutions.

Research and development.

A move to U.S. production



To alleviate shortages and difficulties associated with producing medical isotopes outside the United States, medical isotope manufacturers are bringing domestic facilities online.

One notable example is SHINE Technologies, the largest n.c.a. Lu-177 production facility in the U.S.

A bright new day with SHINE

SHINE facts:

- Largest Lu-177 production facility in the United States.
- One of the only producers of ytterbium-176 outside of Russia.
- Strategically-located U.S. facility to avoid shipping delays that affect isotope half-life.
- Proprietary production process.
- DMF on file with the F.D.A.
- Modular equipment design allows doubling capacity quickly.

SHINE Technologies is shining the way for new opportunities in nuclear medicine.

Poised to become the first vertically integrated manufacturer of n.c.a. lutetium-177 in the world, SHINE conducts every part of target preparation and Lu-177 separation in-house, with an innovative approach that generates less waste, is more cost-effective, and offers the ability to recycle materials more efficiently.

SHINE can support the creation of hundreds of thousands of doses of cancer-fighting medicine each year. SHINE also provides rapid supply from its Midwestern United States base and is focused on relationships and understanding customer needs.

Learn more about our revolutionary offering.

Appendix

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Sources

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[3] Theranostics Global Market Report 2024, The Business Research Company World Nuclear Association. (2024, April 30)

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