Nuclear Medicine
From status *quo* to status *go*

Nuclear Medicine is based on the use of radioactivity for healthcare applications in diagnosis and therapy. Through the use of biomolecules that are labelled with radioisotopes, numerous metabolic, molecular and signalling pathways can be visualized and quantified. This information is used for diagnosis and personalized treatment planning.

Moreover, the same **tracer principle** can be used to target disease in vivo for internal radiation therapy. The use of the same biomolecule labelled with different radioisotopes for diagnosis and therapy is called **theranostics** and was first proposed by Paul Ehrlich a century ago.

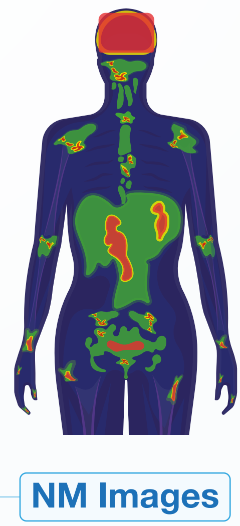
Nuclear Medicine operations require a number of assets ranging from production facilities for radioisotopes, safe GMP Labs and quality control for tracer labelling, nuclear medicine wards that are equipped with appropriate imaging or therapy facilities and trained staff that bring the results from nuclear medicine examinations to use in the context of precision medicine.

Tracer production has benefitted from radiopharmaceutical industry develop an armamentarium of radionuclide production facilities that enables to provide sufficient amounts of all commonly used radionuclides (Fact sheet). The dispatching of these tracers is ensured by complex and dedicated logistics involving means of short- and long-distance transportation. Such network is able to supply the most remote places, crossing borders in conformity with local regulations, while taking in account the natural decay of the product and staying always in conformity with all local regulations.

Nuclear Medicine diagnosis is based on the use of dedicated imaging equipment. Single Photon Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET) allow the spatio-temporal observation of the distribution of tracers that are labelled with single photon emitters and positron emitters, respectively. Today, SPECT and CT come in combinations with CT (SPECT/CT, PET/CT) and MR (PET/MR) for added diagnostic benefits.

Innovation in nuclear medicine is seen in tracer developments and advances in imaging technology. For the first, new tracer concepts become available for imaging early stages of Alzheimer as well as for new therapeutic regimens. Innovation in imaging technology include the introduction of whole-body SPECT imaging, the use of time-of-flight measurements in PET for higher quality images and the routine availability of kinetic parameters for more detailed analysis of tumour metabolism, for example. First promising use cases of AI in combination with nuclear medicine images will help promote the adoption of clinical decision support solutions involving PET and SPECT. Such advances will allow faster and more user-independent decision making and offer improved therapy planning.

Nuclear medicine operations from **radionuclide production** (reactor, cyclotron, generator) to **radiotracer labelling**, **injection** into the patient, **generation of NM images** (SPECT or PET) and **incorporation** into diagnostic and therapeutic pathways for personalized care.



NUCLEAR MEDICINE EUROPE
the industry association

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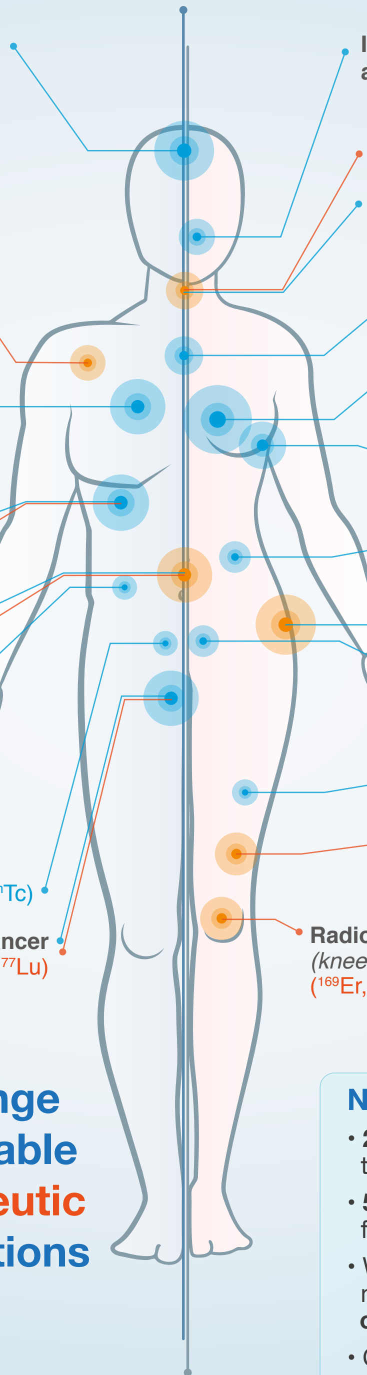
Clinical applications of nuclear medicine include, for example, cardiology, oncology, neurodegenerative disease and inflammation. There is solid evidence of the diagnostic benefits of molecular, tracer-based differentiation of malignant disease and biological degenerations.

Theranostics describes the concept of combined therapy and diagnostics and is a testimony to the principle of nuclear medicine and the serial labelling of the same biomolecule with a radioisotope for diagnosis (step 1) and therapy (step 2).

DIAGNOSIS & THERAPY



A wide range of radionuclides is available for diagnostic and therapeutic nuclear medicine applications

Nuclear Medicine Facts 2020

- **24000 SPECT** systems are operational that support 40 mio examinations per year
- **5700 PET** systems (most of them being PET/CT) for 6 mio examinations per year
- Worldwide supply of radionuclides for nuclear medicine is provided by **16 reactors and 1200 cyclotrons**, of which 800 are used for [^{18}F] exclusively
- Clinical acceptance of nuclear medicine grew steadily over the past 10 years