A new colleague in nuclear medicine, the clinical technologist

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EDITORIAL

A new colleague in nuclear medicine, the clinical technologist: quo vadis?

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Background

Healthcare is rapidly changing and gaining complexity. In the past decades, technological development has led to major progress in the field of healthcare, medical scientific research and medical education. The result of the development in medical technology is an impressive increase of diagnostic and therapeutic possibilities and extensive specialisation of healthcare professionals. Technology is increasing not only in quantity, but also in complexity. High-quality technology demands knowledge and insight to cope with this technology and to implement it in the most optimal and safe way. Healthcare today calls for professionals with combined scientific, medical, engineering and informatics background, and demands a multidisciplinary approach.

As medical technology was emerging fast, a Technical Medicine educational programme has been designed and has started in 2003 at the University of Twente in the Netherlands, including the opportunity to follow a subsequent clinical fellowship, and was the first of its kind in the world (https://www.nvvtg.nl/technische-geneeskunde/, https://www.nvvtg.nl/fellowships/). Technical Medicine has now gained recognition as a new, full-fledged discipline in Dutch healthcare. This was followed by other Universities, such as the Technical University of Delft, the Netherlands, and a few educational programmes outside the Netherlands; however, these are not fully comparable. The length of the scholarship in the Netherlands is a bachelor programme of 3 years followed by a master of 3 years, which includes 2 years of clinical internships, combining patient care and research. Main educational programme lines in the Netherlands are (molecular) imaging and intervention, and sensing and stimulation.

Its acknowledgement was accelerated by the fact that the knowledge domain belonging to this new group of professionals has been officially recognised by the Dutch law. The novelty of this profession lies in the fact that graduates need to register in the Dutch BIG-registry (e.g. legal public registration for professions in individual healthcare), and are then qualified to independently perform certain reserved clinical procedures in the Netherlands. These clinical competencies are as follows (https://www.nvvtg.nl/technische-geneeskunde/):

- Surgical procedures;
- Catheterization;
- Injections;
- Punctures;
- Procedures with ionising radiation.

The medical professional is predominantly named clinical technologist, which is the legally protected title belonging to this profession, but in other settings they are also referred to as technical physician or technical medicine specialist. The clinical technologist is responsible for their professional procedurals. Conform physicians and nurses, they are BIG (Beroepen in de Individuele Gezondheidszorg) registered. The BIG register is a legal, online and public register for Professions in Individual Health Care. Only healthcare professionals who are registered in this register may use the protected professional title and may independently perform the reserved actions associated with the profession (https://english.bigregister.nl/). The Dutch Association for Technical

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Medicine (NVvTG) (https://www.nvvtg.nl/technische-geneeskunde/) was founded in 2009 as the professional association for this new healthcare professional (https://www.nvvtg.nl/technische-geneeskunde/). The NVvTG is dedicated to the following:

- Ensure the quality of all clinical technologists in the Netherlands
- Stimulate scientific development
- Serve the interests of her members
- Represent the profession in the Netherlands

Role of clinical technologist

The clinical technologist will, based on thorough insight in both the functioning of the human body and technology, with their own responsibility

- Perform medical technical complex procedures;
- Optimise existing medical technical interventions or procedures; and
- Design and develop new diagnostic and therapeutic opportunities.

After finishing education and training, the clinical technologist is mainly positioned in the hospital, (clinical) research, related industry or at universities (education) (see Fig. 1A). The majority of clinical technologists in medical research are starting with a PhD project, and from there follow different career paths. If we focus on the hospital, several clinical fields of expertise are covered by the clinical technologist (see Fig. 1B).

If we zoom-in on nuclear medicine, an important opportunity for the clinical technologist is to contribute to clinical implementation of developments in molecular biology and precision or personalised medicine, as these items are directional for (nuclear) medicine. Depending on the local clinical situation and personal interests, the clinical technologist can focus on medical collaboration with the nuclear medicine physician, endeavour a position in the technical domain closer to the medical physicist or find a balance between the two. The final goal is to work in a multidisciplinary environment, in which the clinical technologist has its own unique expertise and clinical responsibilities.

A first opportunity lies in the need for ongoing innovation in the characterisation of the biological behaviour for treatment options, prognosis and therapy prediction by using diagnostic molecular imaging. In nuclear medicine, a growth is seen in new theragnostic agents (e.g. [^{177}Lu]PSMA in prostate cancer) using a specific radiopharmaceutical for the diagnosis, and the same compound labelled with a therapeutic radionuclide for treatment [1–3]. Clinical studies starting to show that the personalised treatment approaches, including pre-treatment dosimetry, can have a large impact on therapeutic efficacy and reduce toxicity. As this field is growing so fast and implementation of advances can be complex, the additional help of highly skilled technical-medical colleagues is welcome. The clinical technologist expands together with the nuclear medicine physician and medical physicist, the new field of personalised radionuclide therapy [4, 5].

Similarly, new tools for automatic image segmentation and quantification are a field of intense research. The same is certainly true for innovative artificial intelligence, such as machine learning algorithms and deep neural networks. These integrative prediction models can combine parameters, such as clinical information, lab findings, histopathology, genetic profiles and imaging parameters including radiomics [6–9]. Various experts, including clinical technologist, both in academia and the clinic collaborate in this field.

A next field of interest for the clinical technologist is supporting real-time information procedures, such as in hybrid surgery rooms, interventional nuclear medicine and image-guided surgery. Implementation of new real-time imaging technologies during interventions can be valuable, but they regularly need optimization steps transferring them from a beta-system towards routine clinical practice. In this setting, the clinical technologist has a unique advantage as they can use the technology on patients and provide feedback as well. Clinical technologists are also seen in areas where the multidisciplinary approaches of imaging, dosimetry and radionuclide therapy and/or ablation come together, such as for instance hepatic radioembolization or cryoablation [10–12].

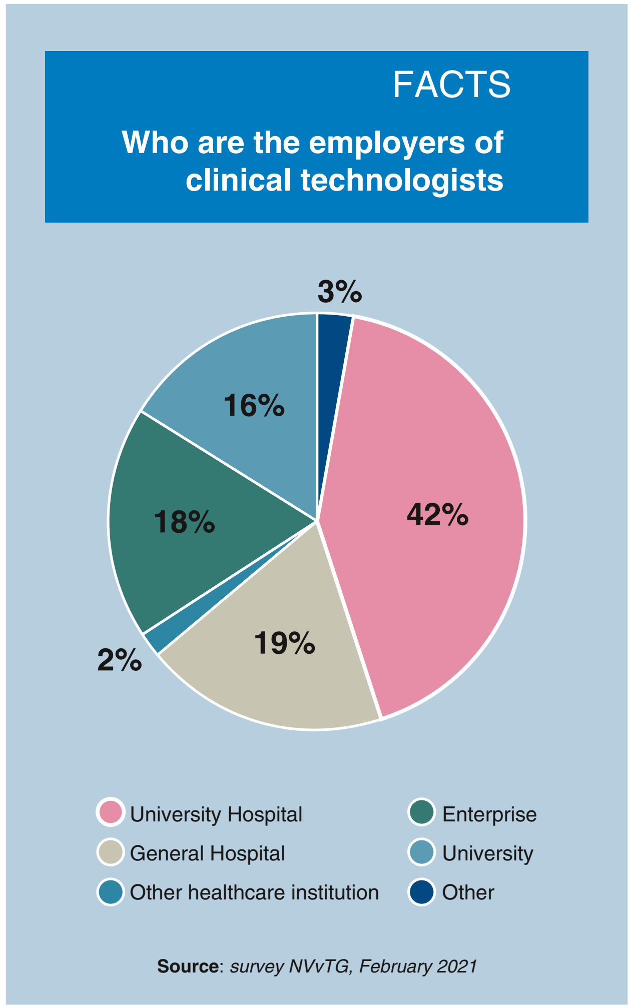
Future clinical technologist in nuclear medicine

As we can speak for the Dutch situation, the clinical technologist possesses different functions in the healthcare system. They participate in direct healthcare, education and training in clinical technology, development and implementation of clinical technology, and clinical research. Besides taking part in developing and implementing new technologies, clinical technologists also contribute to evaluating and optimising existing technologies and processes. The value of this contribution can be measured both by patient outcome and healthcare cost aspects.

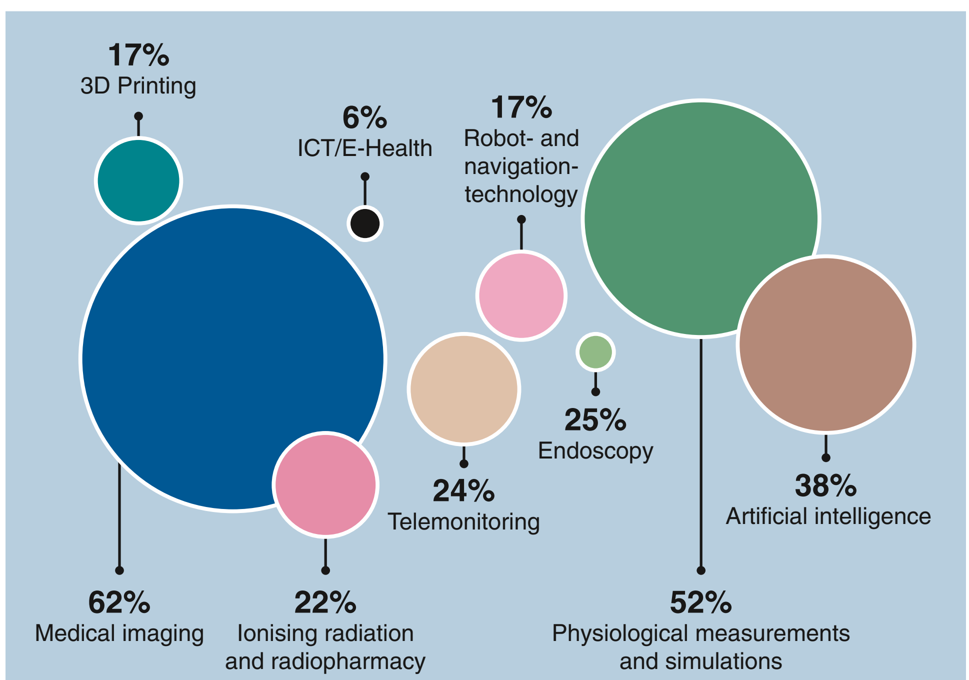
Currently, clinical technologists are licenced health professionals in the Netherlands, registered in a quality register. Similar to medical residents, clinical technologists can be trained additionally via a 2-year specific clinical fellowship to become specialists within a specific field of interest. In this position, clinical technologists develop and apply

Fig. 1 **A** The employers of the clinical technologists in the Netherlands. **B** Overview of the domains of the clinical technologist in the Netherlands

A



B



technical solutions for clinical problems in a specific domain with their own expertise and responsibilities. Clinical technologists are a full-fledged member of the multidisciplinary clinical team for diagnosis and/or therapy, with a specific accent on their expertise in clinical technical execution of the nuclear medicine procedures, and to transform processes more efficiently within the department.

The clinical technologist found opportunities within the healthcare system in the Netherlands. (Super)specialists are needed regarding the rapidly changing clinical technologies in our healthcare system, and therefore, several clinical technologists are already positioned in the Dutch healthcare system. Time will tell how clinical technologists will further integrate into our healthcare system, in particular in nuclear medicine, as it is a profession in development. Collaboration with the nuclear medicine physicians and medical physicists will be pivotal, but good local examples are visible in the Dutch situation.

Declarations

Ethics approval Institutional Review Board approval was not required because the paper is an Editorial.

Consent to participate Not applicable.

Conflict of interest The authors declare no competing interests.

References

1. Huizing DMV, Sinaasappel M, Dekker MC, Stokkel MPM, de Wit-van der Veen BJ. 177 Lutetium SPECT/CT: evaluation of collimator, photopeak and scatter correction. J Appl Clin Med Phys. 2020;21(9):272–7.
2. Woliner-van der Weg W, Schoffelen R, Hobbs RF, Gotthardt M, Goldenberg DM, Sharkey RM, Slump CH, van der Graaf WT, Oyen WJ, Boerman OC, Sgouros G, Visser EP. Tumor and red bone marrow dosimetry: comparison of methods for prospective treatment planning in pretargeted radioimmunotherapy. EJNMMI Phys. 2015;2(1):5.
3. Boss M, Buitinga M, Jansen TJP, Brom M, Visser EP, Gotthardt M. PET-based human dosimetry of ^{68}Ga-NODAGA-exendin-4, a tracer for β-cell imaging. J Nucl Med. 2020;61(1):112–6.
4. Huizing DMV, Koopman D, van Dalen JA, Gotthardt M, Boellaard R, Sera T, Sinaasappel M, Stokkel MPM, de Wit-van der Veen BJ. Multicentre quantitative 68Ga PET/CT performance harmonisation. EJNMMI Phys. 2019;6(1):19. https://doi.org/10.1186/s40658-019-0253-z.
5. Makris NE, Boellaard R, Visser EP, de Jong JR, Vanderlinden B, Wierts R, van der Veen BJ, Greuter HJ, Vugts DJ, van Dongen GA, Lammertsma AA, Huisman MC. Multicenter harmonization of 89Zr PET/CT performance. J Nucl Med. 2014;55(2):264–7. https://doi.org/10.2967/jnumed.113.130112.
6. Noortman WA, Vriens D, Grootjans W, Tao Q, de Geus-Oei LF, Van Velden FH. Nuclear medicine radiomics in precision medicine: why we can't do without artificial intelligence. Q J Nucl Med Mol Imaging. 2020;64(3):278–90.
7. Collarino A, Garganese G, Fragomeni SM, Pereira Arias-Bouda LM, Ieria FP, Boellaard R, Rufini V, de Geus-Oei LF, Scambia G, Valdés Olmos RA, Giordano A, Grootjans W, van Velden FHP. Radiomics in vulvar cancer: first clinical experience using 18F-FDG PET/CT images. J Nucl Med. 2018;60(2):199–206.
8. Beukinga RJ, Wang D, Karrenbeld A, Dijksterhuis WPM, Faber H, Burgerhof JGM, Mul VEM, Slart RHJA, Coppes RP, Plukker JTM. Addition of HER2 and CD44 to 18F-FDG PET-based clinico-radiomic models enhances prediction of neoadjuvant chemoradiotherapy response in esophageal cancer. Eur Radiol. 2021;31(5):3306–14.
9. Saleem BR, Beukinga RJ, Boellaard R, Glaudemans AW, Reijnen MM, Zeebregts CJ, Slart RH. Textural features of 18F-fluorodeoxyglucose positron emission tomography scanning in diagnosing aortic prosthetic graft infection. Eur J Nucl Med Mol Imaging. 2017;44(5):886–94.
10. Burgmans MC, Hendriks P, Rietbergen DDD. Does a widely adopted approach need reconsideration: embolization of parasitized extrahepatic tumor feeders in patients undergoing transarterial liver-directed therapy? Cardiovasc Intervent Radiol. 2020;43(7):1103–4.
11. KleinJan GH, Hellingman D, van den Berg NS, van Oosterom MN, Hendricksen K, Horenblas S, Valdes Olmos RA, van Leeuwen FW. Hybrid surgical guidance: does hardware integration of γ- and fluorescence imaging modalities make sense? J Nucl Med. 2017;58(4):646–50.
12. de Bree R, Pouw B, Heuveling DA, Castelijns JA. Fusion of freehand SPECT and ultrasound to perform ultrasound-guided fine-needle aspiration cytology of sentinel nodes in head and neck cancer. AJNR Am J Neuroradiol. 2015;36(11):2153–8.