State Examination, Stroop test, a 15-word verbal learning test (WLT), the letter-digit substitution task (LDST), the verbal fluency test and the Perdue Pegboard test. Voxel-based morphometry was performed to investigate the association between local grey matter density and cognitive function.

When looking into the verbal fluency test, we found that higher grey matter density in the left parietal lobe and posterior temporal lobe was associated with better performance. Lower grey matter density in the right insular cortex was associated with better performance on the verbal fluency test. Better performance on WLT, a task to test memory, was associated with higher grey matter density in the left hippocampus. Better performance on the Stroop test, a reading/colour naming interference task to test executive function, was related to higher grey matter density in both hippocampi, and lower grey matter density in the left and right thalamus (Figure). Furthermore, we observed that lower grey matter density in the left insula was associated with worse performance on the LDST.

In conclusion, in this study we showed that the detection of more localised differences in brain structure provides relevant information in addition to aggregate measures. Subsequently, this study may provide insight into the pathways of cognitive decline.

*Dr. Hazel I. Zonneveld works at the department of epidemiology and the department of radiology and nuclear medicine at Erasmus MC University Medical Center, Rotterdam, the Netherlands.*

### *Scientific Session*

***Saturday, March 4, 10:30-12:00, Room E2***

***SS 1411 The ageing brain: cognition and dementia***

Moderators: L. Hermoye; Brussels/BE
A. Negaard; Lørenskog/NO

» **The neural substrate of cognition: the Rotterdam study**
H.I. Zonneveld, G.V. Roshchupkin, H.H.H. Adams, W.J. Niessen, M.A. Ikram, M.W. Vernooij; Rotterdam/NL

# Change in paradigm – why medical radiation protection has become a fundamental clinical challenge

## An interview with EuroSafe Imaging Chair, Professor Guy Frija

*Prof. Guy Frija is Chair of the EuroSafe Imaging Steering Committee and Co-Chair of the new International Society of Radiology Quality and Safety Alliance.*

**ECR Today: Radiation protection in medicine has historically been driven by national regulators from the nuclear sector who have established regulations for the safe use of medical imaging. What will be the implications of the new Council Directive 2013/59/Euratom (Basic Safety Standards – BSS Directive)?**

**Guy Frija:** The European Union has a leading role in medical radiation protection, having updated and consolidated five applicable directives into a single legislation entitled Council Directive 2013/59/Euratom (Basic Safety Standards Directive). Issued in December 2013, the Directive must be transposed into national law by EU member states by February 2018.

It is essential to understand that the implementation of the previous European legislation for medical radiation protection has been a failure. It is now important in the transposition phase of the new BSS Directive that all stakeholders collaborate in order to ensure that the proposed safety measures and requirements will be applicable in daily clinical routine.

**ECRT: In how far has the implementation of European radiation protection legislation in the medical field been a failure until now?**

**GF:** Let's take imaging referral guidelines for medical imaging as an example. An ESR survey showed that in most cases they are not used in clinical practice, even in countries where such guidelines are available.

Diagnostic reference levels (DRLs), for example, were established for common protocols on the basis of national surveys. However, they were rarely updated and did not follow the pace of technological progress. In addition, current DRLs do not take into account the distribution of patients' body characteristics nor a disease's prevalence. Optimisation is generally seen as a dose reduction process, even though image quality in relation to clinical need would be much more relevant. This is perhaps why the DRL concept currently in use fulfils the requirements of regulators but not the clinical needs of an optimisation process.

**ECRT: Do you have a remedy?**

**GF:** Radiation protection can be viewed as a process of several inter-related and interdependent steps. The starting point is the justification process; making sure that the requested examination is clinically relevant.

In the United States, using an integrated clinical decision support tool to perform and document this process will be mandatory from 2018. In the EU, there are a variety of co-existing approaches, as responsibility for health systems resides with member states.

However, it is the radiologists' responsibility and interest to lobby national governments to develop a strong policy on justification in order to ensure better and safer use of medical imaging based on clinical considerations.

When CT is performed, it is clear that the technical protocol is driven by the clinical indication. The resultant image quality needed for a reliable interpretation is consequently also directly linked to the clinical indication. Therefore, it is very important for a given facility to record the dose exposure on the basis of the clinical indication rather than on technical and/or anatomical protocols. The development of automatic dose-recording systems would facilitate the establishment of local diagnostic reference levels (LDRLs), which have the advantage of better reflecting the distribution of the patient's body characteristics, as well as the disease's prevalence, and the performance of the modalities used. It has already been shown that LDRLs could be an effective tool for improving the clinical practice, as one can only improve what one can measure.

In addition, using indication-related rather than protocol-based DRLs would sound much better for patients and also for physicians, and could be helpful for external communication.

**ECRT: Europe has a very heterogeneous equipment base, isn't this a hindrance to your plans?**

**GF:** In fact, equipment performance is another extremely important aspect. Modern CT technology has enabled a significant decrease in patient exposure. However, COCIR market surveys show a strong heterogeneity of CT scanners across Europe, which is a huge concern. It is the radiologist's responsibility to highlight this critical aspect to national governments and the European Commission and to encourage the development of equipment upgrade plans.

**ECRT: Another big buzzword surrounded by numerous question marks is clinical audit, which was already made mandatory in the previous Directive but badly implemented …**

**GF:** The audit process should focus primarily on the four clinical steps of clinically oriented radiation protection: justification, clinically-guided protocols, clinically-evaluated image quality, and disease/symptom-oriented DRLs. Fluoroscopy-guided interventions were not considered in this legal requirement, but the clinical approach to patient radiation protection for such procedures is already under way. Paediatric imaging is by definition included in the concept.

**ECRT: What would be the potential impact of this proposed change in paradigm towards clinically oriented radiation protection?**

**GF:** If implemented properly and in a collaborative teamwork setting with all stakeholders involved, aligning radiation protection with clinical concerns could have a significant impact on the quality of daily clinical practice and hence patient outcomes. In summary, radiation protection would become much more appealing if it were clinically based, focused on a patient-centric approach, especially if it were to involve the use of modern equipment.

**ECRT: Radiation protection, however, is not considered a 'sexy' topic by the vast majority of radiologists. EuroSafe Imaging has seemingly improved the visibility and attention radiation protection receives both within the clinical environment and at political level. How are you going to 'sell' the topic to the younger generation of radiologists?**

**GF:** Through EuroSafe Imaging, we will convince them to think differently! First, by propagating that radiation protection become one of the pillars of their daily clinical practice, even though the delivered dose per examination has significantly decreased in the past years. Making it mandatory that an examination is clinically warranted and that the relevant protocol is appropriately set up, as well as that the image quality assessment is a part of the report, will certainly improve the patient outcomes thanks to a clinically driven process optimisation. Radiation protection should no longer be a regulatory constraint, but a way to improve the total quality of daily clinical practice. In addition, modern tools allow us to establish our own practice profiles and to compare it to equivalent facilities. This benchmarking endeavour should be very stimulating. Finally, belonging to a community strongly involved in the development of radiation protection should facilitate a new era of networking between European institutions in order to bring big data to our specialty.

**ECRT: EuroSafe Imaging has served as role model for radiation protection campaigns across the globe. You have recently been appointed Co-Chair of the new International Society of Radiology Quality and Safety Alliance. What is your motivation and mission for this new challenging role?**

**GF:** The aim will be to 'profile' each regional organisation in order to better know and understand local and regional priorities. We will pool experiences and resources into a single website, which will allow us to share experience, knowledge and relevant material. Also we plan to launch a call for action, which will reflect the regional priorities. In other words, the Alliance's activities will be entirely bottom-up.

The contribution of EuroSafe Imaging to this global endeavour will be very important, as we have a lot of material to provide from the European side. We could also propose educational workshops, which would cover the whole spectrum of radiation protection. It is clear that an active cooperation with IAEA activities will be sought.

**ECRT: Congratulations to EuroSafe Imaging and thank you for the interview.**