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# Molecular Imaging and Radiology -Ensuring Our Future

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Three years ago at Erasmus MC, the Board of Directors was advised to look into molecular imaging, to examine not only what projects and developments were underway, but what could be made possible by it. As leader of this inquiry, I produced an advisory paper on how and to what extent medical schools should invest in research into this new and emerging field.

I also had to assess existing research and other endeavours in the field of molecular imaging, to provide information on what might be a good direction or focus for ourselves. Thus, a university-wide cooperative programme on molecular imaging was established, of which I am Steering Committee Chair, which includes heads from all involved departments, e.g. cellular biology, molecular biology, nuclear medicine and other clinical departments where molecular imaging will inevitably bring major medical advances.

### Why Should Radiologists Care?

In the years to come, molecular imaging will have a profound impact on areas like the provision of personalised healthcare and the stratification of risk. In my opinion, it is a fundamental necessity, to be able to to translate this into clinical practices. More and more professionals are getting involved for instance in cellular and molecular imaging, specifically with the actual visualisation or imaging of these processes. If we assume a position of leadership now, radiologists can take this opportunity to make their mark.

### From Research to Clinical Applications

Oncology is the primary area where molecular imaging will have a massive impact. At present, molecular imaging is in the research phase and therefore clinical applications are not yet fully realised. For example, in PET/SPECT, which is in existence for the last two to three decades active in nuclear visualisation of e.g. enzymes and peptides, new probes are being created so the uses of it are increasing. For instance, visualising angiogenesis at a cellular level or the effects of antiangiogenic therapies to monitor at cellular level the pathologic processes are already one practical use of molecular imaging. It is also useful in imaging, labelling and tracking the development of injected stem cells which can be used as a possible therapy or for tissue engineering.

### Developing the Right Tools

For molecular imaging to realise its practical applications, very sensitive imaging tools that provide a clear and accurate image are an essential requirement, but have yet to be developed. This is not the only problem area. For example, in optical imaging, which already has one of the most sensitive tools available in the field of molecular imaging, the depths of penetration achieved so far are miniscule and we can't penetrate very deeply under the surface with current tools. The development of tiny probes is required and these will not be applicable to human organs for a long time. Another problem exists in nuclear medicine, particularly PET/SPECT. Here, the drawback is not the sensitivity of the imaging device but the spatial resolution, meaning that we can see quite well but are not able to comprehended. There are broad areas emerging in animal research that will facilitate the applications of  the identify exactly where we are seeing.

Therefore, hybrid techniques are needed for PET or SPECT CT for example, where tools are combined so that they are both sensitive and spatially accurate. Presently, the only one method to provide both is in MR which, in itself, has the potential to become a good tool for molecular imaging. Many new probes need to be developed to visualise these processes with a good image quality. As MR is exclusively in the hands of radiologists unlike PET/SPECT, this could be a valuable entry point for radiologists to take a leading role in the development of this emerging science. Since molecular imaging is still mainly in the research phase, should an academic department of radiology want to explore this field, the best way in my opinion to do so, is to install high field animal imaging MR systems.

**Conclusion**

The optimistic view is that it will be a few years before the clinical possibilities of molecular imaging are fully comprehended. There are broad areas emerging in animal research that will facilitate the applications of the comprehended. There are broad areas emerging in animal future. The main task for the moment that hinders the development of molecular imaging is the development of the various necessary tools and also the development of the drugs that will be used as probes. As these have to be approved and registered for use, this is a lengthy and costly process. By putting pressure on this process, we hope to speed it up, once governments and authorities realise the importance of personalised medicine.

Also, education for radiologists in molecular imaging must be incorporated, if the next generation are to seize this opportunity. The issue at present is that there is no grounding in molecular biology included in the curricula of trainee radiologists. In order for the next generation of radiologists to understand the molecular basis for disease, this must be addressed, or we as a profession will lose out. At Erasmus, we already have some molecular imaging and molecular biology courses that are in the early stages of creation. Also, it is important for the ESR to recognise their responsibility in harmonising this curriculum across Europe, including training in molecular imaging and molecular biology.

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