SINFONIA field survey of staff dosimetry practice in proton therapy centers

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Introduction

Although dose monitoring of personnel is in place in proton therapy (PT) centers in accordance with national regulations, documentation of staff dosimetry data and practices are limited. Challenges are related to the potential exposure of staff due to the creation of high energy neutrons. Moreover, material activation in PT leads to concerns and doubts related to the risk of staff.
This adds further complications when addressing radiation protection concerns in daily PT practice and can potentially lead to under- and overprotection of staff depending on their working environment and tasks.

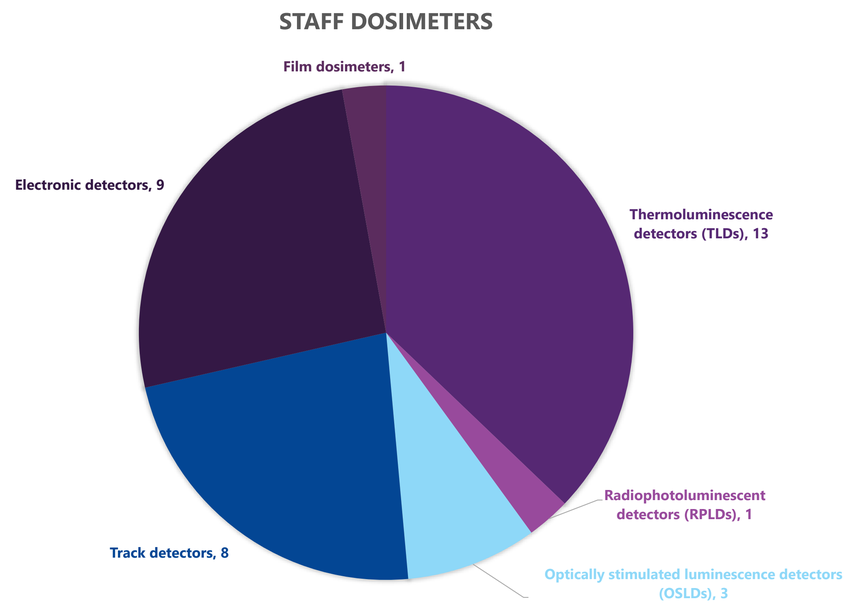
Methods

Within the EU-funded project SINFONIA (Radiation risk appraisal for detrimental effects from medical exposure during management of patients with lymphoma or brain tumour), a survey was sent to all European PT centres, currently operational, regarding the consideration of neutrons for staff monitoring. The following aspects were covered in the survey:

a) staff dosimeters
b) personnel wearing dosimeters and their dose levels
c) ambient dose monitoring systems
d) rooms monitored and their dose levels.

Results

Out of 23 centers, 17 centers answered the survey.
The most widely used dosimeters to monitor staff are Thermoluminescence detectors (TLDs), followed by optically stimulated luminescence detectors (OSLDs) and radiophotoluminescent detectors (RPLDs). In more than half of the centers (10 out of 17) neutrons are considered by means of either track detectors or Albedo TLDs.



In all centers medical physicists are monitored, followed by nurses (88%), maintenance personnel (76%) and radiation oncologists (70%). Administrative personnel is only rarely monitored (1 center). Most of the dose records were below detection limits. Only 30% of the doses reported were detectable and these came mostly from medical physicists, nurses and maintenance personnel. Still, doses to staff working in PT centers are very low (<1 mSv/year) and therefore radiation-related effects to this staff population are not expected.
Almost all centers have fixed monitoring systems and in almost all cases, the ambient monitor system(s) monitored both neutrons and gammas. Berthold (5 centres), Ludlum (3 centres) and WENDI-II (2 centres) are the most widely used detector systems.
Interestingly important locations such as technical rooms (can be close to the treatment room/cyclotron) and accelerator are part of the fixed monitoring areas.

Berthold Ludlum WENDI-II

Transportable detectors are used to verify activation but are also applied in other situations, such as for granting non-monitored people access to specific areas of the facility, monitoring non-controlled rooms as well as for commissioning of the PT facility.

Conclusion

The outcome of the survey confirms good Radiation protection practices and low concern for staff working in PT. In fact, the current classification may be too strict, as doses never exceeded 1 mSv/year. This could suggest it is possible to sample staff monitoring, which will require only few people to be monitored. A similar approach is already done in some countries for staff working in External Beam RadioTheray (EBRT), which perhaps could be also applied for personnel working in PT centers. This can be achieved by following a dialogue with the national radiation protection authority, even though it may be a bit controversial as the concern of secondary neutrons and activation during PT treatments will remain triggering attention towards radiation protection of staff and patients.

Future work

Further measurements are planned to confirm our finding but also to assess doses during accidental exposures, such as staff present in PT room or irradiations of the unborn child. As the extent of corrections for directional and energy dependencies is not always clear, we would also like to further identify knowledge gaps on detector calibrations and corrections.