Assessment of students and residents' awareness of radiation protection in a teaching hospital

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Several radiological examinations may expose patients to significant amounts of ionizing radiation [1-3]. Furthermore, recent evolution of some radiological modalities has increased the number of performed examinations, rising concerns in the scientific community for the possible long term effects on patients [4-5]. While acute effects of radiation exposure, such as erythema or burns following interventional procedures, are evident after a short time, the long term effects are more difficult to determine. Recently, some papers have clearly demonstrated a small but significant increment of cancer in children and young patients who have been exposed to CT scans. These results have confirmed prior studies based on survivors of the Japanese atomic bombs. Although the debate about this risk is still open, it is clear that we cannot underestimate the problem [6,7].

Procedures which make use of ionizing radiation must be handled by professionals with a specific expertise in radiation protection such as radiologists, physicists and radiographers. Inside radiological area, while physicists play a controlling role, radiologists have the great responsibility of assessing if the radiological examination must be performed and, if so, how to perform it in order to minimize patient exposure. Only a full awareness of radiation protection issues and knowledge of the radiation doses produced by different modalities, may allow radiologists to make the right decision, allowing the observance of appropriateness and optimization criteria.

General training about radiation protection needs to be given starting from the university courses and must be followed with specific courses during radiology curriculum, as requested by the Guidelines on radiation protection education and training of medical professionals in the European Union (175/2014) which have set the minimum knowledge expected in each and every practitioner involved in Radiation Protection [8].

In the past decade, many studies have been performed with the aim of estimating the radiation protection background of physicians from varying specialties and most of these studies have demonstrated disappointing results. Most physicians underestimated doses associated with various imaging modalities and in same cases they were not able to differentiate between ionizing and non ionizing radiological examinations [9-13]. Although some studies of medical students’ knowledge of radiology have been previously reported, the specific awareness among medical students about radiation protection issues and radiation doses associated with radiological procedures needs to be further investigated.

The aim of our work, which is still in progress, is:

- to evaluate by means of a questionnaire the knowledge of radiation protection of medical students and radiology residents

- to verify if current teaching is adequate to give future doctors an appropriate knowledge
- to verify if changes of radiology residents curriculum are needed
Description of activity and work performed

Data were collected by means of a survey performed among medical students and radiology residents of Pisa University between September 1\textsuperscript{st} and September 30\textsuperscript{th}, 2015.

Questionnaires were distributed in the occasion of university lessons that medical students attend during the 5\textsuperscript{th} year of their six-year curriculum, and in the occasion of the weekly briefings that radiology residents attend during their five-year curriculum.

The questionnaire, which had been validated in advance to perform a prospective observational study, consisted of 22 questions in a multiple choice format, divided into three sections [14]. The sections are focused on:

- demographic features of the participants (age, title, previous education in radiation protection)
- awareness about radiation protection issues
- knowledge about radiation dose levels of the natural background and common imaging procedures.

The questionnaire was administered over a period of 1 month to 116 participants (56 medical students and 60 radiology residents). Median age was 23.8 e 29.4 for medical students and radiology residents, respectively. The questionnaire was anonymous and it was completed in the presence of an examiner and collected immediately after completion to avoid any bias. For each question a score 1 was given for right answers and a score 0 was given for incorrect or missing answers.

In Table 1 the score concerning the self evaluation of radiation protection knowledge and previous training is reported.

In Figures 1 and 2 we report the preliminary results about the part of the questionnaire related to the actual knowledge in the area of radiation protection.
Table 1: Score questionnaire statistics of the level of awareness of radiation knowledge and previous performed training.

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Fig. 1: Figure 1: Descriptive statistical results of medical students and radiology residents knowledge about radiation questions concerning general radiation protection issues (Questions 1-4). Right answers are highlighted in red.

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**Fig. 2**: Figure 2: Descriptive statistical results of medical students and radiology residents knowledge about radiation questions concerning general radiation protection issues (Questions 5-7). Right answers are highlighted in red.

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Conclusion and Recommendations

Our results, summarized in Figures 1 and 2, demonstrate some shortcomings in medical students and radiology residents knowledge of radiation protection that may be considered in redefining both their curriculum.

Given a score of 1 for each correct answer and a score of 0 for incorrect or missing answers, the total mean score was 4.8 and 5.8 out of 7 for medical students and radiology residents, respectively.

Interestingly, although medical students show a poorer knowledge compared to residents, 94.4% of them assessed to have awareness of radiation protection and 88.7% of them stated to have attended radiation protection courses on a regular basis.

On the contrary, only half of the residents state to have at least a good level of knowledge, and more than half claimed to have rarely or never attended radiation protection courses.

Probably, once medical students graduate and become residents they start the radiology activity, thus realising that their radiation protection knowledge gained during undergraduate studies is limited.

Both medical students and radiology residents lack clear understanding of the concepts related to appropriateness and optimization criteria, as about 20% of them did not know that all professionals (not only radiologists) are considered legally responsible when radiological examinations are not properly performed.

Despite a superior performance, the knowledge of radiology residents leaves room for improvement as well. For instance, it is disappointing the fact that only about 62.7% of residents know that leukemia is the result of stochastic damage and that 13.6% of them believe that radiation risk is independent of gender and age.

Both medical students and, even more so, radiology residents must be provided with appropriate training to ensure that they are aware of radiation risks and know how to prescribe radiological examinations adopting all procedures useful to minimize unnecessary radiation dose.

Our results emphasise the need of improving education of future and present doctors in this critical domain. Further studies are required to carefully design a specific radiation safety training program, considering that it is an essential part of a general safety culture.
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