

Practical Recommendations to Occupational Health Services of Nuclear Facilities for Monitoring of Internal Exposure to Radionuclides

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Abstract

Under French regulation, the occupational physicians are responsible for individual monitoring of internal exposure in nuclear facilities and for dose and health assessment. However, setting monitoring programs, understanding and applying the method to assess the committed effective dose resulting from internal exposure, remains a difficult task despite the wealth of literature and scientific data in this field. This work followed the guidelines for writing recommendations of clinical practice defined by the national authority for health (HAS, agency under supervision of the ministry of health). It is based on scientific knowledge and experience of professional practice in the field of internal dosimetry. The aim is to optimise the medical and dosimetric follow-up of workers at risk of internal exposure and to prevent this risk. The authors insisted on the harmonization of professional practice, on strengthening the record of internal exposures and on the improvement of the information of workers exposed to ionizing radiation.

Keywords: internal exposure, practical recommendations, occupational health practitioners

Context

In France, 64000 workers of basic nuclear facilities (INB) are occupationally exposed to a risk of internal contamination with radioactive material. Their follow-up is ensured by approximately 450 occupational health practitioners.

A working group composed of occupational health practitioners, biological pharmacists and experts in internal dosimetry was set up in 2004, on the initiative of occupational health practitioners of various INB, to discuss and to list the difficulties in dose assessment for cases of internal contamination, in order to harmonize the related practices. In 2008, the group started to draft a guide of recommendations, promoted by the French society of occupational medicine (SFMT) and approved in 2011 by the national authority for health (HAS, agency under supervision of the ministry of health), which could be used as a reference by professionals concerned with this risk.

The guide makes recommendations or requirements based on regulation and international standards, scientific knowledge and practical experience of professionals in this field. Each

item is presented as an argued answer to a practical question, with the aim of supporting the occupational health services.

“Internal exposure to radionuclides” has the regulatory meaning of internal contamination. It corresponds to one or several radionuclides penetrating the human body (incorporation). The consequence of internal exposure is evaluated by assessing the dose delivered to the whole body over a period related to the clearance of the radionuclide. Regarding the health of workers, the occupational physician is under some obligations including:

- to set up monitoring programs based on the analysis of risks at the workplace (fig. 1),

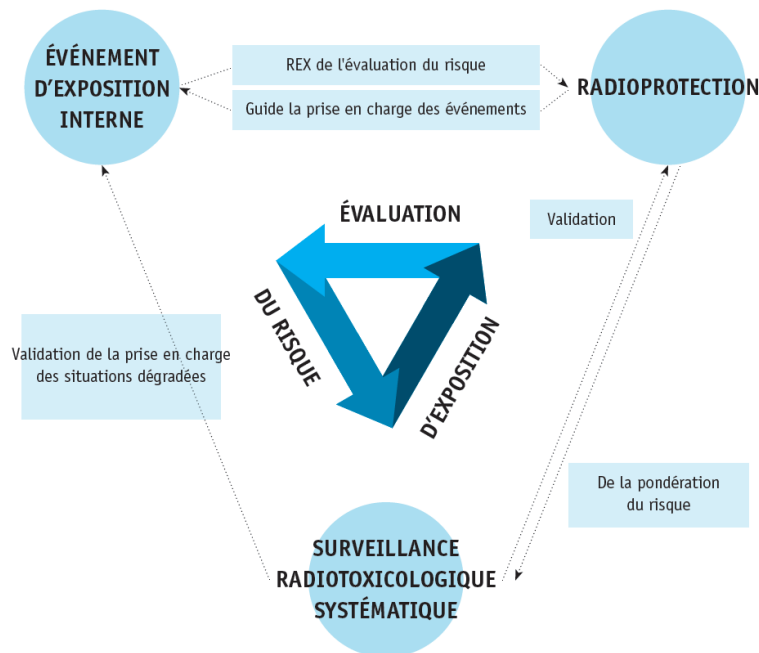


Figure 1. Complementarity of monitoring at the workplace and individual monitoring.

- to assess the committed effective dose resulting from exposures. This is recorded in the medical file of occupational health,
- to assess the health effect of possible exposure to ionizing radiation at work.

Compiling these elements allows the occupational physician to answer questions from the workers, thereby taking care of psychological consequences of internal exposure to radionuclides. However, occupational physicians are commonly faced with difficulties in understanding and applying the method for assessment of committed effective dose resulting from internal exposure, despite the wealth of literature and scientific data in this field.

The regulations regarding the risk of exposure to ionizing radiation confirm these duties in terms of objectives and general principles but provide no operational content or method to fulfil them, notably regarding the definition of monitoring programs, the dose and health assessment. Internal exposure was also the subject of multiple and various recommendations and publications. The publications of the International Commission on Radiological Protection provide recommendations for application in any country whatever the specific national regulation and in most operational contexts. Consequently, these recommendations cannot be very prescriptive and do not need to be very precise. Furthermore, few publications are available in the literature regarding the specific details of operational implementation of individual monitoring in nuclear facilities. Thus they can not, by themselves, provide a working system of reference applicable in daily practice.

Method

To write this guide, the authors chose the “recommendations of clinical practice” method proposed by the HAS, because of the wide topic considered, the number of open questions and the wealth of regulatory and literature references. The items developed in this guide are often discussed by the concerned experts, but do not raise major controversy which would require a public debate. Writing these recommendations involved:

1. Precising the aim of the recommendations and the questions requiring answers,
2. Performing a review of the literature, assigning levels of evidence, compiling a synthesis of data from international and normative documents, analysing data from scientific publications and multidisciplinary working groups, taking into account the experience from clinical cases,
3. Drafting an initial version of the recommendations, assigning grades,
4. Analysing the formal opinions (rating and comments) at the end of the consultation by the reading group,
5. Composing the final version of the recommendations.

The recommendations were autonomously drafted while periodically informing the HAS of the state of the work through numerous exchanges with the head of the HAS department for good professional practices, thus allowing for the needed methodical adjustments.

Promoter group

The promotion of this work was performed by the SFMT because this project came within the scope of the 2010 agreement between the government general division for work (DGT) and SFMT on the writing of recommendations of practice in occupational health aiming at supporting future regulation. The physicians in charge of the coordination of occupational health services in nuclear industries were closely associated to this task.

Working group

The working group was multidisciplinary and represented the various fields and occupations concerned with the topic: occupational health practitioners (physicians and biological pharmacists) having experienced cases of internal exposure in nuclear facilities and experts from various fields of knowledge (workers monitoring, treatment, dose assessment,...) participating in scientific associations, task groups or official institutions (IAEA, AFNOR, ICRP, Cofrac, ISO, IRSN, SFMT, SFRP). The critical review, analysis and synthesis of data from the literature were performed mainly by the subgroup of experts. Meanwhile the subgroup of occupational health practitioners defined and proposed recommendations on the basis of the literature review, or for lack of scientific evidence, according to their experience of clinical practice.

Reading group

The members of the reading group were chosen among professionals representing the various fields considered. Each member answered on a personal rather than institutional basis. The group had to express an opinion, with the help of a rating grid, on the relevance and justification, clarity and readability, ease of application of the recommendations. 40 out of the 59 approached people did answer.

Content

The recommendations answer the following questions:

Regarding implementation, communication, traceability and records: Why, and from what level, assessing the dose? How and who? What results to pass on? To whom? In which form? How to record and to file?

Regarding monitoring programs: What are the objectives, principles and types of monitoring programs? What are the necessary elements for risk assessment? What program to implement and how to confirm its relevance? What consequences of the socioeconomic context on the monitoring program?

Regarding the assessment of the committed effective dose: What model and parameter values to use by default? How to quickly interpret the early measurement results? How to assess and confirm the intake and committed effective dose? What can be said of the uncertainty on the assessed dose? What to expect from dose calculation software? What are the alternatives to the default model?

Regarding health risk and care: From what committed effective dose should the health risk be assessed? How? How to answer workers regarding the health meaning of the assessed dose? (fig. 2)

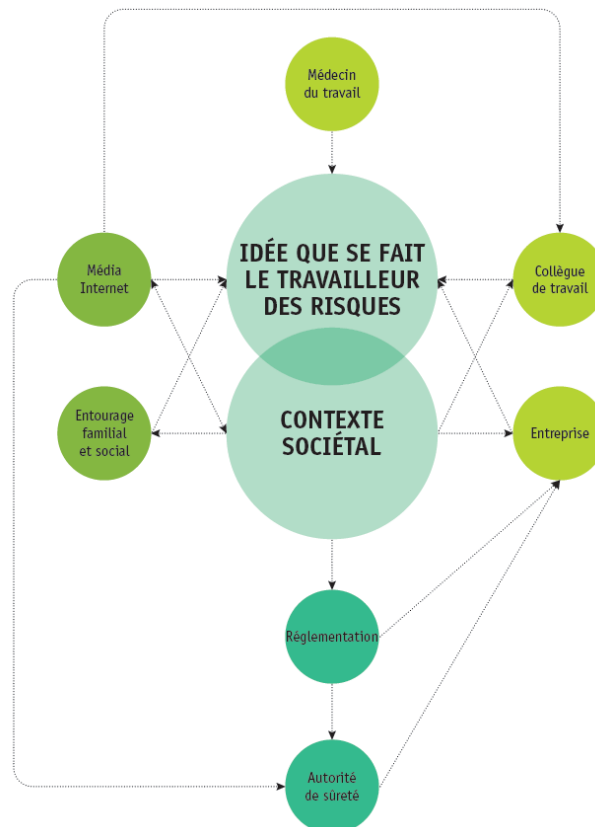


Figure 2: Different influences on the worker's judgement regarding risks.

Limits of the recommendations

These recommendations concern the field of occupational medicine in nuclear facilities, but they may be a basis to develop recommendations over a larger field including nuclear medicine, research and non-nuclear industry. They are also partly limited by the specific

French regulation. Regarding the conditions of exposure, the recommendations target inhalation which is the main route of exposure for workers. They also consider the issue of exposure through a contaminated wound that may cause a local dose at the wound site and an effective dose due to the transfer of activity to the systemic circulation. Still, exposure through ingestion of contaminated diet is the main route of exposure for populations but is not considered in the recommendations. Lastly, these recommendations are limited to the main radionuclides causing occupational exposures in nuclear facilities.

Grading recommendations

The analysis of the literature was performed using the method and the levels of evidence recommended by the HAS [1], adapted to the specificity of the subject considered, in order to grade the recommendations. To do so, a grid of correspondence between the type of article, the level of evidence and the grade of the recommendation was established. Recommendations based on regulation are not graded. Recommendations based on normative references and international recommendations are considered as associated with a high level of evidence and therefore receive the highest grade A. In the absence of data from the literature, the recommendations are based on professional agreement from clinical experience (professional practice and clinical cases).

Outline of the recommendations

Depending on the rating of the reading group, the items considered to answer the questions asked and the structure of the guide were adopted during plenary meetings. Four main themes were retained:

- A. Assessment of committed effective dose: objectives, implementation, communication, records and filing.
- B. Monitoring programs. In routine, for primary prevention, or following an event, for primary and secondary prevention, the occupational health services collect information and assess the risk of exposure at workplaces, prescribe individual monitoring consistent with the level of risk, and periodically evaluate the global monitoring program.
- C. Dose assessment from measurement results. Decision making is supported by early gradation criteria for the potential significance of the contamination, operational criteria for interpretation of bioassay results, methods for assessment and validation of the committed effective dose, and criteria for requesting support from expert bodies.
- D. Health risk and care by the occupational health practitioner. The guide provides the occupational health practitioners with elements for estimation of the individual health risk depending on the assessed dose. It includes consistent information to convey to the worker, answering possible concern.

For each sub-theme or question, the following outline was retained: targeted excerpt of regulatory and normative requirements, and/or international recommendations; analysis of the literature and data from professional practice; opinion of the working group; recommendations graded according to the level of evidence.

Conclusion

The practical recommendations of this guide are based on regulation, norms, science and professional practice. They deal with occupational and medical monitoring of internal exposure of workers to radionuclides in nuclear facilities. They aim at optimizing the protection against the risk of internal exposure and the medical follow-up of workers exposed to this risk by:

- harmonizing the professional practice in occupational medicine,
- strengthening the primary prevention through an improvement of the radiological cleanliness of workplaces, in coordination with the other players in prevention for occupational health and taking into account the practical experience,
- improving the information of workers on the nature of the risks they are exposed to.

These recommendations therefore aim three objectives:

1. to improve the design of monitoring programs adapted to the risk of exposure,
2. to precise the method for interpretation of monitoring results,
3. to provide some elements to estimate the health risk associated with a dose.

The document (in French) may be downloaded from the website of the SFMT [2]. An English translation is under progress. While it is aimed at occupational health practitioners in the nuclear industry, the guide can also help emergency physicians with the management of nuclear or CBRN incidents. Finally, a new working group is being set up to draft similar recommendations concerning the staff of nuclear medicine departments.

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