An appropriate response to any radiological emergency

IRSN mobilizes its expertise and intervention resources according to the severity of the situation.

Confirmed or suspected emergency

At the request of public authorities (safety authorities, prefectures, town halls...), industrials, physicians, third countries and international organizations, the IRSN is immediately mobilizable to:

- Confirm the radiological nature of the event;
- Characterize the risks of human and environment exposure;
- Secure the scene of the incident and recommend the implementation of preventive and protective measures;
- Characterize the exposure of involved people.

National nuclear crisis organization

IRSN puts its expertise at the service of the National Nuclear Crisis Organization by setting up its Technical Crisis Center. Teams of experts are in a position to provide an assessment of the situation and of the consequences for human and the environment, to put in place the necessary means.
IRSN is a WHO Collaborating Center for Radiological Protection.

For more information, please consult the IRSN website: www.irsn.fr/EN

Technical Crisis Center mobilizable in less than one hour, 24/24, with the support of 40 experts.

A fleet of mobile facilities, unique in Europe, capable of responding to any radiological emergency involving internal contamination with gamma emitters, with an on-site measurement capacity of up to 2,500 people per day.

IRSN
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IRSN
INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE
Enhancing nuclear safety

A wide technical capacity and expertise to face any accidental exposure to ionizing radiation

The French Institute for Radiological Protection and Nuclear Safety

IRSN is a public organization with industrial and commercial activities (EPIC).

IRSN's missions have been consolidated by the Act No. 2015-992 of 17 August 2015 concerning Energy Transition and Green Growth (TECV). IRSN is the national public expert on nuclear and radiological risks.

IRSN contributes to public policies in the fields of nuclear safety and ionizing radiation protection for public health and environment. As a research and scientific organization it acts in consultation with all stakeholders concerned by these policies, while preserving its independence of judgment.

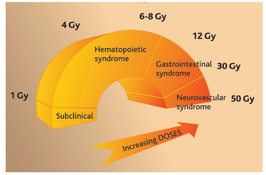
IRSN is placed under the joint authority of the Ministry of Environment, Energy and Marine Affairs, the Ministry of Education, Higher Education and Research, the Ministry of Social Affairs and Health, the Ministry of Defense.

How to characterize the clinical manifestations of an accidental exposure to ionizing radiation

Depending on the nature of the accident, the radiation source may be external or incorporated into the body.

External irradiation

Global
Acute radiation syndrome (ARS)



- The extension of ARS depends on the source type, the exposure duration, the dose received, and the dose distribution in the body.
- Symptoms are early and severe, particularly as the dose received is high.
- The 24-hour initial phase is characterized by nausea, vomiting, asthenia, headache, diarrhea, and incapacitation.
- The concept of single-organ failure (bone marrow, digestive system, neurovascular system) is evolving towards the concept of radiation-induced multi-organ failure.

Local
Skin radiation syndrome (radiological burn)

A radiological burn is different from a thermal burn because of:

- No immediate shock;
- A lesion extended on surface and in depth;
- A paroxysmal pain that resists to major analgesics (prognostic indicator);
- A long, fragile, unpredictable healing.

A radiological burn can lead to an extensive necrosis if not diagnosed.

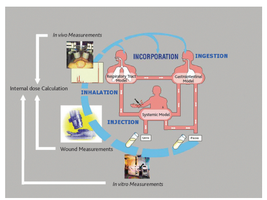
Internal contamination

Various routes of contamination

Radionuclides may enter the body through ingestion, inhalation, transcutaneous transfer or injured skin.

Different target organs

The incorporated radionuclides may be distributed uniformly in the organism (e.g. cesium) or they may accumulate in one or more organs (e.g. iodine in the thyroid, plutonium in bone).



Experts and specific means to assist in diagnosis, prognosis and to guide the therapeutic strategy

In case of external irradiation

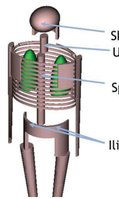
Knowledge of the scenario and of the dose received by an accidentally overexposed individual is essential.
In support of the clinical examination, the physical and biological dosimetry carried out by the experts of the IRSN allow physicians to make an initial diagnosis.

Global external irradiation

The assessment of the dose received is based on several complementary techniques.

Experimental dose reconstruction by physical dosimetry

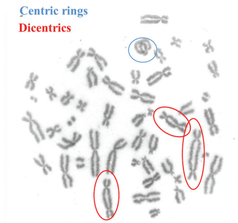
Dosimeters adapted to the type of radiation are placed on the surface of and inside dummies.



Anthropomorphic dummies are used and a numerical simulation of particle transport using a Monte Carlo code is performed to represent the victim at the time of the accident.

Dose assessment by biological dosimetry

Conventional cytogenetics allows counting of radiation-induced chromosomal aberrations on circulating lymphocytes.



Therapeutic strategy

The IRSN provides technical support to clinicians taking care of irradiated individuals and determines with them the therapeutic strategy to adopt. This depends on the estimated dose to the bone marrow and the severity of the disease.

- **Heterogeneous medullary aplasia**

Treatment with hematopoietic growth factors is recommended. It allows the stimulation of the medullar regions saved for an endogenous hematopoietic reconstitution.

- **Homogeneous and irreversible medullary aplasia**

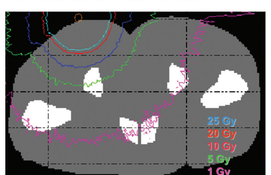
Bone marrow transplantation is perfor med, according to the 2005 European consensus.

Local external irradiation

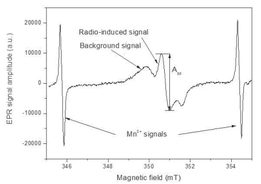
Several complementary techniques provide an estimate of the dose received and of its distribution in the body.

Experimental dose reconstruction by physical dosimetry

Suitable dosimeters are placed on the surface and inside moldings to reconstructed the received dose.



Using MRI or scanner patient images, physicists can reconstruct the anatomy of the irradiated area and simulate the transport of radioactive particles. The isodose curves are thus superimposed on the anatomical structures and used to guide the surgical operation.



The free radicals produced by the irradiation are measured by electronic spin resonance (ESR) on biological materials or on materials sampled from the victim environment. The amplitude of the ESR signal depends on the received dose.

Therapeutic strategy

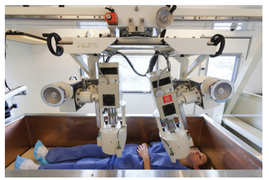
Defined jointly by the IRSN and physicians in charge of the patients, it depends on the mapping of the dose received to the skin surface and lesion, as well as to the bone marrow close to the exposed area. Three actions can be envisaged:

- A broad and deep excision around the necrotic tissues, if possible on the basis of a mapping of the dose received;
- Local treatment with growth factors;
- The implementation of a local cell therapy.

In case of internal contamination

The assessment of the excretion and/or retention of radionuclides in the organism makes possible the calculation of the committed effective dose received by the contaminated individual.
It can be performed by two complementary techniques.

In vivo measurements

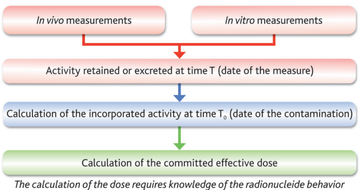


The X and gamma emitters are measured directly to assess the total activity present in the body or in a target organ. This measure can be carried out on the IRSN's fixed or mobile facilities.

In vitro measurements

The α, β and γ emitters are measured in excreta (urine and feces). Unlike direct measurement, the results may not be available immediately depending on whether or not the sample should be treated.

Internal Dose Assessment



The calculation of the dose requires knowledge of the radionucleide behavior in the body (biokinetic models)

Recommended treatments

- To undress and shower the contaminated person;
- To decrease the absorption of radionuclides: Prussian blue (Cs, Th);
- To increase excretion of radionuclides: DTPA (Pu, Am);
- To prevent the accumulation of iodine in the thyroid: potassium iodide (KI).