

ST1 - LESSONS LEARNED FROM DOSIMETRIC AND HEALTH SCREENING, EVACUATION AND HEALTH SURVEILLANCE

Executive Summary

The objective of Subtask 1 of the SHAMISEN project was to review guidelines and experiences from previous radiation emergencies regarding management of dosimetric screening, evacuation and health surveillance. This was achieved through three complementary actions covering the entire spectrum from emergency response and evacuation to health surveillance and epidemiological studies:

A1.1. Critical review of recommendations on—and experiences with—dose assessment, evacuation, medical assessment of potentially exposed people, and dose reconstruction in intermediate to long term timeframes;

A1.2 Critical review of long-term health (medical) surveillance programmes;

A1.3 Critical review of lessons learned from epidemiology on radiation risks from radiation accidents.

The lessons learnt feed into the recommendations made in Subtask 3.

A1.1. Critical review of recommendations on—and experiences with—dose assessment, evacuation, medical assessment of potentially exposed people, and dose reconstruction in intermediate to long term timeframes

A critical review of peer-reviewed documents, grey literature, and expert-based information was conducted by a working group including partners in the project and invited experts. Key points considered included:

1. recommendations in place at the time of the accidents and experiences on dose assessment for internal and external contamination during the early and recovery phases for workers, evacuees and people living in contaminated territories;
2. integration of dose information with initial medical assessment/management and health follow up and surveillance;
3. criteria for identifying persons requiring dose assessment, monitoring and retrospective dosimetry for workers, evacuees and people living in contaminated territories;
4. considerations for evacuation decision making; and
5. communication of dose estimates/values to different stakeholders, including local populations, medical community and decision/policy makers.

The review focused specifically on lessons from the Chernobyl and Fukushima accidents and on: how and when dose assessment was performed; for which category(ies) of people; whether and how this was used for medical management and follow-up and for evacuation; and whether and how the dose assessments were used to communicate with stakeholders (including the affected populations).

The working group analyzed, in particular, whether the dosimetry was suitable for:

1. decision making in the first hours/days after the beginning of the accident;
2. medical decision-making in the aftermath of the accident;
3. decision making related to evacuation and returning to their homes after lifting of the evacuation orders;
4. reassurance of affected populations, allowing them both to feel, and to be, well-monitored for radiation exposure;
5. enabling populations to better manage their situation and feel empowered to take control of their everyday life;
6. long-term medical follow-up of exposed individuals;
7. supporting epidemiologic studies.

The main lessons learned in this report are below:

- For workers, there was scarce coordination and harmonization of dosimetry systems from different facilities/companies, making any compilation and comparison difficult and available dosimeters were inadequate in the exposure circumstances. Measurement condition of internal dose could have been optimised in both accidents. For evacuees and people living in contaminated territories, many data were not recorded because they were not considered to be critical due to the priority to decontaminate. The object of monitoring in each phase was different;
- Mandatory evacuation by plant condition and/or projected dose was ordered not only for residents but also for patients and medical staff in hospitals and nursing homes, leading to avoidable deaths or worsening of diseases in the following days;
- Hospitals were not prepared or not willing to receive possibly contaminated persons, and there was heterogeneity in the management of the health countermeasures (stable iodine distribution) for workers (each employer adopted different measures) and for residents;
- Dose assessment for Chernobyl clean-up workers was very heterogeneous, depending on the organization which sent the workers to the site. In contrast all workers involved in clean-up work after the Fukushima accident had dose assessments or measurement, depending on the group. Concerning dose monitoring of the general population, criteria after both accidents were unclear though priority was given to children, teenagers and pregnant women, especially in thyroid measurements and external exposure measurements;
- Communication should be based on trust for people. Explanation/information should be adapted to the person's demands and needs. To educate medical doctors and teachers seems to be more feasible.

A1.2 Critical review of long-term health (medical) surveillance programmes

A working group composed of SHAMISEN partners and experts carried out a detailed critical review of:

- national laws, regulations and other legal acts that laid down the scope and principles of long term medical surveillance programmes implemented in Ukraine, Belarus, the Russian Federation and Baltic countries;
- national reports published in the three mostly affected countries on the 20th, 25th and 30th anniversary of the Chernobyl accident;
- peer-reviewed publications reviewing health surveillance programmes (including screening activities) launched after the Chernobyl and Fukushima accidents and their impact on the health indicators.

The review also included personal communication with experts.

The key points considered were the:

1. Principles for justifying long-term health surveillance programmes and defining categories of affected population to be under health surveillance;
2. Goal and scope of the health surveillance programmes;
3. Criteria for assessing impact of the medical surveillance programmes on the health of populations concerned, including assessment of validity;
4. Cost-effectiveness of the medical surveillance and other issues arising during its implementation;
5. Contribution to well-being of populations concerned.

The review conducted in SHAMISEN showed that there is often confusion between health surveillance and epidemiology while the objectives are different and the criteria also. In the current report the terms are used as follows:

Health/medical surveillance aims to evaluate whether individuals affected by an accident suffer from some health (including psychosocial) conditions. This involves contact with and follow-up of affected individuals (e.g in the form of medical check-ups, questionnaire surveys) and is also a basis for providing support or treatment as required. This is the subject of the current action (A1.2).

Epidemiology (covered in A1.3) aims to:

- evaluate whether the radiation exposure/accident has impacted disease rate/risk - this can be done through "epidemiological surveillance", based on population/hospital/health-insurance registries;
- where possible, improve our knowledge on effects of radiation - using analytical epidemiological approaches.

The main lessons learned for health/medical surveillance include:

- The designing and launching of long-term health (medical) surveillance programmes were based on initial medical evaluation that included census of the affected people with possible early dose assessment which were not always complete or well-documented;
- People who received exposures that resulted in clinically significant deterministic effects such as acute radiation syndrome, radiation skin burns etc. after the Chernobyl accident, are under systematic lifetime clinical follow-up for early diagnostics and timely medical interventions and treatment of exposure-related complications and diseases including cancer development;
- Preventive medical long-term surveillance is also justified in populations with sufficiently high levels of exposure. Health monitoring of the affected general population is aimed at investigating potential adverse health effects that could be related to radiation exposure and/or to the accident and its consequences with special attention to be given to population groups that could be more prone to detrimental effects, for example, pregnant women, and children;
- Assessment of the impact of the long-term health surveillance programmes on health is important but generally lacking;
- In addition to preventive monitoring of health of affected populations, an important role of long-term health surveillance is the reassurance given to populations in response to their concerns and worries about potential health impacts of the situation, regardless of their exposure levels. However, this requires careful planning, including consideration of communication of the objectives and results to the public and media, if the surveillance is to alleviate rather than enhance concerns, as exemplified by the controversy following the Fukushima thyroid ultrasound screening.

A1.3 Critical review of lessons learned from epidemiology on radiation risks from radiation accidents.

A critical review of the organization and logistics of epidemiological follow-up of past radiation accidents was conducted by a Working Group composed of partners in the project and external experts. Key points considered included 1) definition of the study populations (workers involved in the accident and its clean-up, evacuees and residents of the contaminated areas, with particular attention to potentially vulnerable groups: children, pregnant women, elderly or ill); 2) their identification and follow-up (screening and collection of health data); and 3) dose measurement and reconstruction (in collaboration with Action 1.1). The review was based on a detailed literature review, as well as on information about study design, follow-up and dosimetry collected directly from the principal investigators of the main studies through completion of detailed questionnaires.

The outcome of this review is summarised in the full report in the form of detailed tables on study populations, follow-up mechanisms, dose reconstruction, dose distribution and, where appropriate, study results covering all studies identified that focus on the radiation effects of four accidents (Chernobyl, Fukushima, Three Mile Island and Fleurus).

Epidemiological studies of radiation risks from accidents can have one of two objectives:

1. Evaluating whether the accident has impacted disease rates – "*epidemiological surveillance*" through ecological studies in which disease rates are compared between population groups with different exposure levels and over time;
6. Improving our knowledge on the effects of radiation through analytical studies (cohort or case-control studies with individual information).

Essential criteria for both objectives are the need for information about a) doses (at the group level for objective 1; at the individual level for objective 2); b) dose distributions and size of the exposed

populations which will determine the anticipated statistical power of a study; c) well established and validated follow-up mechanisms for outcome assessment; and d) appropriate permissions from ethics review committees and informed consent from participants in the case of studies involving contact with participants or use of personal information.

Lessons learned are summarized here as input for recommendations in ST3.

Existing accidents

General population

The review shows that, for the most part, levels of doses in the general population appear to be too low in the populations around Fleurus, Fukushima and TMI for informative analytical studies of radiation effects on health to be possible. It is of interest, however, to monitor disease trends (in particular cancer) in order to evaluate whether any unexpected increase may occur. This will be important to answer the concerns of the general population as well as of health and radiation protection professionals. Should any unexpected increase occur, this may reflect inadequate assessment of doses or confounding by other risk factors and analytical studies could then be planned to assess a possible risk in a more detailed fashion.

In the case of Chernobyl, general population doses are also generally low and the conduct of ecological studies, as a surveillance tool, is also recommended. Ecological studies have been very useful to identify a dramatic increased risk of thyroid cancer in young people (who received very high doses of ^{131}I to the thyroid), which was subsequently confirmed in cohort and case-control studies. They also suggest a possible increased risk of breast cancer among young women in the most contaminated districts. Analytical studies of populations with higher doses, including the evacuees (if appropriate cohorts can be set-up, dose estimated and follow-up conducted), thyroid diseases in the contaminated areas and other diseases for which ecological studies indicate a possible increased risk (e.g. breast) would also be informative.

Clean-up workers

Cohorts of onsite and offsite Fukushima clean-up workers have recently been assembled in Japan. Given the currently available information on population size and dose levels, it is unlikely that they will provide much new information on the magnitude of radiation risks following low to moderate dose exposures, though careful follow-up is needed and, possibly, improvements in dose estimates.

Cohorts of Chernobyl clean-up workers have already provided much important information about radiation risks, mainly through the conduct of nested case-control studies or through active screening. Because of incompleteness of follow-up in the Chernobyl Registries, any cohort study of clean-up workers should preferably rely on linkage with population based registries of mortality and cancer. Availability of reliable doses is also an issue in the Chernobyl Registries and a critical review of doses is needed before planning any study aimed at radiation risk assessment. Further, because many outcomes of interest also have other risk factors, study designs in which information on these factors can be collected (case-subcohort studies or nested case-control studies) should be preferred to allow correct adjustment for possible confounding or effect modification factors.

Possible future accidents

Should a nuclear accident occur in the future, in Europe or elsewhere, careful assessment of the criteria listed above is needed.

Existence of population based registries – in particular for cancer and congenital anomalies – will greatly facilitate the rapid establishment of epidemiological surveillance systems in the form of ecological studies. To be informative, however, such ecological studies require health monitoring systems able to provide objective indicators of the disease frequency, agreements to access these health data, and need to be based on reliable estimates of doses at the geographical level.

As indicated above, setting up and follow-up of analytical (cohorts or case-control) studies requires careful consideration of levels of doses, size of the population, follow-up mechanisms as well as ethical and data protection aspects and limitations and sustainability of financial resources.