

Medical Preparedness and Response

Educational Material

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IAEA SAFETY RELATED PUBLICATIONS

IAEA SAFETY STANDARDS

Under the terms of Article III of its Statute, the IAEA is authorized to establish standards of safety for protection against ionizing radiation and to provide for the application of these standards to peaceful nuclear activities.

The regulatory related publications by means of which the IAEA establishes safety standards and measures are issued in the **IAEA Safety Standards Series**. This series covers nuclear safety, radiation safety, transport safety and waste safety, and also general safety (that is, of relevance in two or more of the four areas), and the categories within it are **Safety Fundamentals**, **Safety Requirements** and **Safety Guides**.

Safety Fundamentals (blue lettering) present basic objectives, concepts and principles of safety and protection in the development and application of nuclear energy for peaceful purposes.

Safety Requirements (red lettering) establish the requirements that must be met to ensure safety. These requirements, which are expressed as 'shall' statements, are governed by the objectives and principles presented in the Safety Fundamentals.

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The IAEA's safety standards are not legally binding on Member States but may be adopted by them, at their own discretion, for use in national regulations in respect of their own activities. The standards are binding on the IAEA in relation to its own operations and on States in relation to operations assisted by the IAEA.

Information on the IAEA's safety standards programme (including editions in languages other than English) is available at the IAEA Internet site

www.iaea.org/ns/coordinet

or on request to the Safety Co-ordination Section, IAEA, P.O. Box 100, A-1400 Vienna, Austria.

OTHER SAFETY RELATED PUBLICATIONS

Under the terms of Articles III and VIII.C of its Statute, the IAEA makes available and fosters the exchange of information relating to peaceful nuclear activities and serves as an intermediary among its Member States for this purpose.

Reports on safety and protection in nuclear activities are issued in other series, in particular the **IAEA Safety Reports Series**, as informational publications. Safety Reports may describe good practices and give practical examples and detailed methods that can be used to meet safety requirements. They do not establish requirements or make recommendations.

Other IAEA series that include safety related publications are the **Technical Reports Series**, the **Radiological Assessment Reports Series**, the **INSAG Series**, the **TECDOC Series**, the **Provisional Safety Standards Series**, the **Training Course Series**, the **IAEA Services Series** and the **Computer Manual Series**, and **Practical Radiation Safety Manuals** and **Practical Radiation Technical Manuals**. The IAEA also issues reports on radiological accidents and other special publications.

FOREWORD

Radiation is widely used in medicine, industry, agriculture and research. It provides invaluable benefits. However, radiation sources can be lost, stolen, or otherwise not under proper control, and this can lead to injuries to people who come into contact with them. Even so, radiation accidents are rare. Between 1944 and 2001, altogether 420 accidents were registered worldwide: approximately 3000 persons were injured, with 133 fatalities (including the 28 victims of the Chernobyl accident).

Often the victims of radiation emergencies are unaware that they may have been exposed to radiation. Even if health consequences of exposure are first seen by medical doctors, a proper diagnosis may not be immediately forthcoming. Lack of knowledge about the clinical effects of radiation exposure is one of the main reasons why many accidental injuries are not recognized sufficiently early to prevent further exposures and to provide for the most effective treatment. Therefore, a wider understanding of the health consequences of radiation exposure among health authorities and medical personnel, needs to be developed.

The IAEA-WHO educational programme on Medical Preparedness and Response to Radiation Emergencies was developed to provide medical personnel with knowledge of health consequences of radiation exposure. The programme consists of 24 modules including 30 lectures, a demonstration, a drill and five video films.

This educational programme has been prepared by the IAEA amending and developing on the material provided in 1997 by Boston University School of Medicine (BUSM) in co-operation with REAC/TS for the IAEA train-the-trainers courses organized within the regional technical co-operation project RER/9/049 in 1998-2001. WHO, involving experts from its Radiation Emergency Medical Preparedness and Assistance Network (REMPAN) Centres, has reviewed it for publication. The lectures are prepared in the form of MS PowerPoint slides with explanatory notes. The educational material is published on CD-ROM to facilitate its use. Health authorities and medical personnel are encouraged to use this material for educational purposes in their respective countries.

The provision of the initial training material by BUSM, and the contribution of all radiation medicine experts to the drafting and review of this material are sincerely appreciated. The permission of the United States Air Forces Radiobiology Research Institute (Bethesda, MD, USA) for the use of several figures from its CD-ROM titled "Medical Management of Radiation Accidents" is also acknowledged.

Dr. I. Turai of the Division of Radiation and Waste Safety was the Scientific Secretary responsible for this IAEA-WHO publication.

INTRODUCTION

Background

Aware of the institutional difficulties and managerial weaknesses of general emergency medicine in Eastern European countries, in 1996 Boston University School of Medicine (BUSM), in co-operation with the Radiation Emergency Assistance Center and Training Site (REAC/TS) and the University of Massachusetts Medical Center (UMMC) proposed that the IAEA sponsor and conduct a special regional project to enhance the radiation emergency medical preparedness and response in Eastern and Central Europe. Following review of the project by the Division of Radiation and Waste Safety of the IAEA, the IAEA Department of Technical Co-operation approved the BUSM proposal as a four-year regional project under the designation 'RER/9/049 Medical Education for Nuclear Accident Preparedness'.

The first IAEA-BUSM train-the-trainers course was conducted under this project in Oak Ridge, USA, in October 1997, and was directed at 28 participants from 13 European countries. The original REAC/TS training material was based on national regulations, infrastructure and radiation emergency management practice. This training material, which includes excellent practical drills on detection and removal of radioactive contaminants from exposed/injured people, was taught in the REAC/TS setting for over a decade. Further to a BUSM proposal, the American International Health Alliance (AIHA) provided additional financial aid within regional project RER/9/049 to support the attendance of East European participants at follow-up training courses in radiation emergency medicine.

Altogether, 12 training courses (seven regional and five national or subregional) were organized jointly by the IAEA and the BUSM between October 1997 and October 2001. 250 medical doctors and 50 non-medical emergency responders attended these weekly courses (sponsored by the IAEA and AIHA). In turn, eighty trainees then served as trainers at the follow-up national courses at ten other sites, recruiting 450 medical trainees (sponsored purely by national authorities).

Nonetheless, there is a need to train a considerably larger number of medical professionals to (a) recognize radiation injuries, (b) provide first aid, specialized medical treatment and follow-up to radiation exposed/contaminated people, and (c) organize emergency medical preparedness and response in the the case of a radiation accident.

The IAEA and WHO jointly prepared and issued two publications on the subject in 1998: Safety Report No. 2. entitled "*Diagnosis and Treatment of Radiation Injuries*" and Safety Report No. 4. entitled "*Planning Medical Response to Radiation Accidents*". In 2000, a joint leaflet and a poster on "*How to Recognize and Initially Respond to an Accidental Radiation Injury*" were published in all official UN languages and distributed to all Member States.

Experience gained during the training of radiation emergency medicine at IAEA sponsored courses in various European, East-Asian or Latin-American countries (within TC projects RER/9/049, RER/9/062, RAW/9/006, ROM/0/005, UKR/9/015, CPR/9/025, RLA/9/031 MEX/9/044) and at a training workshop jointly conducted by WHO and the IAEA in 1999 in Africa, has made it clear that there was a need to develop standardized training materials for worldwide use in the diagnosis of radiation accident and treatment of victims.

Objective

To provide material that can be used to update the knowledge of the participants in medical preparedness and response to a nuclear or radiological emergency.

By the end of the course the participants will be able to train:

- emergency medical personnel to recognize and respond to radiation overexposure including establishing and maintaining contact with appropriate response authorities;
- emergency medical teams to provide prehospital care for overexposed, injured or contaminated persons;
- hospital staff to provide treatment for overexposed, injured or contaminated victims.

Scope

This training material is prepared for five-day IAEA and WHO sponsored courses for emergency medical personnel (physicians and head nurses who specialize in emergency medicine and may be involved in prehospital care for overexposed, injured or contaminated persons); relevant medical specialists (haematologists; radiopathologists; surgeons in burn departments); medical school professors teaching relevant subjects; and senior health administrators responsible for training, planning, and managing of medical response in a radiation emergency.

Structure

The training material starts with general information on radiation accidents, and on radiation emergency medical preparedness and response. A briefing in practical radiation physics and basic dosimetric terms follows. A demonstration of radiation monitoring devices aims at enabling a doctor to detect whether his/her patient is contaminated with radioactive materials. Day 1 finishes with the presentation of two short teaching video films on the causes and effects of radiation and the requirements of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources.

Lectures on Day 2 review the biological and health effects of exposure to radiation. A video film covers the treatment of Chernobyl victims.

Day 3 is devoted to the management of local radiation injuries and radioactive contamination. Pre-hospital and hospital preparedness and response to radiation accidents are presented in brief lectures and a video film. A drill is used to reinforce the training.

Day 4 provides a review of ten radiation accidents focusing on their causes, medical management, biodosimetry and lessons learned. A video film presents the surgical treatment of the Georgian accident victims (Lilo, 1997) in France. Psychological effects of radiation exposure and injury are discussed.

Day 5 provides an overview of nuclear emergency preparedness and response; iodine prophylaxis; planning medical response to radiological accidents; international co-operation and providing information for medical assistance to radiological accidents.

To test whether main message of the teaching material is understood, each lecture has been completed with a multiple choice test.

Users of this material should note that copies of the teaching video films are not included on the CD. They can, however, be officially requested for national training courses.

Training for Radiation Emergency Preparedness and Response

Medical Preparedness and Response

(Modules I — XXIV including Lectures No. 1–30 for 5-day training courses)

1st day

- I. (1) Radiation accidents: scope of the problem, statistics
- II. (2) Radiation emergency medical preparedness and response
- III. (3) Practical radiation physics for emergency medical personnel
- IV. (4) Dose concepts, quantities and units, basic principles and methods of radiation protection
- V. (5) Radiation detection, monitoring devices and their uses
- VI. Radiation causes and effects (video)
- VII. Basis Safety Standards of the IAEA (video)

2nd day

- VIII. (6) Biological effects of ionizing radiation at molecular, cellular, tissue and organ levels (2hrs)
- IX. (7) Dose-effect curves, deterministic and stochastic effects of radiation
- X. (8) Biodosimetry: available methods and their role in dose assessment and prognosis
- XI. (9) Acute Radiation Syndrome: clinical picture, diagnosis and treatment (2hrs)
- XII. Treatment of Chernobyl victims (video)

3rd day

- XIII. (10) Diagnosis and treatment of local radiation injuries
- XIV. (11) Medical management of combined radiation injuries
- XV. (12) External and internal contamination: decontamination and decorporation (2 hrs)
- XVI. (13) Emergency medical management on site and at prehospital level
- XVII. (14) Hospital preparedness to and management of radiation accident victims (20 min presentation + video 25 min)
- XVIII. Handling of contaminated patients (demonstration and drill: 2 hrs)

4th day:

- XIX. Causes and medical response in selected accidental cases and lessons to be learned (5 hrs)
 - (15) Major nuclear accidents: health consequences of Chernobyl (30 min)
 - (16-17) Radiation accidents with known radiation origin: Iran, Peru (2x20 min)
 - (18-22) Radiation accidents with unknown origin: case reports on Goiania, Estonia, Georgia, Turkey and Thailand (5 papers 30 min each)
 - (23) Accidental exposure in medical applications: Costa Rica (20 min)
 - (24-25) Criticality accidents: Sarov (Russia), Tokaimura (Japan) (2x20 min)
 - Treatment of Georgian radiation accident patients in France (Video: 20 min)
- XX. (26) Psychological effects of long-term exposure and radiation injury

5th day

- XXI. (27) Overview of nuclear emergency preparedness and response; the iodine prophylaxis
- XXII. (28) Planning the medical response to radiological accidents
- XXIII. (29) International co-operation for medical assistance to radiological accidents
- XXIV. (30) Providing information for medical community and public

KEYS

to multiple choice test questions to 30 lectures of Medical Modules

(1)	1b	2a	3b	4c	5c	6b		
(2)	1b	2c	3a	4b	5c			
(3)	1b	2c	3c	4c	5a			
(4)	1e	2b	3a	4c	5a			
(5)	1c	2a	3d	4c	5d			
(6)	1a	2b	3b	4b	5c			
(7)	1c	2ad	3bc	4ab	5ac	6c	7a	8b
(8)	1a	2b	3c	4a	5c			
(9)	1c	2b	3b	4d	5a	6c	7a	
(10)	1c	2b	3c	4d	5b			
(11)	1b	2a	3c	4c	5a			
(12)	1c	2c	3b	4d	5a			
(13)	1a	2b	3c					
(14)	1d	2c	3a	4f				
(15)	1d	2c	3b	4a				
(16)	1a	2b	3b	4d	5c			
(17)	1c	2e	3b	4d	5c	6e	7b	
(18)	1c	2b	3d	4a	5b	6c	7c	8d
(19)	1c	2c	3a	4c	5d	6c		
(20)	1b	2c	3d	4b	5c	6e		
(21)	1b	2e	3c	4c	5d	6b		
(22)	1b	2d	3e	4c	5d			
(23)	1c	2b	3e	4b				
(24)	1d	2b	3d	4f	5c			
(25)	1e	2b	3c	4a	5e	6d		
(26)	1b	2c	3abc	4ad	5ab			
(27)	1d	2f	3g	4b				
(28)	1d	2c	3c	4c				
(29)	1b	2c	3b	4a				
(30)	1a	2a	3c	4b				

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