Train the Trainers Workshop on Medical Physics Support for Nuclear or Radiological Emergencies

Centers for Disease Control and Prevention

Atlanta, Georgia, USA

IAEA
International Atomic Energy Agency

CDC
Centers for Disease Control and Prevention

REAC/TS
Radiation Emergency Assistance Center/Training Site
Managed by ORAU for DOE

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1. Introduction

The management of Nuclear or Radiological Emergency (NRE) situations requires specially trained personnel. Commonly, clinical medical physicists (usually practicing in radiology, radiotherapy, and nuclear medicine) are part of the team responsible for the proper and safe use of ionizing radiation I a hospital environment. Although medical physicists, especially clinical medical physicists working in hospitals, have in-depth knowledge in radiation dosimetry, including dose reconstruction and dose measurements, they are usually not involved in NRE response. Tapping the reservoir of skills and expertise of clinical medical physicists (who often are the only local radiation protection experts) may strengthen the current NRE preparedness and response mechanisms. However, in a few instances where medical physicists were involved in NREs, it appeared that many lacked specific knowledge and some skills that are required in such situations. This lack of specific knowledge and skills is probably due to the fact that most current medical physics curricula do not include a specific module on this topic. As a response to this finding, the IAEA, in consultation with the World Health Organization (WHO), the International Organization for Medical Physics (IOMP) and the International Radiation Protection Association (IRPA), decided to initiate a project to develop a specific training package to help prepare medical physicists to support NRE situations. Development of the training package started in 2014 with the support of the Government of Japan and in collaboration with Fukushima Medical University (FMU) and the National Institute of Radiological Sciences (NIRS). The package was also endorsed by The Japan Society of Medical Physics (JSMP). The training package was applied for the first time at the International Workshop that was held in 2015, in Fukushima, with the support of FMU and NIRS. Using lessons learned and experience acquired during the first Workshop, the IAEA in collaboration with Argonne National Laboratory (ANL), the Centers for Disease Control and Prevention (CDC), and the Radiation Emergency Assistance Center/Training Site (REAC/TS) have organized the second “Train the Trainers Workshop on Medical Physics Support for Nuclear or Radiological Emergencies”. The effort has been supported in part by the United States of America National Nuclear Security Agency (NNSA). The Emory University School of Medicine made the Experiential Center for Learning available for the practical exercise portion of the workshop in collaboration with the department of Emergency Medicine.

The current workshop has been designed to provide a specific training on NRE preparedness and response for clinical medical physicists. It also aims to:

- Encourage/facilitate the embedding of medical physicists in NRE preparedness teams, in cooperation with other professions and organizations, at strategic and operational levels, both within hospitals and in the wider emergency planning structure;
- Recognize the essential contributions of medical physics staff (technicians, dosimetrists etc.) in NRE preparedness programmes and to ensure appropriate training;
- Promote the interaction of medical physicists with other professional groups involved in NRE preparedness, including through participation in regular training and exercises; and
- Encourage consideration of the potential of appropriately trained medical physicists to contribute to multidisciplinary NRE training of other professional groups, both within and outside the health care settings.

2. Objective and Structure of the Workshop

2.1. Objective of the Workshop

The objective of this workshop is to provide the participants with a good understanding of their potential complementary roles in NRE situations, and to prepare them to contribute effectively to support the response to such situations, as identified in emergency preparedness plans. The participants are also expected to contribute to the training of other health care professionals in response to NRE situations. The workshop will also introduce the participants to a multidisciplinary team approach in dealing with NRE situations.

2.2. Structure of the Workshop

This five day workshop will consist of lectures, demonstrations, simulation, role play, and practical sessions followed by discussions with the participants. The topics to be covered include the following Modules:

- Module 1: Introduction
- Module 2: Nuclear and Radiological Emergencies
- Module 3: Radiation Measurements and Instrumentation
- Module 4: Dose Assessment and Dose Reconstruction
- Module 5: Monitoring and Decontamination of People Waste Management – Scene and Reception Centre
- Module 6: Monitoring and Decontamination of People, Waste Management – Hospital
- Module 7: Biological Effects of Radiation – Cell and Tissue Effects, stochastic effects
- Module 8: Protection Strategies for the Public
- Module 9: Protection Strategies for Workers
- Module 10: Medical Management
- Module 11: Psychosocial Effects and Impacts on Mental Health
- Module 12: Effective Risk Communication
- Module 13: Education and Training in NRE (Theory and Practice, Training of Others)

The detailed contents of each module are given in section 3: "Training modules"

2.3. Target Audience and Participants' Qualifications

The workshop addresses clinical medical radiation physicists working in hospitals, in one of the following areas: radiation oncology, diagnostic radiology, nuclear medicine and/or radiation protection. The specific requirements for participation are given below:

- Postgraduate degree at the Master degree level or equivalent,
- Completion of a specialized clinical training programme in radiation oncology, diagnostic radiology or nuclear medicine;
- Minimum of three years' experience as a clinical medical radiation physicist, with a radiation protection function in their employment;
- Involvement in education and training in radiation protection;
- Previous involvement in regional or national emergency response activities is highly desirable.

2.4. Expected Output

Participants will gain the skills and knowledge necessary to contribute effectively to the response to an NRE situation as identified in emergency preparedness plans. They will have a better understanding of their potential roles in NRE situations and be in a position to contribute to the training of others in the response to NRE situations.

2.5. Workshop Programme

	Monday, 23 May 2016	Tuesday, 24 May 2016	Wednesday, 25 May 2016	Thursday, 26 May 2016	Friday, 27 May 2016
08:00	08:00 - 09:00: Registration	**Shuttle bus pickup times (meeting point: in front of the hotel)** Monday: 07:00 Tuesday - Friday: 08:00			
09:00	09:00 - 09:30: Opening Remarks 09:30 - 10:00: Introduction *(A. Meghzifene)*	09:00 - 10:30: Rapid Dose Magnitude Estimation to Help Guide Medical Management - with Examples *(S. Sugarman)*	09:00 - 11:30: Monitoring and Decontamination of People - Scene and Reception Centres *(A. Ansari, K. Caspary)*	09:00 - 10:00: Protection Strategies for the Public *(A. Salame- Alfie)*	09:00 - 11:00: Tabletop Exercise *(Z. Kazzi, A. Ansari, A. Meghzifene)*
10:00	10:00 - 11:00: Nuclear and Radiological Emergencies *(A. Ansari)*	10:30 - 10:45: Short break 10:45 - 12:15: Rapid Dose Magnitude Estimation to Help Guide Medical Management - with Examples *(S. Sugarman)*		10:00 - 10:45: Protection Strategies for Workers *(J. Anderson)* 10:45 - 11:00: Short break	
11:00	11:00 - 11:15: Short break 11:15 - 12:15: Nuclear Radiological Emergencies (Sources and Case Studies) *(M. Jenkins)*		11:30 - 12:30: Transportation to Emory Hospital	11:00 - 12:15: Medical Management - Part 1 *(N. Dainiak)*	11:00 - 11:15: Short break 11:15 - 12:15: Effective Risk Communication - Principles *(K. Vidoloff, V. Siegel)*
12:00	12:15 - 13:30: Lunch Break	12:15 - 13:30: Lunch break	12:30 - 13:00: Initial Brief with Lunch	12:15 - 13:30: Lunch break	12:15 - 13:30: Lunch break
13:00	13:30 - 15:30: Radiation Measurements and Instrumentation (+demo) *(M. Jenkins)*	13:30 - 15:30: Environmental Dose Assessment - with Examples *(T. Kraus)*	13:00 - 17:00: Unique Challenges of Monitoring and Decontamination of Patients at Hospitals (demonstration and practical exercise) *(N. Dainiak, M. Jenkins, C. Iddins, W. Baxter, Z. Kazzi)*	13:30 - 14:30: 12. Medical Management - Part 2 *(N. Dainiak)*	13:30 - 15:00: Effective Risk Communication - Practical Training *(K. Vidoloff, V. Siegel)*
14:00				14:30 - 15:30: Our Experience in Tokai-mura Nuclear Accident *(S. Mineishi)*	
15:00	15:30 - 16:00: Short break	15:30 - 15:50: Short break 15:50 - 17:50 Visit to the CDC Radiobioassay Laboratory		15:30 - 15:50: Short break 15:50 - 16:50: The Psychosocial Impact and What You Can Do To Help *(J. David)*	15:00 - 15:30: Coffee break 15:30 - 16:30: Knowledge Testing, Workshop Evaluation Discussion
16:00	16:00 - 17:30: The Biological Effects of Radiation *(T. Jorgensen)*			16:50 - 17:50 Transformative Learning: Integration of Theory to Practice for Adult Learning *(C. Piper)*	16:30 - 17:30: Conclusion, Evaluation, Plenary
17:00					

A Reception dinner will be held on Wednesday, May 25, 2016

2.6. Contributors to Drafting and Review

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2.7. Lecturers at the Train the Trainers Workshop on Medical Physics Support for Nuclear or Radiological Emergencies

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3. Training Modules

3.1. Module 1: Introduction

Table 1. Contents of Module 1

Objective	The aim of this module is to introduce the participants to the role of the medical physicist in the context of proper response to NRE events, to orientate them to the topics and prepare them for the course. This module will also introduce participants to the framework of disaster medicine
Pre-requisites (Learning in Place)	The participants are expected to meet the pre-requisites for admission to the training workshop and to have the prior learning in place as required by each Module
Learning Outcomes	Participation in Module 1 will enable: • Awareness of the general concept and medical physics related aspects of preparedness and response to NRE • Understanding of the role of the medical physicist within an emergency response plan and the requirements to act efficiently and effectively • Knowledge of the various types and planning categories of NRE • Familiarity with the main, relevant IAEA Safety Standards and Guidelines [5, 6]
Core knowledge and Competencies	This module will provide an introduction to the overall objective and goals of the workshop. In preparation for other modules, this module will introduce: • Nuclear and Radiological Emergencies • Radiation Measurement and Instrumentation • Dose Assessment and Reconstruction (including environmental dose assessment) • Monitoring, Decontamination (People, Area) and waste management • Biological Effects of Radiation • Protection Strategies for Public and Workers • Medical Management and Psycho-social Effects of NRE • Risk communication • Training in NRE (theory and practice, training of others) • Role of the medical physicist in response teams (may vary depending on local situations)
Teaching and Learning Activities	Lecture

Reading list	[1]. INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements Part 3. No. GSR Part 3, IAEA, Vienna, 2014 [2]. INTERNATIONAL ATOMIC ENERGY AGENCY, Arrangements for Preparedness for a Nuclear or Radiological Emergency: Safety Guide, Safety Standards Series No. GS-G-2.1., IAEA, Vienna, 2007 [3]. INTERNATIONAL ATOMIC ENERGY AGENCY, Preparedness and Response for a Nuclear or Radiological Emergency: General Safety Requirements, Safety Standards Series No. GSR Part 7, IAEA, Vienna, 2015 [4]. INTERNATIONAL ATOMIC ENERGY AGENCY, Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency: General Safety Guide, IAEA Safety Standards SERIES No. GSG-2, IAEA, Vienna 2011 [5]. INTERNATIONAL ATOMIC ENERGY AGENCY, Roles and Responsibilities, and Education and Training, Requirements for Clinically Qualified Medical Physicists, IAEA Human Health Series No 25, IAEA, Vienna, 2013 [6]. INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Procedures for medical response during a nuclear or radiological emergency, IAEA-EPR Medical, IAEA, Vienna, 2005 [7]. INTERNATIONAL ORGANIZATION FOR MEDICAL PHYSICS, Policy Statements 1-3, 2012-2013, http://iomp.org/?q=node/5, Accessed on April 23, 2015 [8]. INTERNATIONAL ORGANIZATION FOR MEDICAL PHYSICS/INTERNATIONAL RADIATION PROTECTION ASSOCIATION, Statement of Collaboration between IOMP and IRPA on the Use of Ionizing Radiation in Health Care, 2012, http://iomp.org/?q=node/5, Accessed on April 23, 2015 [9]. INTERNATIONAL ATOMIC ENERGY AGENCY, Postgraduate Medical Physics Academic Programmes, TCS no. 56, IAEA, Vienna 2013 [10]. INTERNATIONAL LABOUR ORGANIZATION: International Standard Classification of Occupations (ISCO-08; 2008), http://www.ilo.org/public/english/bureau/stat/isco/, Accessed on April 23, 2015

3.2. Module 2: Nuclear and Radiological Emergencies

Table 2. Contents of Module 2

Objective	This module aims to provide an overview of nuclear and radiological emergencies (NRE). Module 2 aims to introduce the participant to the emergency response framework
Pre-requisites (Learning in Place)	Awareness of national emergency response plans

Learning Outcomes	Participation in Module 2 will enable the participant to: • Describe nuclear and radiological emergencies • List the types of emergencies and emergency planning categories • Discuss general aspects of preparedness and response to NRE • Apply the IAEA Safety Standards to a known context • Understand the possible roles of the medical physicist considering the characteristics of various types of NRE events
Core knowledge and Competencies	Module 2 will enable the learner to acquire knowledge in: • Fundamentals of nuclear and radiological emergencies • Framework for emergency response criteria • Types of emergency • Emergency planning categories • Areas and zones (basic information) • Basic responsibilities for emergency preparedness and response – Incident Command System (ICS) • Goals of emergency Preparedness and Response • Interventional levels and operational criteria (definition) • Previous incidents and accidents • Identification of response teams and communication between different groups
Teaching and Learning Activities	Lecture
Reading list	[1]. INTERNATIONAL ATOMIC ENERGY AGENCY, Arrangements for Preparedness for a Nuclear or Radiological Emergency: Safety Guide, Safety Standards Series No. GS-G-2.1., IAEA, Vienna, 2007 [2]. INTERNATIONAL ATOMIC ENERGY AGENCY, Preparedness and Response for a Nuclear or Radiological Emergency: General Safety Requirements, Safety Standards Series No. GSR Part 7, IAEA, Vienna, 2015 [3]. INTERNATIONAL ATOMIC ENERGY AGENCY, Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency: General Safety Guide, IAEA Safety Standards SERIES No. GSG-2, IAEA, Vienna, 2011 [4]. INTERNATIONAL ATOMIC ENERGY AGENCY, The Radiological Accident in Goiânia Expand reading list, IAEA, Vienna, 1988 [5]. INTERNATIONAL ATOMIC ENERGY AGENCY, Lessons learned from Accidental Exposures in Radiotherapy, Safety Report Series 17, IAEA, Vienna, 2000 [6]. INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements Part 3. No. GSR Part 3, IAEA, Vienna, 2014 [7]. INTERNATIONAL ATOMIC ENERGY AGENCY, Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR-Method (2003), IAEA, Vienna, 2003. [8]. INTERNATIONAL ATOMIC ENERGY AGENCY, Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency, EPR-Exercise (2005), IAEA,

	Vienna, 2003. [9]. INTERNATIONAL ATOMIC ENERGY AGENCY, IAEA Safety Glossary: Terminology Used in Nuclear Safety and Radiation Protection, 2007 Edition, IAEA, Vienna, 2007 [10]. INTERNATIONAL ATOMIC ENERGY AGENCY, Actions to Protect the Public in an Emergency due to Severe Conditions at a Light Water Reactor, EPR-NPP-PPA (2013), IAEA, Vienna, 2013.

3.3. Module 3: Radiation Measurements and Instrumentation

Table 3. Contents of Module 3

Objectives	The aim of this module is to provide an overview of the main types of monitoring instrumentation used in nuclear or radiological emergency (NRE) situations and to provide an opportunity for participants to acquire the knowledge and skills to be able to measure radiation levels with proper selection of instrumentation. The creation and use of an appropriate medical physicist's grab-and-go kit for NRE response will also be discussed
Prerequisites (Learning in Place)	Knowledge of fundamental radiation physics (e.g. interaction with matter, radiation detection, quality control, calibration, uncertainties)
Learning Outcomes	Participation in Module 3 will enable the participant to: • Perform a variety of radiation measurements with a range of instruments (including dose rate surveys) • Perform functional and calibration checks • Discuss the difficulties in alpha, beta, low-energy photon, and neutron measurements • Select appropriate monitoring instrumentation for NRE situations • Understand physical limitations and uncertainties of dose measurements • Keep an inventory of available equipment in the hospital • Understand how to create, maintain and use an emergency grab-and-go kit for response to NRE events • Understand how to use the pocketbook for medical physicists' response to NRE events in conjunction with the grab-and-go kit and other relevant equipment and resources • Understand the role of the medical physicist in the performance of radiation measurements and managing the use of other relevant instrumentation during NRE events
Core knowledge and Competencies	Module 3 will enable the learner to acquire knowledge in: • Radiation Measurement Systems specific to and suitable for NRE (e.g. Detectors, Dose Rate Meters, Contamination Monitors, In-vivo Monitoring, Personal Dosimeters, Gamma-Spectroscopy, Portal Monitors) • Use of Nuclear Medicine Instrumentation in events of NRE • Quality control of measurement (e.g. calibration, physical limitations, uncertainty) • Surface contamination measurements

	Module 3 will enable the learner to have competence in: • Ambient dose rate measurements with a survey meter • Activity measurements with NaI or Ge spectrometers • In-vivo activity measurements with Whole-Body Counter • Create use and maintain the grab-and-go kit and medical physicists' pocketbook for response to NRE • Keeping an inventory of available equipment and resources in the hospital • Conduct basic dose rate surveys • Conduct basic measurements in contaminated foodstuffs and water
Teaching and Learning Activities	Lectures, demonstrations and practical training
Reading list	[1]. INTERNATIONAL ATOMIC ENERGY AGENCY, Measurement of Radionuclides in Food and the Environment A Guidebook. Technical Reports Series 295. STI/DOC/010/295, IAEA, Vienna, 1989 [2]. INTERNATIONAL ATOMIC ENERGY AGENCY, Individual Monitoring, Practical Radiation Technical Manual, IAEA-PRTM-2 (Rev. 1), IAEA, Vienna, 2004 [3]. KNOLL, G. F., Radiation Detection and Measurement, 4th edn, John Willey & Sons, (2011) 860 pp [4]. BURGESS P., CORBY, R., DELAHUNTY, D., et al, Practical Radiation Monitoring, Measurement Good Practice Guide No. 30, NATIONAL PHYSICAL LABORATORY, 2014 [5]. INTERNATIONAL ATOMIC ENERGY AGENCY, Workplace Monitoring – Volume 1: Radiation Dose Rates and Surface Contamination (draft), IAEA-TECDOC-XYZ, IAEA, Vienna [6]. BURGESS, P. H., Guidance on the Choice, Use and Maintenance of Hand-Held Radiation Monitoring Equipment, NATIONAL RADIOLOGICAL PROTECTION BOARD, NRPB R326, Chilton, Didcot, 2001

3.4. Module 4: Dose Assessment and Dose Reconstruction

Table 4. Contents of Module 4

Objectives	The aim of this module is to inform participants about methods and tools that may be used for dose assessment and reconstruction relevant to medical management, in case of NRE situations
Prerequisites (Learning in Place)	• Knowledge of the contents of ICRU report 60 and ICRP report 103 • Basic knowledge of internal dose calculation models • Understanding of radiation measurement quantities and units necessary to perform dose assessment and reconstruction
Learning Outcomes	Module 4 will enable participants to: • Describe how the quantities are applied to estimations of radiation dose • Describe how the model limitations and uncertainties may affect

	the dose estimations • Estimate radiation dose when data may be incomplete • Use the appropriate ICRP models for internal/external dose estimation • Estimate external and internal dose from directly, as well as indirectly ionizing radiation, in cases of NRE • Estimate dose from intake of contaminated food and water • Understand personal dosimetry in emergency situations • Assess the basic environmental impact of NRE events and how it could contribute to dose • Recognize basic nuclides dispersed in the environment in case of NRE • Understand the role of the medical physicist in the assessment and reconstruction of radiation dose during NRE events
Core knowledge and Competencies	Module 4 will enable the learner to acquire knowledge in: • Physical Quantities, Protection Quantities, Operational Quantities (ambient dose equivalent, personal dose equivalent) • Quantities used for external radiation dose • Quantities used for internal radiation dose (committed equivalent dose/committed effective dose) • Models used to estimate radiation dose from intake of radionuclides (lung model, GI-tract model, systemic models for retention and excretion) • Phantoms for radiation dose estimation • The use of dose assessments and reconstructed doses • The concept and limitation of collective dose • The basic nuclides dispersed in the environment in case of NRE • The internationally agreed intervention levels for water and food
Teaching and Learning Activities	Lecture, examples of estimation of radiation dose from published dose coefficients (data from direct measurements)
Reading list	[1]. INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements Part 3, No. GSR Part 3, IAEA, Vienna, 2014 [2]. INTERNATIONAL ATOMIC ENERGY AGENCY, Calibration of radiation protection monitoring instruments, Safety Report Series No. 16, IAEA, Vienna, 2008 [3]. INTERNATIONAL COMMISSION ON RADIATION UNITS & MEASUREMENT, Fundamental Quantities and Units for Ionizing Radiation (Report 60), ICRU, 1998 [4]. INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37 (2-4), ANNEX B. QUANTITIES USED IN RADIOLOGICAL PROTECTION, ICRP, 2007 [5]. INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, Compendium of Dose Coefficients based on ICRP Publication 60, ICRP Publication 119, Ann. ICRP 41(Suppl.), ICRP, 2012 [6]. INTERNATIONAL COMMISSION ON

RADIOLOGICAL PROTECTION, Conversion Coefficients for Radiological Protection Quantities for External Radiation Exposures, ICRP Publication 116, Ann. ICRP 40(2-5), ICRP, 2010

[7]. INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, Human Respiratory Tract Model for Radiological Protection, ICRP Publication 66, Ann. ICRP 24 (1-3), ICRP, 1994

[8]. INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, Age-dependent Doses to Members of the Public from Intake of Radionuclides - Part 1, ICRP Publication 56, Ann. ICRP 20 (2), ICRP, 1990

[9]. INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, Conversion coefficients for use in radiological protection against external radiation. ICRP Publication 74, Ann. ICRP 26 (3/4), ICRP, 1996

[10]. INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, Application of the Commission's Recommendations for the Protection of People in Emergency Exposure Situations, ICRP Publication 109, Ann. ICRP 39 (1), ICRP, 2009

[11]. INTERNATIONAL COMMISSION ON RADIATION UNITS & MEASUREMENT, Quantities and Units in Radiation Protection Dosimetry (Report 51), ICRU, 1993

3.5. Module 5: Monitoring and Decontamination of People, Waste Management – Scene and Reception Centre

Table 5. Contents of Module 5

Objectives	This Module will guide the participants to: • Acquire knowledge about reception centres • Identify the roles and responsibilities of medical physicists in a reception centre
Prerequisites (Learning in Place)	Participants must review the content of previous Modules, in particular "Radiation Measurements and Instrumentation" (Module 3)
Learning Outcomes	On completion of this Module the participant will be able to: • Design a reception centre • Develop monitoring procedures based on the scale of the event and resources available • Establish segregated radiation zones • Take a leading role in setting up a reception centre (e.g. operational planning, staffing, layout design, arrangements to prevent contamination of facility and communication with the members of the team) • Recognize criteria for decontamination of people in a radiation emergency • Generate appropriate records of the monitoring/decontamination of individuals • Provide radiation protection training of staff assigned to the reception centre

	• Use equipment for the detection and quantification of possible external contamination on people in an NRE situation (hand-held monitors, automatic hand and foot monitors, portal monitors) • Establish appropriate mechanisms of waste management in the reception centre • Understand the role of the medical physicist in the monitoring and decontamination of patients and waste management at the reception centre during NRE events
Core knowledge and Competencies	Module 5 will enable the learner to acquire knowledge and competence in the: • Design and establishment of a reception centre • Fundamentals of radiation monitoring and decontamination procedures. National, regional and local NRE emergency preparedness schemes. Management of radioactive waste and associated radiation protection • Training of staff in radiation protection
Teaching and Learning Activities	Lectures, demonstrations, practical use of monitors, individual and group exercises
Reading list	[1]. INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Procedures for monitoring in a nuclear or radiological emergency, IAEA-TECDOC-1092, IAEA, Vienna, 1999 [2]. INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Procedures for medical response during a nuclear or radiological emergency, IAEA-EPR Medical, IAEA, Vienna, 2005 [3]. INTERNATIONAL ATOMIC ENERGY AGENCY, Medical Preparedness and Response for a Nuclear or Radiological Emergency Training Materials, EPR-Medical/T 2014, Use of Detection Equipment, Lecture 18, IAEA, Vienna, 2014 [4]. INTERNATIONAL ATOMIC ENERGY AGENCY, Medical Preparedness and Response for a Nuclear or Radiological Emergency Training Materials, EPR-Medical/T 2014, Hospital Preparedness and Management of Persons Accidentally Exposed to Ionizing Radiation, Lecture 23, IAEA, Vienna, 2014 [5]. INTERNATIONAL ATOMIC ENERGY AGENCY, Medical Preparedness and Response for a Nuclear or Radiological Emergency Training Materials, EPR-Medical/T 2014, Medical Response to a Radiation Mass Casualty Event, Lecture 24, IAEA, Vienna, 2014 [6]. INTERNATIONAL ATOMIC ENERGY AGENCY, Medical Preparedness and Response for a Nuclear or Radiological Emergency Training Materials, EPR-Medical/T 2014, Planning and Preparedness for Medical Response to Malicious Events with Radioactive Material, Lecture 26, IAEA, Vienna, 2014 [7]. OHBA, T., MIYAZAKI, M., SATO, H., et al., A strategy for a rapid radiological screening survey in large scale radiation accidents: a lesson from an individual survey after the Fukushima Daiichi nuclear power plant accidents, Health Phys. 2014; 107(1): 10-17 [8]. ROJAS-PALMA, C., LILAND, A., JERSTAD, et al., Triage, Monitoring and Treatment of people exposed to ionising radiation following a malevolent act, TMT Handbook, 2009. [9]. INTERNATIONAL ATOMIC ENERGY AGENCY, The Radiological Accident in Goiania, IAEA, Vienna, 1988.

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[15]. CENTERS FOR DISEASE CONTROL AND PREVENTION, Population Monitoring in Radiation Emergencies: A Guide for State and Local Public Health Planners, 2nd Edition, Atlanta, GA, 2014.
[16]. CENTERS FOR DISEASE CONTROL AND PREVENTION, A Guide to Operating Public Shelters in a Radiation Emergency, Atlanta, GA, 2014.
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3.6. Module 6: Monitoring and Decontamination of People, Waste Management – Hospital

Table 6. Contents of Module 6

Objectives	The aim of Module 6 is to understand the unique issues regarding monitoring and decontamination in hospitals
Prerequisites (Learning in Place)	Participants must have learning in place from previous Modules, in particular: • "Radiation Measurements and Instrumentation" (Module 3) • "Monitoring and Decontamination of People – Scene and reception centre" (Module 5)
Learning Outcomes	On completion of Module 6 participants will be able to: • Localize a radiation source, identify the radionuclide(s) and quantify the activity • Describe situations in which life threatening injuries take precedence over decontamination and monitoring • Wound decontamination (shrapnel removal, debridement) • Understand the role of the medical physicist in the monitoring and decontamination of patients and waste management within the hospital environment during NRE events

Core knowledge and Competencies	Module 6 will enable the learner to acquire knowledge and competence in the: • Choice of appropriate instrumentation and techniques for localization, identification and quantification of radiation sources • Strategies for decontamination of wounds • Proper management of incidents to prioritize life threatening injuries against decontamination and monitoring
Teaching and Learning Activities	• Lecture, demonstration, observation, individual and group exercises • Search exercises with different kinds of instruments • Localizing of a radiation source, identifying the radionuclide(s) and quantifying the activity • Examples of adequate decontamination
Reading list	[1]. INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Procedures for monitoring in a nuclear or radiological emergency, IAEA-TECDOC-1092, IAEA, Vienna, 1999 [2]. INTERNATIONAL ATOMIC ENERGY AGENCY, Generic procedures for assessment and response during a radiological emergency, IAEA-TECDOC-1162, IAEA, Vienna, 2000

3.7. Module 7: Biological Effects of Radiation – Cell and Tissue Effects, Stochastic Effects

Table 7. Contents of Module 7

Objectives	The aim of this Module is to guide the participant to: • Understand the processes of carcinogenesis and genetic radiation effects and their influencing factors • Understand the effects of ionizing radiation on cells and tissues and their medical consequences • Characterization of biological effects with respect to relevant dose assessment (including biological dose indicators), dose response and risk models • Acknowledge factors impacting on the quality and quantity of these effects
Prerequisites (Learning in Place)	The assumed learning in place is a: • Basic understanding of anatomy and physiology • Basic understanding of epidemiological methodology and its limitations • Knowledge of biology related to carcinogenesis • Basic knowledge on the effects of radiation on biological systems at the cellular, tissue/organ and whole organism level
Learning Outcomes	At the completion of this Module participants will be able to: • Describe the methodology for assessing probability of occurrence of stochastic and cell/tissue/organ/whole body effects • Discuss requirements regarding exposure data selection and quality • Discuss biological dose indicators • Discuss dose-response and risk models and explain dose response analyses

	• Understand tissue tolerance and relevant influencing factors • Interpret epidemiological data • Understand the role of the medical physicist in the assessment of probability and severity of biological effects of radiation
Core knowledge and Competencies	Module 7 will enable the learner to acquire knowledge in: • Quantities and units (absorbed, equivalent dose) • The transformation of physical interaction to biological effects • DNA damage and biological consequences • Multi-step carcinogenesis theory, initiating and promoting factors • Tumour incidence and mortality • Cell survival and influencing factors (intrinsic radiosensitivity, cell cycle effects, radiation quality, dose rate/fractionation, overall exposure time, oxygenation), modes of cell death • Equieffective dose calculations (LQ model, EQDx) • Retrospective biological dose indicators (ESR, gene expression, cytogenetics (dicentrics, FISH, PCC), micronuclei, comet assay) • General pathogenesis of early, late, consequential late tissue effects, including latent times and typical examples • Atypical tissue effects (e.g. eye lens, gonads, embryo/fetus) • Radiation syndromes (cerebrovascular, gastrointestinal, mucocutaneous, haematopoietic) and relevant dose indicators (early clinical symptoms, lymphocytes, hair follicles, spermatogenesis) • The impact of dose inhomogeneities (within organs, partial vs. total body exposure) • Dose-effect relationships tolerance doses and risk models • Tissue weighting factors and effective dose • Factors influencing risk (incl. exposure conditions, e.g. Dose-Rate, radiation quality, age at exposure, sex, genetic factors, lifestyle related factors, exposed organ) including examples • Factors influencing tissue effects (instrinsic radiosensitivity, recovery, repopulation, redistribution) • Genetic radiation effects and consequences, with relevant examples
Teaching and Learning Activities	Lectures, demonstration of examples of calculations
Reading list	[1]. OZASA, K., SHIMIZU, Y., SUYAMA, A., et al., Studies of the mortality of atomic bomb survivors, Report 14,1950-2003: an overview of cancer and noncancer diseases. Radiat Res. 2012; 177(3):229-243. [2]. JOINER, M., VAN DER KOGEL, A., Basic Clinical Radiobiology, 4th edn, Hodder Education (2009) 288 pp [3]. SHRIEVE, D. C., LOEFFLER, J. S., Human radiation injury, 1st edn, Lippincott Williams & Wilkins, (2011) 533 pp [4]. UNITED NATIONS SCIENTIFIC COMMISSION ON THE EFFECTS OF ATOMIC RADIATION, Sources, Effects and Risks of ionizing radiation, UNSCEAR 2013 Report, Volume I, Annex A, Levels and effects of radiation exposure due to the nuclear accident after the 2011 great east-Japan earthquake and

tsunami, UNSCEAR, New York, 2014
[5]. INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37 (2-4), ANNEX B. QUANTITIES USED IN RADIOLOGICAL PROTECTION, ICRP, 2007
[6]. UNITED NATIONS SCIENTIFIC COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION, Effects of ionizing radiation, UNSCEAR 2006 Report: Volume II, Annex C - Non-targeted and delayed effects of exposure to ionizing radiation, UNSCEAR, New York, 2006
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[11]. BENTZEN, S. M., DÖRR, W., GAHBAUER, R., et al., Bioeffect modeling and equieffective dose concepts in radiation oncology – Terminology, quantities and units. Radiother. Oncol. 2012; 105: 266-268
[12]. INTERNATIONAL ATOMIC ENERGY AGENCY, Cytogenetic Dosimetry: Applications in Preparedness for and Response to Radiation Emergencies, Emergency Preparedness and Response, EPR-Biodosimetry, IAEA, Vienna, 2011
[13]. HALL, E.J. and A.J. GIACCIA, Radiobiology for the radiologist, 7th edn, Lippincott Williams & Wilkins (2012) 576 pp

3.8. Module 8: Protection Strategies for the Public

Table 8. Contents of Module 8

Objective	The aim of this Module is to enable the participant to understand the basic concepts, strategies and measures for protecting the public in events of NRE
Prerequisites (Learning in Place)	Preparedness and Response for a Nuclear or Radiological Emergency in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant [6]
Learning Outcomes	This Module will enable the participant to: • Understand and discuss the basic strategies for the prevention of deterministic and stochastic events

	• Describe methods used to reduce exposure to the public using protective actions in response to a NRE • Recognize the situations when sheltering, evacuation and relocation are recommended • Recognize when the response may include actions to reduce inadvertent ingestions, decontamination of individuals, and prevention of ingestions of potentially contaminated food, milk or water, or reduce uptake of radioactive iodine • Describe the strategy to prevent the spread of contamination through embargo and quarantine of food crops and livestock • Describe operational interventional levels (OILs) • Recognize the cases in which iodine thyroid blocking (ITB) is required • Describe the role of the medical physicist in the radiation protection of contaminated or overexposed members of the public
Core knowledge and Competencies	Module 8 will enable the learner to acquire knowledge in the: • Preventative actions to avoid the spread of contamination • Methods to reduce public exposure including countermeasures • Pathways of exposure through food, milk and water • Techniques and strategies to reasonably reduce public exposure and dose during an emergency
Teaching and Learning Activities	Lectures, examples
Reading list	[1]. INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements Part 3. No. GSR Part 3, IAEA, Vienna, 2014 [2]. INTERNATIONAL ATOMIC ENERGY AGENCY, Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency: General Safety Guide, IAEA Safety Standards SERIES No. GSG-2, IAEA, Vienna, 2011 [3]. INTERNATIONAL ATOMIC ENERGY AGENCY, Actions to Protect the Public in an Emergency due to Severe Conditions at a Light Water Reactor, EPR-NPP Public Protective Actions, IAEA, Vienna, 2013 [4]. INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. Application of the Commission's Recommendations for the Protection of People in Emergency Exposure Situations. ICRP Publication 109. Ann. ICRP 39 (1), ICRP, 2009 [5]. INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Procedures for medical response during a nuclear or radiological emergency, IAEA-EPR Medical, IAEA, Vienna, 2005 [6]. INTERNATIONAL ATOMIC ENERGY AGENCY, IAEA Report on Preparedness and Response for a Nuclear or Radiological Emergency in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant, IAEA, Vienna, 2013

3.9. Module 9: Protection Strategies for Workers

Table 9. Contents of Module 9

Objective	The aim of this Module is to enable the participant to understand the basic concepts, strategies and measures for protecting workers in events of NRE
Prerequisites (Learning in Place)	Preparedness and Response for a Nuclear or Radiological Emergency in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant [6]
Learning Outcomes	On completion of this Module the participants will be able to: • Explain the components of the ALARA concept and how it is implemented in an emergency situation • Describe the concept of universal precautions and its value to reducing worker contamination • Discuss radiation protection measures that may be used in emergency response for workers • Make dose estimates of workers from elevated radiation levels in the environment and of radioactive contamination of people and buildings • Explain knowledge of the arrangements for controlling, and guidance values for restricting, exposure of emergency workers (BSS- No. GSR Part 3, Requirement 45; Table IV.2) • Describe the role of the medical physicist in the radiation protection of contaminated or overexposed workers
Core knowledge and Competencies	Module 9 will enable the learner to acquire knowledge and competence in: • Universal precautions • ALARA principles and implementation in an emergency • Calculating individual dose estimates from radiation measurements in the environment • Techniques and strategies to minimize practical worker dose reasonably during an emergency • Estimating measurable quantities (ambient dose equivalent, personal dose equivalent)
Teaching and Learning Activities	Lecture
Reading list	[1]. INTERNATIONAL ATOMIC ENERGY AGENCY, Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency: General Safety Guide, IAEA Safety Standards SERIES No. GSG-2, IAEA, Vienna, 2011 [2]. INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements Part 3. No. GSR Part 3, IAEA, Vienna, 2014 [3]. INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. Application of the Commission's Recommendations for the Protection of People in Emergency Exposure Situations. ICRP Publication 109. Ann. ICRP 39 (1), ICRP, 2009 [4]. INTERNATIONAL ATOMIC ENERGY AGENCY, Manual for first responders to a radiological emergency, Emergency

	Preparedness and Response, EPR-First Responders, IAEA, Vienna, 2006 [5]. INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Procedures for medical response during a nuclear or radiological emergency, IAEA-EPR Medical, IAEA, Vienna, 2005 [6]. INTERNATIONAL ATOMIC ENERGY AGENCY, IAEA Report on Preparedness and Response for a Nuclear or Radiological Emergency in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant, IAEA, Vienna, 2013

3.10. Module 10: Medical Management

Table 10. Contents of Module 10

Objective	This Module aims to provide general knowledge about medical response to radiation emergencies (incident site, reception centre/emergency ward, advanced care)
Prerequisites (Learning in Place)	Modules 4-6
Learning Outcomes	This Module will enable participants to: • Describe the basic concepts of radiation emergency medicine • Understand the Physicians' perspective in triage and treatment • Describe the role of the medical physicist in the evaluation and follow-up of contaminated or overexposed patients
Core knowledge and Competencies	Module 10 will enable the learner to acquire knowledge of: • Levels of response to an incident (on site, reception centre, hospital) • Medical management of acute radiation syndrome, Cutaneous Radiation Syndrome (CRS, Local radiation injury), and contaminated patients (internal and external) • Clinical cases (Goiania, Peru, France, Morocco and Chile accidents – Clinical accidents, specifically in radiotherapy) • Role of the medical physicist in the treatment of overexposed or contaminated patient • Chelating agents: Their use and limitations • Basic concepts of radiation emergency medicine • Clinical flow of treatment and management for emergency cases • International cooperation and networking for assistance in NRE situations
Teaching and Learning Activities	Lectures, review of practical clinical cases/accidents
Reading list	[1]. INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Procedures for medical response during a nuclear or radiological emergency, IAEA-EPR Medical, IAEA, Vienna, 2005 [2]. INTERNATIONAL ATOMIC ENERGY AGENCY, Training Material for Medical Preparedness and Response to a Nuclear or Radiological Emergency, IAEA/WHO, http://www-ns.iaea.org/tech-areas/emergency/technicalproducts.asp?s=1#6, Accessed on April 23, 2015 [3]. INTERNATIONAL ATOMIC ENERGY AGENCY, IAEA Publications on

Accident Response, http://www-pub.iaea.org/books/IAEABooks/Publications_on_Accident_Response, Accessed on April 23, 2015
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3.11. Module 11: Psychological Effects and Impacts on Mental Health

Table 11. Contents of Module 11

Objective	The objective of Module 11 is to provide medical physicists with an awareness of the importance of socio-psychological stress due to NRE
Prerequisites (Learning in Place)	N/A
Learning Outcomes	At the completion of this Module the participants will be able to: • Describe some major psychological effects resulting from the NRE • Discuss the concept of risk perception • Understand the possible role of the medical physicist in tackling psychological effects and impact of NRE on mental health of contaminated or overexposed patients, workers and residents
Core knowledge and Competencies	Module 11 will enable the learner to acquire knowledge of: • Risk perception for individuals, the population and groups of interest • Psycho-sociological effects of NRE. Type and level of mental stress depending on the situations of evacuation (e.g. temporary housing, voluntary evacuation) • Short and long term psychological effects after the NRE • Mental health consequences for healthcare workers • Social, cultural and economic consequences of NRE
Teaching and Learning Activities	Lecture, review of practical cases

Reading list	[1]. SLOVIC, P., Informing and educating the public about risk, Risk Anal. 1986; 6(4) :403-15 [2]. BROMET, E. J., Mental health consequences of the Chernobyl disaster, J. Radiol. Prot. 2012; 32(1): N71-75 [3]. THE CHERNOBYL FORUM: 2003–2005, Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts and Recommendations to the Governments of Belarus, the Russian Federation and Ukraine, Second Revised Edition, Printed by IAEA, 2006 [4]. YABE, H., SUZUKI, Y., MASHIKO, H., et al., Psychological distress after the Great East Japan Earthquake and Fukushima Daiichi Nuclear Power Plant accident: results of a mental health and lifestyle survey through the Fukushima Health Management Survey in FY2011 and FY2012, Fukushima J. Med. Sci. 2014; 60(1): 57-67 [5]. INTERNATIONAL ATOMIC ENERGY AGENCY, Health in Disasters: A Science and Technology Studies Practicum for Medical Students and Health Care Professionals, IAEA (in preparation)

3.12. Module 12: Effective Risk Communication

Table 12. Contents of Module 12

Objective	The aim of this Module is to present an overview of effective risk and crisis communication in response to NRE situations and to facilitate the participants to acquire practical knowledge and skills for effective risk and crisis communication
Pre-requisites (Learning in Place)	Participants will be expected to have experience in interacting with healthcare professionals such as medical doctors and nurses and to have fundamental knowledge in radiation protection principles
Learning Outcomes	At the end of this Module participants will be able to: • Explain the principles and strategies of effective health communication, risk communication, crisis communication and emergency risk communication • Compare and contrast these communication concepts • Discuss public perception of risk, hazard and outrage • Recognize the importance of working with risk communication professionals before, during and after a radiation emergency • Adjust effective communication style to different social and economic background and regulatory framework • Describe the role of medical physicists in the multi-disciplinary NRE response team • Recognize the challenges to effective risk communication, such as the lack of communication before NRE, radiation quantities and units, insufficient evidence of low-dose risk assessment, and public perception of risks • Understand the role of the medical physicist in effective risk communication during NRE events, working in coordination with communication staff as a subject matter expert and spokesperson in developing messages for the media, the public and key target audiences

Core Knowledge and Competencies	Module 12 will enable the learner to acquire knowledge in: • The fundamental knowledge of risk communication in the context of public health • The basic techniques of risk communication and principles of risk perception • The 3Cs (consensus, care, crisis) of communication • The principles and strategies for communicating risk to the public and key target audiences • Various communication tools such as social media • The role of risk communication as a component of risk analysis (the other components are risk management and risk assessment) • Interview strategies / guidelines
Teaching and Learning Activities	Lecture, role play, group discussions, video clips, case studies
Reading list	[1]. INTERNATIONAL ATOMIC ENERGY AGENCY, Communication with the Public in a Nuclear or Radiological Emergency, Emergency Preparedness and Response, EPR-Public Communications, IAEA, Vienna, 2012 [2]. CENTERS FOR DISEASE CONTROL AND PREVENTION, Crisis Emergency & Risk Communication, CDC, 2014. [3]. SANDMAN, P. (1993). *Responding to Community Outrage: Strategies for Effective Risk Communication* . Available online at http://www.psandman.com/media/RespondingtoCommunityOutrage.pdf [4]. WITTE, K. (1994). Fear control and danger control: A test of the extended parallel process model. Communication Monographs, 61(2), 113-134. [5]. INTERNATIONAL ATOMIC ENERGY AGENCY, Manual for first responders to a radiological emergency, Emergency Preparedness and Response, EPR-First Responders, IAEA, Vienna, 2006 [6]. WORKING GROUP ON PUBLIC COMMUNICATION OF NUCLEAR REGULATORY ORGANISATIONS, Nuclear Regulatory Organisations, the Internet and Social Media: The What, How and Why of Their Use as Communication Tools, OECD, NEA, 2014 [7]. ENVIRONMENTAL PROTECTION AGENCY, Communicating Radiation Risks: Crisis Communications For Emergency Responders, EPA 402-R-07-008, EPA 2007, Revised June 2008 [8]. AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, A Primer on Health Risk Communication, ATSDR, 1987 [9]. SCOTLAND & NORTHERN IRELAND FORUM FOR ENVIRONMENTAL RESEARCH, Communicating understanding of contaminated land risks, SNIFFER, 2010 [10]. COVELLO, V. T., Risk communication, radiation, and radiological emergencies: strategies, tools and techniques, Health Phys. 2011; 101(5): 511-530 [11]. RISK AND REGULATION ADVISORY COUNCIL, A Practical Guide to Public Risk Communication: The Five Essentials of Good Practice, RRAC, 2009 [12]. ROPEIK, D., Risk communication: More than Facts and Feelings, IAEA Bulletin 2008; 50-1: 58-60

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[14]. INTERNATIONAL ATOMIC ENERGY AGENCY, Health in Disasters: A Science and Technology Studies Practicum for Medical Students and Health Care Professionals, IAEA (in preparation)

3.13. Module 13: Education and Training in NRE (theory and practice, training of others)

Table 13. Contents of Module 13

Objective	The aim of this Module is to introduce the participants to adult learning principles and methods of adapting and communicating complex material to health professionals with various backgrounds. Participants will gain knowledge required for them to become effective trainers of medical physicists and other health professionals with specific relevance to the support of response to nuclear and/or radiological emergencies.
Pre-requisites (Learning in Place)	No pre-requisites are required but this module will be related to all other modules (2-12).
Learning Outcomes	At the end of this Module participants will be able to: • Understand the role of the medical physicist as a trainer within the multi-disciplinary NRE response team at their workplace • Discuss how to use adult learning principles and strategies when preparing complex material for training and exercises in the scope of NRE • Discuss how to adapt training curricula, training materials, training activities and teaching style to the multiple audiences and the local environment/workplace • Describe how to present and simplify complex material in an adult learning environment • Contribute to building a team of healthcare professionals for response to NRE events through the presentation of appropriate workshops and seminars
Core Knowledge and Competencies	Module 13 will enable the learner to acquire knowledge and competence in: • The fundamental principles of adult learning and continuing professional development • The fundamental presentation skills and teaching techniques required in healthcare professionals' education/learning • The fundamental principles of simplifying complex material for learning • Methods to assess the results of training (testing) • The STS Approach to enhance professionalism and build competence • The principles of teamwork and teambuilding that can be applied to the design of teaching and learning activities
Teaching and Learning Activities	Participatory learning activities, role play, delegate presentations, group discussion, design of teaching and learning activities etc.

Reading list

[1]. INTERNATIONAL ATOMIC ENERGY AGENCY, Communication with the Public in a Nuclear or Radiological Emergency, Emergency Preparedness and Response, EPR-Public Communications, IAEA, Vienna, 2012

[2]. CHHEM, R. K., CLANCEY, G. K., (Eds.) (2014). Health in Disasters: A Science and Technology Studies Practicum for Medical Students and Healthcare Professionals. (In preparation)

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4. Practical training

4.1. Practical training for Module 3: Radiation Measurements and Instrumentation

Format: Practical Training, using various types of radiation instruments
Duration: 60 Minutes

This session is designed to reinforce the information learned in Module 3. Course participants will be divided into two groups with two stations for practicing radiation measurements and observing radiation detection and identification instrumentation:

- **Station 1:** At this station, participants will practice: proper instrument and battery checks, using appropriate speed and distance for surveying for contamination on surfaces with a pancake probe, and using compatible units of measurements with screening criteria. Students will also practice using a personal dosimeter: charge the personal dosimeter and recording the appropriate starting reading with units.
- **Station 2:** At this station, participants will practice proper instrument and battery checks for dose rate meters, and practice taking dose rate measurements using appropriate units. Participants will also observe operation of gamma spectroscopy.

4.2. Practical training for Module 5: Monitoring and Decontamination of People Waste Management – Scene and Reception Centre

Title: Monitoring and Decontamination of People at Reception Centres
Format: Practical Demonstration

This demonstration is designed to reinforce the following learning outcomes related to the Module 5 instructions, monitoring and decontamination of people at a reception centre after a nuclear or radiological emergency:

- Design and establishment of a reception centre
- Develop monitoring procedures based on the scale of the event and resources available

- Establish segregated radiation zones
- Recognize criteria for decontamination of people in a radiation emergency
- Use equipment for the detection and quantification of possible external contamination on people

Participants will be divided into three groups and will rotate through the following stations:

- **Design and Layout:** At this station, participants will work through layout considerations for a potential reception centre, focusing on the placement of radiological monitoring and staff, establishing contamination control zones. Participants will be provided with example floorplans and scenarios and will be asked to design a reception centre plan featuring segregated radiation control zones and an appropriate distribution of staff and monitoring resources.
- **Radiological Monitoring:** At this station, participants will receive hands-on training on the use of handheld and stationary radiation monitoring instruments. Participants will have a chance to practice handheld radiological survey techniques on mannequins with hidden sources. Participants will also discuss the implementation of a layered approach to radiological monitoring at the reception centre, the selection of proper instrumentation for different response scenarios, and the importance of proper monitoring technique, such as taking background measurements and using headsets to hear audible counts, when available.
- **Staffing and Flow:** At this station, participants will review staffing needs, identify potential bottlenecks, and discuss ways to maximize throughput at the reception centre. Participants will also be introduced to and provided a demonstration of CDC modelling software that can be used for reception centre planning.

Each group will spend 20 minutes at each station, before rotating to the next station.

4.3. Practical training for Module 6: Monitoring and Decontamination of People, Waste Management – Hospital

Title: Emergency Department Evaluation of a Patient Contaminated with Radioactive Materials
Format: Simulation Case Scenario

Objectives

After the completion of this exercise, participants will be able to:

- Prepare to receive patients injured in a dirty bomb incident
- Assess and decontaminate patients injured in a dirty bomb incident

Exercise Description

Participants will be divided into 4 groups that will each go through the exercise once. Participants will receive an initial briefing followed by a demonstration by staff from the REAC/TS team. Each group will receive and care for one simulated patient played by an actor. Each group will include one or more simulated health care provides (e.g., physician, nurse, paramedic). The exercise will be observed by one or two instructors who will guide participants through the scenario.

Debriefing will be done at the end as a group.

Table 4.1: Agenda for Module 6 Practical Training

Time	Large Classroom	Simulation Room
12:30p – 1:00pm	Initial Brief with Lunch	
1:00pm-1:45pm	Demonstration	
2pm-3pm	Groups C, D Video and Break	Groups A, B Drill
3:15pm – 4:15pm	Groups A, B Video and Break	Groups C, D
4:30pm –5pm	Debriefing	All Instructors
5:00pm	Shuttle Pick-Up and Departure to Hotel	

Additional Notes

Lunch will be provided by the host institution.

Please dress comfortably for the exercise as you will be expected to get dressed in personal protective equipment during the exercise.

4.4. Practical training for Module 12: Effective Risk Communication

Format: Practical Training, small group work and discussion
Duration: 90 minutes

This session is designed to reinforce the information learned in Module 12. Using the scenario presented in the tabletop discussion (displaced well logging source), course participants will be engaged is discussing the public needs for information, developing communication messages, delivery of those messages, rumour control, coordination with public information officer at the hostile, and specific roles of medical physicists in these activities.

The discussion is conducted in the following order:

- Scenario update: review of key points based on the tabletop discussion from morning session (5-7 minutes)
- Lecture: Overview of communication plan (5 – 7 minutes)
- **Activity:** Small group discussion: Who are the main audiences in a radiation incident? (10 minutes)
- Lecture: Review key audiences based on proximity to incident; Developing effective public messages; Review of key research related to message development; Tips for communication success (20-25 minutes)
- Lecture: Review of delivery mechanisms and media channels (5-7 minutes)
- Scenario update
- **Activity**: Small group discussion: rumour control, message delivery, and working with Public Information Officers at the hospital (15 minutes)
- Scenario update

- **Activity**: Small group discussion: role of medical physicists in addressing rumour control and stigma (15 minutes)
- Lecture: Review of communication planning (5 minutes)
- **Activity**: Asking participants how they will apply this information at their hospitals (5- 7 minutes)

4.5. Tabletop Exercise

Duration: 90 minutes

Objectives

In this tabletop exercise, participants will:

- Discuss with health care providers the difference between contamination with radioactive materials and exposure to radiation and assist in radiation dose estimation after whole body exposure.
- Advise health care providers about personal and property protection measures including personal protective equipment, dosimeters and radiation emergency area set up.
- Discuss the initial assessment and decontamination of patients contaminated with radioactive materials.

Scenario Description

A young man who works at a construction site finds an abandoned piece of equipment on Monday morning and places it in his right pants pocket. He drops it off at a junkyard owned by 2 of his friends in the evening. He asks them to break the metal casing and see if it has any scrap value.

The construction worker develops nausea and vomiting after lunch and heads to the hospital on Tuesday morning.

The 2 junkyard owners develop illnesses as well and present to the same hospital on Saturday after they learn that the source contained radioactive material.

Participants

- Workshop participants will be divided into two groups and each group will play the role of medical physicists based at hospitals.
- Workshop faculty will simulate the roles of emergency medicine physicians and media representatives.

5. Reading List

[1]. ACKEY, H., YAGER, R.E., The impact of a Science/Technology/Society teaching approach on student learning in five domains, Journal of Science in Educational Technology 2010;(19):602-611.

[2]. AOKI, T., Experiencing ethnicity as a Japanese Canadian teacher: Reflections on a personal curriculum, Curriculum Inquiry 1986;13(3): 321-335.

[3]. AOKI, T., Rethinking curriculum and pedagogy. Kappa Delta Pi Record 1999, Summer, 180-186.

[4]. CHHEM, R. K., CLANCEY, G. K., (Eds.) (2014). Health in Disasters: A Science and Technology Studies Practicum for Medical Students and Healthcare Professionals. (In preparation)

[5]. HACKET, E. J., AMSTERDAMSKA, O., LYNCH, M., WAJCMAN, J., (Eds.), The Handbook of Science and Technology Studies (3rd ed), MIT Press, London, UK, 2008.

[6]. MANSOUR, N., Science-Technology-Society (STS): A new paradigm in Science education. Bulletin of Science, Technology & Society 2009;29(4):287-297.

[7]. MINGAT, A. (1998). The strategy used by high-performing Asian economies in education: Some lessons for developing countries”. World Development, 26(4): 695-715.

[8]. NATIONAL SCIENCE TEACHERS ASSOCIATION, Science/Technology/Society: A new effort for providing appropriate science for all. In YAGER, R., (Ed.), What research says to science teacher: the science, Technology & Society Movement (3-5), Washington DC, National Science Teachers Association. Vol. 7, 3-6 (1993).

[9]. RIP, A., STS in Europe, Science, Technology and Society 1999;4(1):73-80.

6. Additional Resources

[1]. FMU-IAEA International Academic Conference Archives of presentations http://www.fmu.ac.jp/radiationhealth/conference-workshop/, Accessed on May 15, 2015.

[2]. STIEGHORST, C., HAMPEL, G., Communication with the Public after Fukushima – Social Media and Conventional Media. http://www-pub.iaea.org/iaeameetings/cn224p/Session10/Stieghorst.pdf, Accessed on May 15, 2015.

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