Brief Summary of ICRP 105

Volume 37 No. 6 2007
ISSN 0146 6453
ISBN 978 0 7020 3102 1

ICRP

Annals of the ICRP

ICRP Publication 105

Radiological Protection in Medicine

ELSEVIER

Ch1: Background

- ICRP report 105 was prepared by committee 3 in 2007
- It is prepared by Task Groups and Working Parties
- Committee 3 has published other related Reports:(84, 85, 86, 87, 93,…)

Ch2: Uses of Ionizing Radiation in Medicine

- Radiation exposure comes mainly from Medical practice (95 %).
- This report focus on rad. exp. to patients, Comforters and researchers
- World wide: 2000 m X-ray, 32 m NM, 6 m Rx /year (UNSCEAR 2000).
- World wide: 2 m X-ray machines, 2.3 m radiation workers (UNSCEAR 2000).

Ch3: Biological Basis for Radiological Protection

- Deterministic Effects:
  - Tissue related reaction (cells die)
  - Dose rate dependent
  - Tissue and organ related depending on threshold
- Stochastic Effects:
  - Damage to DNA in cells (somatic effects)
  - Damage to DNA in germ cells (heritable effects)
  - Dose rate independent

Ch3: continue

- Effects of in-utero Irradiation:
  - Lethal Effects: embryo is sensitive to radiation in the pre-implantion stage. (below 100 mGy there is no significant risk).
  - Malformations: it occurs at 3^{rd} – 8^{th} week at a threshold of 100 mGy.
  - Central Nervous System: 8 to 25 weeks if fetal dose is > 1 Gy then mental retardation
  - Leukaemia and Childhood cancer: radiation will increase the probability of such effects.

Ch4: Dosimetric Quantities

- Absorbed Dose= energy absorbed/ mass (Gy)
- Equivalent Dose= AD x W_{rad} (Sv)
- Effective Dose = $\Sigma\{ED \times W_{tissue}\}$ (Sv)

- Effective Dose is used as a principal protection quantity for the establishment of radiological protection guidance.

Ch5: Framework of Radiological Protection (2007)

- The fundamental principles:
  - Justification of practice
  - Optimization of protection
  - Application of dose limits
- Source-related:
  - Using new source should be justified to do more good than harm
  - The radiation dose should be optimized and kept as low as reasonably achievable.
  - Using “Dose Constraint” in planned exposure and “reference levels” for existing and emergency situations.

Ch5: continue

- Individual related:
  - it applies in planned exposure situations except for medical exposure of patients.
  - It insures to limit exposures so as to keep doses below the thresholds.
- Types of Exposures:
  1. Medical Exposure
  2. Occupational Exposure
  3. Public Exposure

Ch6: Unique Aspects of Rad. Prot. In Medicine for Patients

- Deliberate Exposure:
  - In Radiology exams, the aim is not to deliver dose but rather to use radiation for diagnosis.
- Voluntary Exposure:
  - Patient are informed with signing a consent
  - With regard to biomedical research, the vouluntary exposure benefit the society not the individual.
- Medical Screening of Patients:
  - Screening of patients for certain population is recommended (example: Mammography)

Ch6: continue

- Unjustified screening using CT and PET is not recommended.
- All patient undergoing screening should be fully informed about benefits and risks.

- Radiation Therapy:
  - The goal is to increase tumor control and lower normal tissue complication
- Management of Radiation Dose:
  - The goal is to use the appropriate dose to obtain the desired image or therapy.

Ch6: continue

- Demographics of patient population:
  - The Risk estimates were derived for age and sex averaged populations in order to establish a radiological protection guidelines.
  - Exposure of young children, the life time risk of death is higher than for adults
- Range of detriments from rad. Dose in Med.
  - Minimal, example chest X-ray to elderly patient
  - Significant, exp. CT exam (absorbed dose= 10-100 mGy).
  - Lethal, exp. Overdose in radiation therapy

Ch7: Discussion of the Term "Practice"

- In the field of medicine, it refers to the medical care that a practitioner provides to a patient.
- "Radiological Practice in medicine" refers to the utilization of ionizing radiation in medicine

Ch8: Justification of radiological Practice in Medicine

- The Commission requires only that the net benefit be positive.
- The Commission disapproves the unnecessary referrals for diagnostic examinations if it is unjustified practice.
- 3 levels of justification:

    1. proper use of radiation do good more than harm.
    2. specified procedure for specified objective is defined.
    3. application of procedure to patient

Ch8: continue

- Justification of a defined radiological procedure:
  - It is a matter of national and international professional bodies to benefit the patient and society as a whole.
  - It depends of the available resources of the country.
  - Staff and public exposures should be considered.
- Justification of a procedure for an individual patient:
  - It should include checking the details of the procedure, the alternative procedure, expected dose, and previous exposure history…

Ch9: Optimization of Protection for Patients in Medical Exposures

- General Approach applies at two levels:
  1. the design, selection, and construction of equipment.
  2. the day-to –day method of working
- Use of diagnostic reference levels and dose constraints:
  - Management of patient dose facilitated by the use of diagnostic reference levels.
  - Dose constraints are applicable to the comforters ,carer, and researchers.
- Management of Medical Exposures:
  - Simple , low cost measures are available to reduce dose to patient.

Ch10: Diagnostic Reference Levels

- Diagnostic Reference levels (ICRP 60 & 73):
  - It is the values of measured quantities above which some specified action or decision should be taken (recording, investigating, intervention, and action levels).
- Diagnostic Reference levels (SG 2):
  - Additional advise was provided which includes establishing diagnostic reference levels for medical imaging tasks *(details are found in Supporting Guidance 2).*

Ch11: Individual Dose Limit

- It is not appropriate to apply dose limits to medical exposures of patients because such limits would often do more harm than good.

Ch12: Preventing Accidents in Radiation Therapy

- It is accomplished by the design of equipment , premises and the working procedure in the department.
- *Examples:* calibrate machines, checks leakage, checking and double checking treatments and protocols, communicating among team members regarding patients treatment…

Ch13: Managing Accidents and Incidents Involving Radioactive Material

Examples to reduce exposure in emergency situations:

- Administration of KI for excessive administration of radioactive iodine in patients treated with thyroid therapy.
- Survey of areas when missing a radioactive source to locate and store a way.
- Isolating a contaminated area from a NM spill and proper evacuation of staff for clean up and decontaminate.
- Doing Preventive and precautionary measures in case of improper disposal of a teletherapy source (evacuation, decontamination,…)

Ch14: Education and Training

- There should be radiological protection training for all those involved with radiation.
- Three categories of physicians:
  1. MD whose specialty id radiation related (radiologist, RO…)
  2. MD who utilize Radiation in their practice (urologist, cardiologist...)
  3. MD who prescribe medical radiation procedures (family medicine…)
- Education and training appropriate to each category should be given in medical school teaching, residency and focused courses.

Ch15: Institutional Arrangement

- Medical Physicists in Hospitals should play a key role in training and education for all staff.
- Quality Assurance Programs, Audits and regular inspection is essential in institutions to insure radiation protection is being practiced *(exp acceptance and performance testing).*
- Record Keeping of occupational exposures, procedure dose measurements (Radiology), dose planning(Radiation therapy), administered activity (NM)…all these records should be kept for comparison with reference levels and for any future evaluations.

Ch16: Practical Methods of Protection other than for Patients

- Occupational Exposures:
  - It is facilitated by designation of workplace into 2 areas: Controlled and Supervised.
  - Individual Monitoring of staff
  - Careful use of shielding, distance and time limits
  - Working conditions of pregnant workers should take into consideration the additional equivalent dose to fetus/embryo not to exceed 1 mSv during pregnancy.
- Public Exposure:
  - Public access to hospitals and radiology rooms should be carefully restricted especially in controlled areas.

Ch16: continue

- Exposure of volunteers in biomedical research:
  1. guarantee a free and informed choice.
  2. adoptions of dose constraints.
  3. use of ethics committee for study conduction
- Exposure of Comforters and Carers of Patients:
  - Adoption of dose constraints for adults (less than 5 mSv/episode).
  - Young children, infants, and visitors not engaged in direct comforting should be treated as members of the public (less than 1 mSv/year).