The International Commission on Radiation Units and Measurements (ICRU)

Goals and recent achievements

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IRPA-Madrid, May 2004
The International Commission on Radiation Units and Measurements (ICRU)

General survey of the ICRU achievements

Dosimetry and Radiation Protection in Radiology

Protection of the Patient in Radiation Therapy (normal tissue tolerance)
BRIEF HISTORICAL REVIEW - The Mandate of the ICRU

In 1925, the First International Congress of Radiology, in London, recognized the need for international standardization of units and measurements and appointed the International X-Ray Unit Committee, subsequently the International Commission on Radiation Units and Measurements (ICRU).

The demands came from the medical (radiological) community, but the needs in the area of radiation protection was also recognised.

In 1928, at the Second International Congress of Radiology, an international agreement on the definition of a unit of x-ray dose, the röntgen, was achieved based on measurements with air-filled ionization chambers.

In 1937, the ICRU recommended a definition of the röntgen applicable to both x rays and gamma rays.
General survey of the ICRU activities

ICRU
Set of quantities and units for ionizing radiations

FIELDS OF APPLICATION

Radiation physics
Methods of measurement
Numerical values of involved quantities (Tables)

Low dose / Low dose rate
Definitions of terms and concepts (quantitatives)

Radiation protection
Radiation therapy
Medical imaging
Other applications

Occupational Air Crew
Radiology CT (MRI) Nuclear medicine
CT - Patient dosimetry - Image quality

WP 2
WP 1

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Some recent ICRU Reports on fundamental radiation physics and numerical values:

ICRU Report 74 (2005)
Stopping Powers for Heavy Ions

ICRU Report 63 (2000)
Nuclear Data for Neutron and Proton Radiotherapy and for Radiation Protection

ICRU Report 60 (1998)
Fundamental Quantities and Units for Ionizing Radiation

Secondary Electron Spectra from Charged Particle Interactions

ICRU Report 49 (1993)
Stopping Powers and Ranges for Protons and Alpha Particles (with data disk)
General survey of the ICRU activities

ICRU

Set of quantities and units for ionizing radiations

FIELDS OF APPLICATION

Radiation protection
Radiation therapy
Medical imaging
Other applications

Low dose / Low dose rate
Definitions of terms and concepts (quantitative)

Radiology
CT (MRI)
Nuclear medicine

CT - Patient dosimetry - Image quality

Occupational
Air Crew
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Dosimetry and Radiation Protection in Radiology

Protection of the Patient in Radiation Therapy (normal tissue tolerance)
Medical Imaging – Radiology (In press or preparation):

Harmonisation in Reporting Patient Dose in Radiological Imaging
Patient Dose and Image Quality in Computed Tomography (CT)

Image Quality in Nuclear Medicine Published ICRU Reports:

#54 Medical Imaging-The assessment of Image Quality (1995)
#48 Phantoms and Computational Models in Therapy, Diagnosis and Protection (1992)
#46 Photon, Electron, Proton and Neutron Interaction Data for Body Tissues (1992)
#41 Modulation Transfer Function of Screen-Film Systems (1985)
Protection of the patient in radiology: the relevant quantities to determine

**Deterministic effects (high doses)**

Severity of the lesion is related to the dose at the most heavily irradiated site (usually the skin).
The dose at the most irradiated area of the skin is thus a relevant quantity to determine as accurately as possible.

**Stochastic effects**

More complex issue - Low probability
Mean organ dose correlates with risk of cancer induction (ICRP)
Determination of the mean organ dose is possible, using sophisticated Monte Carlo techniques (with assumptions).
Possibility to derive mean organ dose from the dose-area-product (DAP) for a given procedure.
Standards Laboratories: calibration of ionisation chambers in kerma in air, free-in-air.

Medical/radiobiological communities: Quantity absorbed dose in water(tissues), on beam axis, at skin/entrance, with backscatter

Conversion factors:
- from kerma \(\rightarrow\) absorbed dose,
- from air \(\rightarrow\) water,
- with/without backscatter.

for different conditions in:

ICRU # 73 Patient Dosimetry for X Rays Used in Medical Imaging (appear early 2005)
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General survey of the ICRU achievements

Dosimetry and Radiation Protection in Radiology

Protection of the Patient in Radiation Therapy
(normal tissue tolerance)

In radiation therapy:
- the radiation field is known (planned)
- the required accuracy is high (5 %)
Fig. 2. Dose-effect relationships for tumour control (1) (open symbols) and for skin and intestinal damage (2) (closed symbols) after neutron (circles) and photon (triangles) irradiation of T_{4B} bladder tumours. As the curves for skin and intestinal damage are almost identical, just one curve is shown. The curves have been computed adopting equation (1) (modified from Battermann et al. [4]).
Figure A1.1. Treatment of medulloblastoma in a child. Sagittal reconstructed view of the cerebro-spinal space illustrating the volumes: CTVs (light red) and PTVs (light blue).

Figure A1.2. Sagittal reconstructed view illustrating the treatment technique: the lateral photon beams irradiating PTV-1; the lateral photon beams irradiating PTV-1B (boost to the posterior fossa); the posterior upper and lower 15-MeV electron beams irradiating the spine, PTV-2A, and PTV-2B.
Fig. 2.3.b. The demonstrated tumor in the right hilar region extending into the lung tissue, but not involving the chest wall is the GTV, and is shown by the striated area.
Some recent ICRU Reports in the field of radiation therapy

Prescribing, Recording and Reporting Electron Beam Therapy

ICRU Report 50 (1993)
Prescribing, Recording and Reporting Photon Beam Therapy

ICRU Report 50 (1999)
Prescribing, Recording and Reporting Photon Beam Therapy
(Supplement to ICRU Report 50)

ICRU Report 58 (1997)
Dose and Volume Specification for Reporting Interstitial Therapy

including:

Accurate dosimetry (protocols)
Harmonisation in language, concepts, definitions
Dose specification for reporting
Reference points, reference volumes for reporting
Reporting irradiation of normal tissues

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ICRU Reports in the field of radiation therapy, in preparation

Prescribing, Recording and Reporting Proton Beam Therapy (jointly with the IAEA)

Prescribing, Recording and Reporting Intensity Modulated Radiation Therapy (IMRT) and Conformal Therapy with Photons

Prescribing, Recording and Reporting Brachytherapy in Gynecology (Revision of ICRU Report 38, 1985)

including:

Modern Irradiation Modalities (Particles)
Accurate dosimetry (protocols)
From Reference Points to Volumes for reporting

Reporting irradiation of normal tissues (i.e., maximum dose, dose-volume histogram)

All this information is available on our web site:

www.icru.org

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