ICRU CONCEPT

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International Commission on
Radiation Units and Measurements, Inc.

ACTIVITY
EXPOSURE
ABSORBED DOSE
TISSUE MODIFYING FACTOR


ACTIVITY

ACTIVITY

THE EMISSION OF IONIZING RADIATION OR PARTICLES CAUSED BY THE SPONTANEOUS DISINTEGRATION OF ATOMIC NUCLEI

ci/Kci/Bq


EXPOSURE

EXPOSURE

EXPOSURE OF X-RAYS AND GAMMA RAYS. IT IS DEFINED AS THE ELECTRIC CHARGE FREED BY SUCH RADIATION IN A SPECIFIED VOLUME OF AIR DIVIDED BY THE MASS OF THAT AIR

rontgen


ABSORB

ABSORBED DOSE

The quantity of ionizing radiation absorbed by a body, measured (usually in Grays) as the energy absorbed per unit mass

rad/Gy


Retained/IQ

TISSUE MODIFYING FACTOR

RELATIVE SENSITIVE OF DIFFERENT TISSUES AND ORGANS AFTER EXPOSED TO RADIATION

rem/sv


I
C
R
U

Radiation Units

There are a number of units to measure radiation dose and exposure:

- **rad or radiation absorbed dose**

  The amount of radiant energy absorbed in a certain amount of tissue.
- **gray (Gy)**

  A unit of absorbed radiation equal to the dose of one joule of energy absorbed per kilogram of matter, or 100 rad. The unit is named for the British physician L. Harold Gray (1905-1965), an authority on the use of radiation in the treatment of cancer.
- **milligray (mGy)**

  A unit of absorbed radiation equal to one thousandth of a gray, or 0.1 rad.
- **rem or roentgen-equivalent-man**

  A unit of measurement that takes into account different biological responses to different kinds of radiation. The radiation quantity measured by the rem is called equivalent dose.
- **millirem**

  One thousandth of a rem, the unit for measuring equivalent dose.
- **roentgen (R, r)** *(rent-gen, rent-chen)*

  The international unit of exposure dose for x-rays or gamma rays. Roentgens are named after Professor Wilhelm Konrad Roentgen, the man who discovered x-rays in 1895.
- **sievert (Sv)** *(see-vert)*

  The unit for measuring ionizing radiation effective dose, which accounts for relative sensitivities of different tissues and organs exposed to radiation. The radiation quantity measured by the sievert is called effective dose.
- **millisievert (mSv)** *(mill-i-see-vert)*

  One thousandth of a sievert, the unit for measuring effective dose.

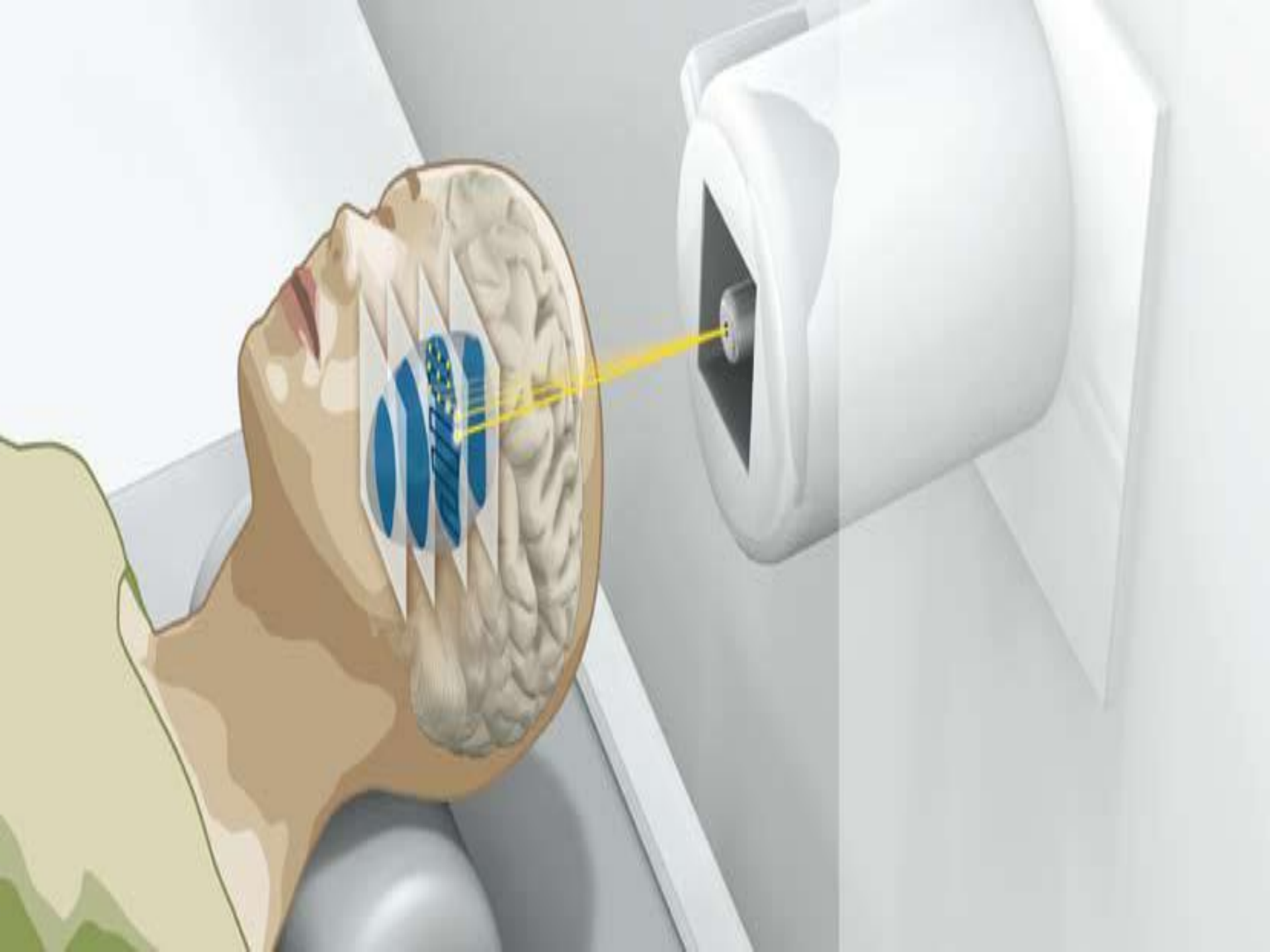
CGS/SI


SIEMENS
Healthineers
BIOGRAPH Vision
SIEMENS
Healthineers

Linac Beam


TomoTherapy


ELEKTA
icon

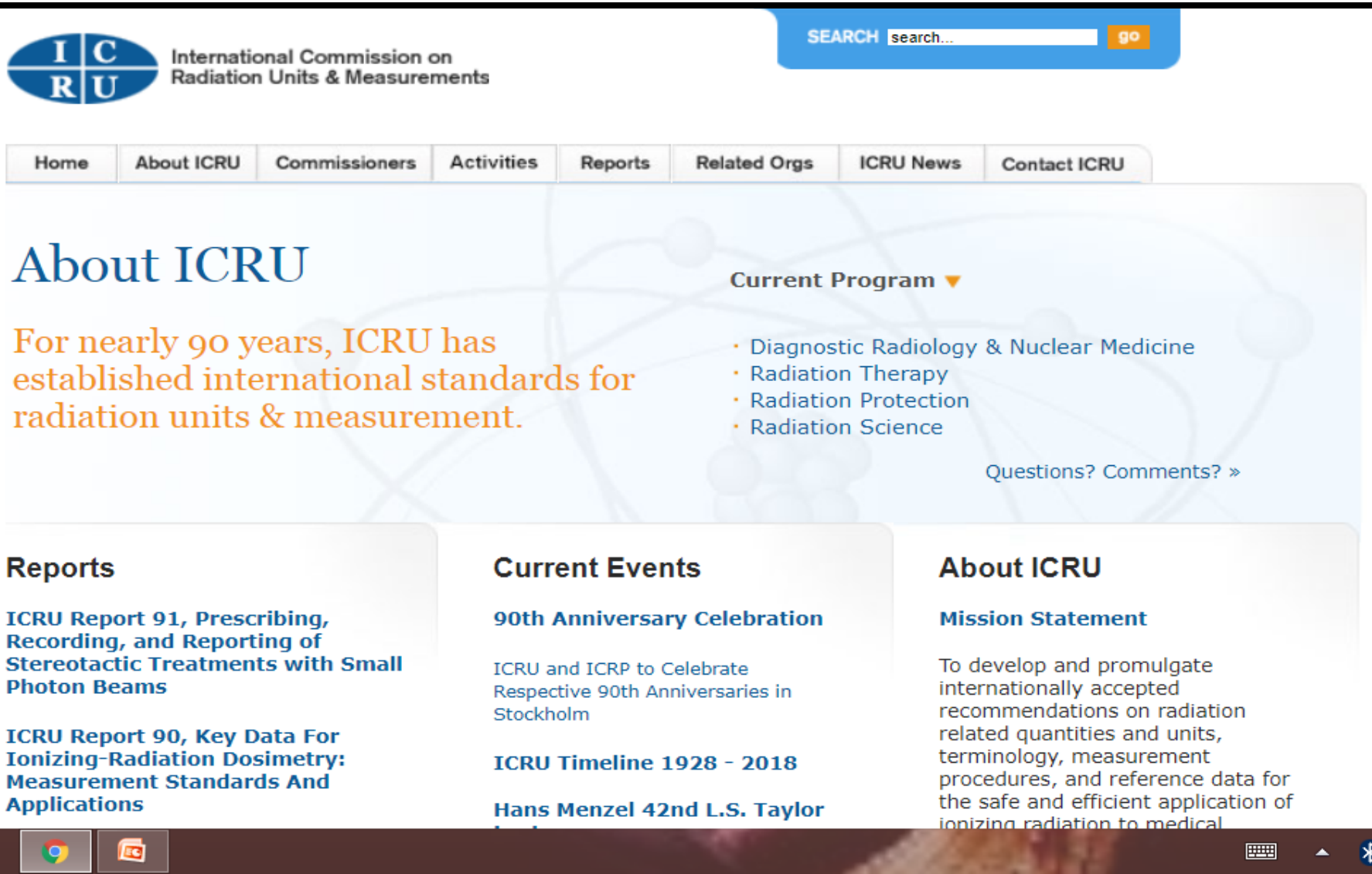


DIAGNOSIS
TREATMENT
MEASUREMENT
INDUSTRY
PROTECTION
INSTRUMENTATION

History

1. The ICRU (**originally known** as the International X-Ray Unit Committee and later as the International Committee for Radiological Units)
2. Was conceived at the First International Congress of Radiology (ICR) in London in 1925 and officially came into being at ICR-2 in Stockholm in 1928.
3. The primary objective was to propose a unit for measurement of radiation as applied in medicine. From 1950 the ICRU expanded its role significantly to embrace a wider field.
4. Initially meetings were held **every 3 years at ICR congresses** (excluding the 13-year period encompassing World War II) with one physicist and one radiologist from each participating country having the right of attendance with the Chairman being nominated by the ICR host country.
5. A **permanent Commission** was elected in 1953

WEBSITE


International Commission on
Radiation Units & Measurements
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About ICRU
For nearly 90 years, ICRU has established international standards for radiation units & measurement.
Current Program
· Diagnostic Radiology & Nuclear Medicine
· Radiation Therapy
· Radiation Protection
· Radiation Science
Questions? Comments? »
Reports
ICRU Report 91, Prescribing, Recording, and Reporting of Stereotactic Treatments with Small Photon Beams
ICRU Report 90, Key Data For Ionizing-Radiation Dosimetry: Measurement Standards And Applications
Current Events
90th Anniversary Celebration
ICRU and ICRP to Celebrate Respective 90th Anniversaries in Stockholm
ICRU Timeline 1928 - 2018
Hans Menzel 42nd L.S. Taylor
About ICRU
Mission Statement
To develop and promulgate internationally accepted recommendations on radiation related quantities and units, terminology, measurement procedures, and reference data for the safe and efficient application of ionizing radiation to medical

Administration

The Commission's secretariat is in Stockholm and its legal status is that of British charity (Not-for-profit organisation).

90th year celebration

STOCKHOLM

Celebrating 90 Years of Expertise
– Radiation Protection in the Next Decade

Time: 17–18 October, 2018

Radiation quantities

The commission has been responsible for defining and introducing many of **units of measure**. The number of different units for various quantities is indicative of changes of thinking in world metrology, especially the movement from CGS to SI units

SISTER

1. The ICRU is a sister organisation to the International Commission on Radiological Protection (ICRP).
2. In general terms the ICRU defines the units, and the ICRP recommends how they are used for radiation protection

AIMS

1. To collect and **evaluate the most relevant** data and information pertinent to the problems of ionizing radiation for inclusion in its reports.
2. To strive to **maintain close contacts** with organizations, professional societies and statutory bodies that benefit from its work.

Principal objective of ICRU

The development of internationally accepted recommendations regarding:

- (1) quantities and units of radiation and radioactivity;
- (2) procedures suitable for the measurement and application of these quantities in diagnostic radiology, radiation therapy, radiation biology, nuclear medicine, radiation protection, and industrial and environmental activities;
- (3) physical data needed in the application of these procedures, the use of which assures uniformity in reporting.

UNIFORM REPORTING

MISSION

To develop and promulgate internationally accepted recommendations on radiation related quantities and units, terminology, measurement procedures, and reference data for the safe and efficient application of ionizing radiation to medical diagnosis and therapy, radiation science and technology, and radiation protection of individuals and populations.

BENEFICIARIES

1. Radiation oncologists
2. Radiotherapists,
3. Diagnostic radiologists,
4. Nuclear medicine physicians,
5. Medical physicists,
6. Radiation dosimetrists,
7. Radiation protection practitioners and scientists in research,
8. Industry (including nuclear power) and universities,
9. Regulators,
10. Radiobiologists,
11. Epidemiologists,
12. Emergency preparedness engineers,
13. Environmentalists and
14. Instrument designers

Yearly commission meeting

2017 Annual Commission Meeting **<2017 Commission Photo>**

The 2017 ICRU Meeting will be held 1-4, April at the Fiesta Inn, Mexico City, Mexico and at Universidad Nacional Autónoma de México

2016 Annual Commission Meeting **<2016 Commission Photo>**

The 2016 ICRU Meeting was held was held 16-19,April 2016 at the Hotel Quirinale, Rome, Italy and at ENEA, Frascati, Italy

2015 Annual Commission Meeting **<2015 Commission Photo>**

The 2015 ICRU Meeting was held was held 9-14 May 2015 at Cliniques Universitaires Saint Luc, Brussels, Belgium.

2014 Annual Commission Meeting **<2014 Commission Photo>**

The 2014 ICRU Meeting was held was held 9-14 May 2014 at ICRU Headquarters, Bethesda, Maryland USA.

Gray medal

GRAY MEDAL

The prestigious Gray Medal was established by the ICRU in 1967. The medal is awarded for outstanding contributions to scientific fields of interest to the ICRU and honors the late Louis Harold Gray, former member and Vice Chairman of the ICRU and eminent medical physicist and radiobiologist. The medal is awarded with a frequency determined by the ICRU and is usually awarded, in rotation, to recipients in the fields of Radiation Oncology, Medical Imaging and Basic Radiation Science. The medal is presented at an appropriate international event where the recipient is invited to give a scientific lecture.

RECIPIENTS

1969 L V Spencer (Radiation Physics)
1975 J W Boag (Radiation Physics)
1977 M M Elkind (Radiobiology)
1981 M Tubiana (Radiation Oncology)
1985 H H Rossi (Radiation Physics)
1989 D Schulte-Frohlinde (Radiation Chemistry)
1995 H R Withers (Radiobiology)
1999 P Lauterbur (Medical Imaging)
2001 H D Suit (Radiation Oncology)
2003 R M Fry (Radiobiology)
2003 M J Berger (Radiation Physics)
2005 C E Metz (Medical Imagng)
2007 E J Hall (Radiation Oncology)
2009 A van der Kogel (Radiobiology)
2011 D T Goodhead (Radiation Science)
2013 W A Kalender (Medical Imaging)
2015 F A Stewart (Radiation Oncology)
2017 C A Mistretta (Radiation Science)

Liaison with other Organizations

American Association of Physicists in Medicine

American Society for Radiation Oncology

Bureau International de Métrologie Légale

Bureau International des Poids et Mesures

Canadian Nuclear Safety Commission

Council for International Organizations of Medical Sciences

European Association of Nuclear Medicine

Food and Agriculture Organization of the United Nations

International Atomic Energy Agency

International Commission on Radiological Protection

International Council for Science ICSU

Financial support is provided by the following organizations:

1. American Association of Physicists in Medicine

1. Health Physics Society

1. International Atomic Energy Agency

1. International Radiation Protection Association

1. International Society of Radiology

1. Radiological Society of North America

Report Writing Committees

1. The Commission is assisted by Report Committees working on an adhoc basis to produce draft reports on specific subjects.
2. They may be assisted by consultants. Commission members, called sponsors, ensure the liaison between committee and Commission

Reports in Preparation

Measurement and Reporting of Radon Exposures

Prescribing, Recording, and Reporting Brachytherapy for Cancer of the Cervix

Key Data Measurement Standards in Dosimetry of Ionizing Radiation

Prescribing, Recording, and Reporting Ion-Beam Therapy

Prescribing, Recording, and Reporting Stereotatic Treatments with Small Photon Beams

Bioeffect Modeling and Equieffective Dose Concepts in Radiation Therapy

Operational Radiation Protection Quantities for External Radiation

Monitoring and Assessment of Radiation Releases to the Environment

MEMBERSHIP

MEMBERSHIP

Since the sixth meeting in 1950 members have been elected to the ICRU by incumbent Commissioners. The Commission is composed of a maximum of 15 members selected for their scientific ability and is widely regarded as one of the foremost panel of experts in radiation medicine and in the other fields of ICRU endeavor. Meetings of the full Commission are held annually.

CURRENT MEMBERS

H-G Menzel (Germany), *Chairman*
P M DeLuca, Jr (USA) *Vice Chairman*
T R Mackie (USA), *Secretary*
S M Bentzen (USA), Executive Director
V Grégoire (Belgium), Executive Director
J M Boone (USA)
M-E Brandan (Mexico)
A Chiti (Italy)
D T Burns (France)
E Fantuzzi (Italy)
R W Howell (USA)
P Olko (Poland)
B O'Sullivan (Canada)
D Rogers (Canada)
N Saito (Japan)

Recently published reports

81 Quantitative Aspects of Bone Densitometry (2009)
82 Mammography: Assessment of Image Quality (2009)
ICRP 110 Adult Reference Computational Phantoms (2009) [with ICRP]
83 Prescribing, Recording, and Reporting Photon-Beam Intensity-Modulated Radiation Therapy (IMRT) (2010)
84 Reference Data for the Validation of Doses from Cosmic Radiation Exposure of Aircraft Crew (2010) [with ICRP]
ICRP 116 Dose Conversion Coefficients for Radiological Protection Quantities for External Radiation Exposures (2010) [with ICRP]
85a Fundamental Quantities and Units (2011)
86 Quantification and Reporting of Low-Dose and other Heterogeneous Exposures (2011)
87 Radiation Dosimetry and Image Quality Assessment in Computed Tomography (2012)
88 Measurement and Reporting of Radon Exposures (2012)
89 Prescribing, Recording, and Reporting Brachytherapy for Cancer of the Cervix (2013)
90 Key Data for Ionizing-Radiation Dosimetry: Measurement Standards and Applications (2014)

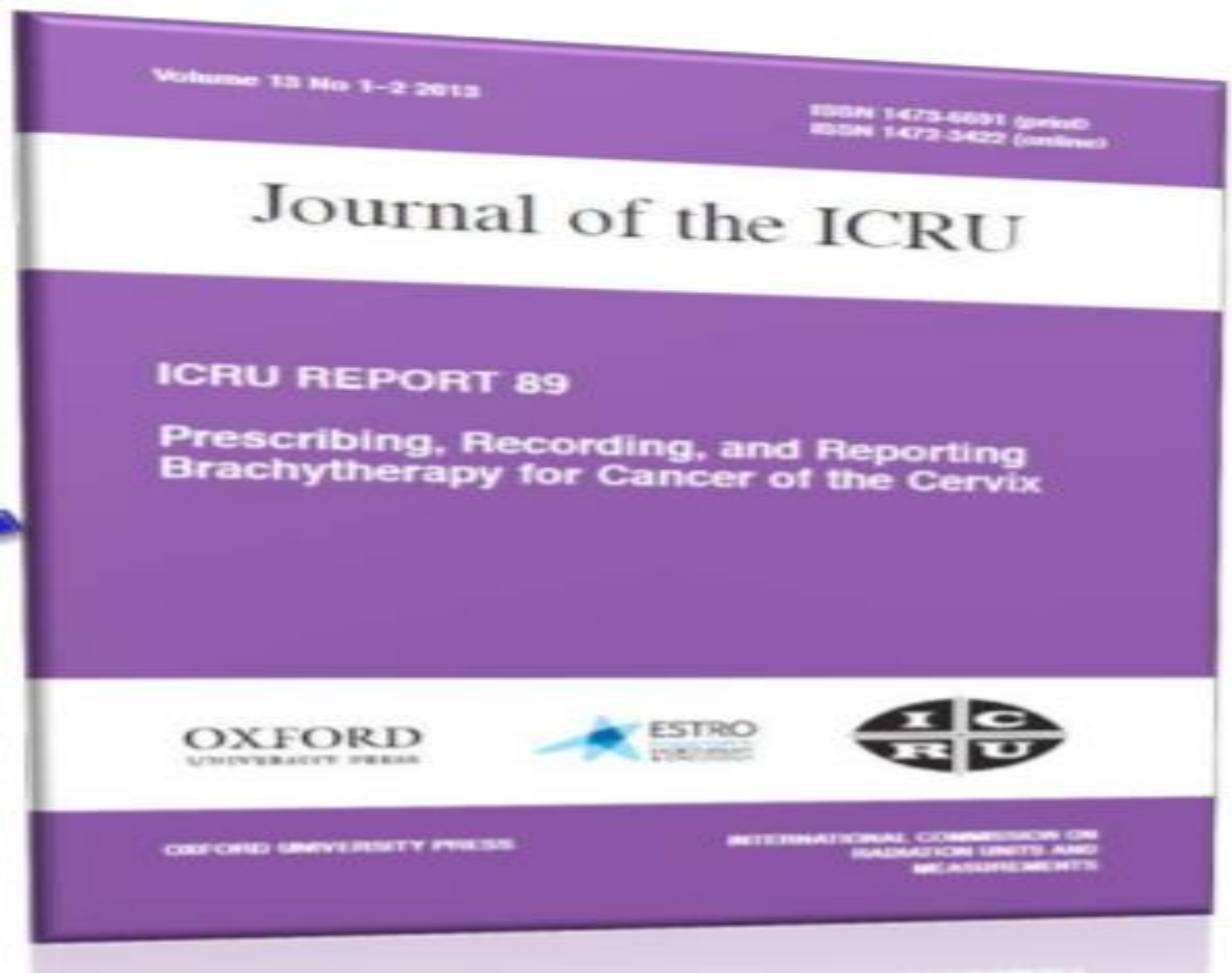
COLLABORATION

COLLABORATIONS

Professional societies, government agencies and departments, national laboratories and statutory organizations, the US National Council on Radiation Protection (NCRP), international organizations including the International Atomic Energy Agency (IAEA), World Health Organization (WHO), the International Commission on Radiological Protection (ICRP), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the International Organization for Standardization (ISO), the International Bureau of Weights and Measures/*Bureau International des Poids et Mesures* (BIPM) and the International Committee for Weights and Measures/*Comité International des Poids et Mesures* (CIPM).

Evolution of radiation units

EVOLUTION OF RADIATION UNITS (ICRU RECOMMENMDATIONS)					
QUANTITY		UNIT			DATE
Name	Symbol	Unit	Special name	Symbol	
Exposure	X	1 e.s.u. per 0.001293 g of air	röntgen	r→R	1928
Absorbed dose	D	erg g^{-1}			1950
Activity	A	3.7×10^{10} s^{-1}	curie	Ci	1953
Absorbed dose	D	100 erg g^{-1}	rad	rad	1953
Fluence	Φ	cm^{-2} or m^{-2}	(reciprocal area)	(SI)	1962
Dose equivalent	H	100 erg g^{-1}	röntgen equivalent man	rem	1971
Absorbed dose	D	J kg^{-1}	gray	Gy (SI)	1974
Activity	A	s^{-1}	bequerel	Bq (SI)	1974
Dose equivalent	H	J kg^{-1}	sievert	Sv (SI)	1977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Prescribing, Recording, and Reporting Brachytherapy for Cancer of the Cervix
OXFORD
UNIVERSITY PRESS
ESTRO
ICRU
OXFORD UNIVERSITY PRESS
INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS

- In the late 1950s the ICRU started publishing reports on an irregular basis - on average two to three a year.

- In 2001 the publication cycle was regularised and reports are now published bi-annually under the banner "Journal of the ICRU"

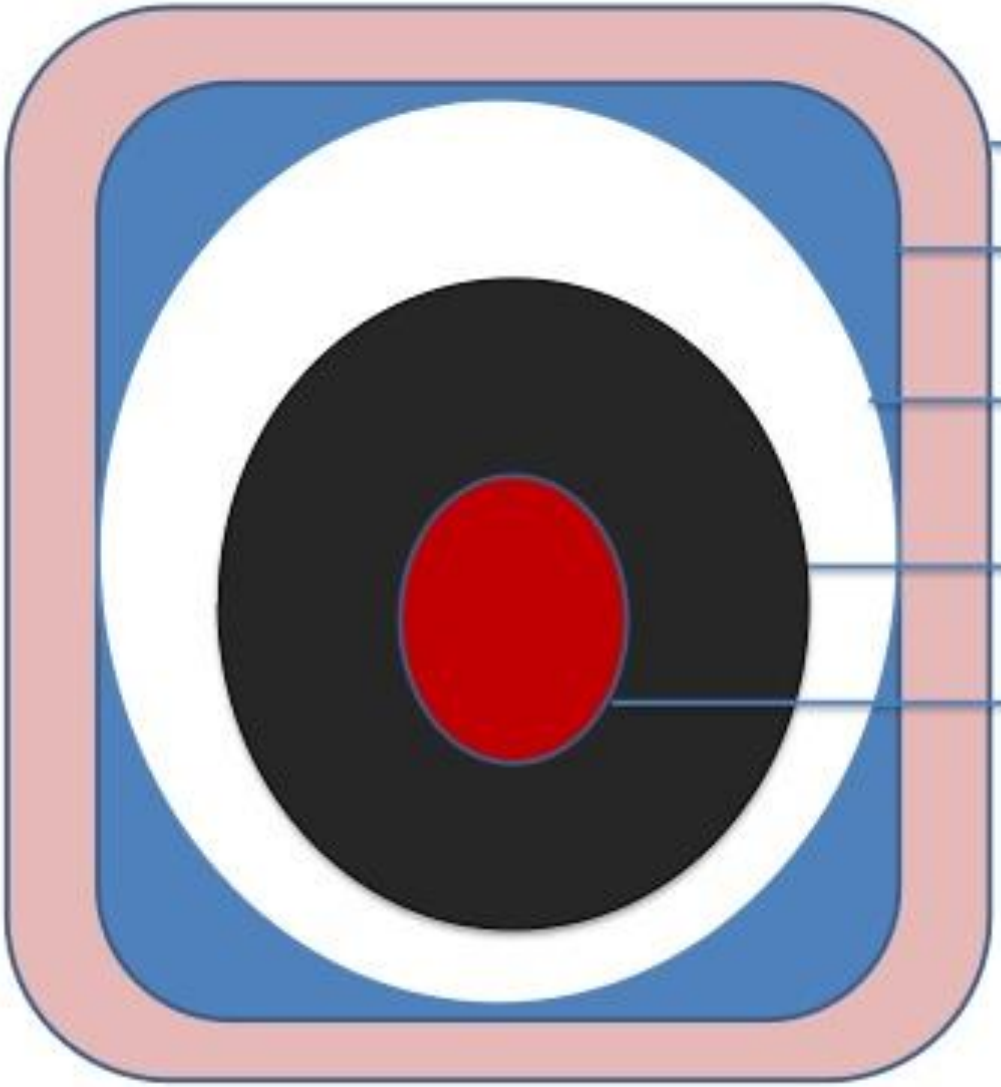
ICRU Report 38

Dose and Volume Specification for Reporting Intracavitary Therapy in Gynecology

ICRU REPORT 50

Prescribing, Recording, and Reporting Photon Beam Therapy

ICRU 50



Irradiated Volume

Treated Volume

Planning Target Volume (PTV)

Clinical Target Volume (CTV)

Gross Tumor Volume (GTV)

ICRU Report 58

Dose and Volume Specification for Reporting Interstitial Therapy

ICRU Report 60

Fundamental Quantities and Units for Ionizing Radiation

ICRU Report 62

Prescribing, Recording and Reporting Photon Beam Therapy

ICRU REPORT 71

Prescribing, Recording, and Reporting Electron Beam Therapy

ICRU Report 76

Measurement quality assurance for ionizing radiation dosimetry

ICRU Report 78

Prescribing, Recording, and Reporting Proton-Beam Therapy

ICRU Report 83

Prescribing, Recording, and Reporting Intensity-Modulated Photon-Beam Therapy IMRT

ICRU REPORT 84

PREGNANCY AND MEDICAL RADIATION

ICRU Report 85a-Revised

Fundamental Quantities and Units for Ionizing Radiation

ICRU Report 89

Prescribing, Recording, and Reporting Brachytherapy for Cancer of the Cervix

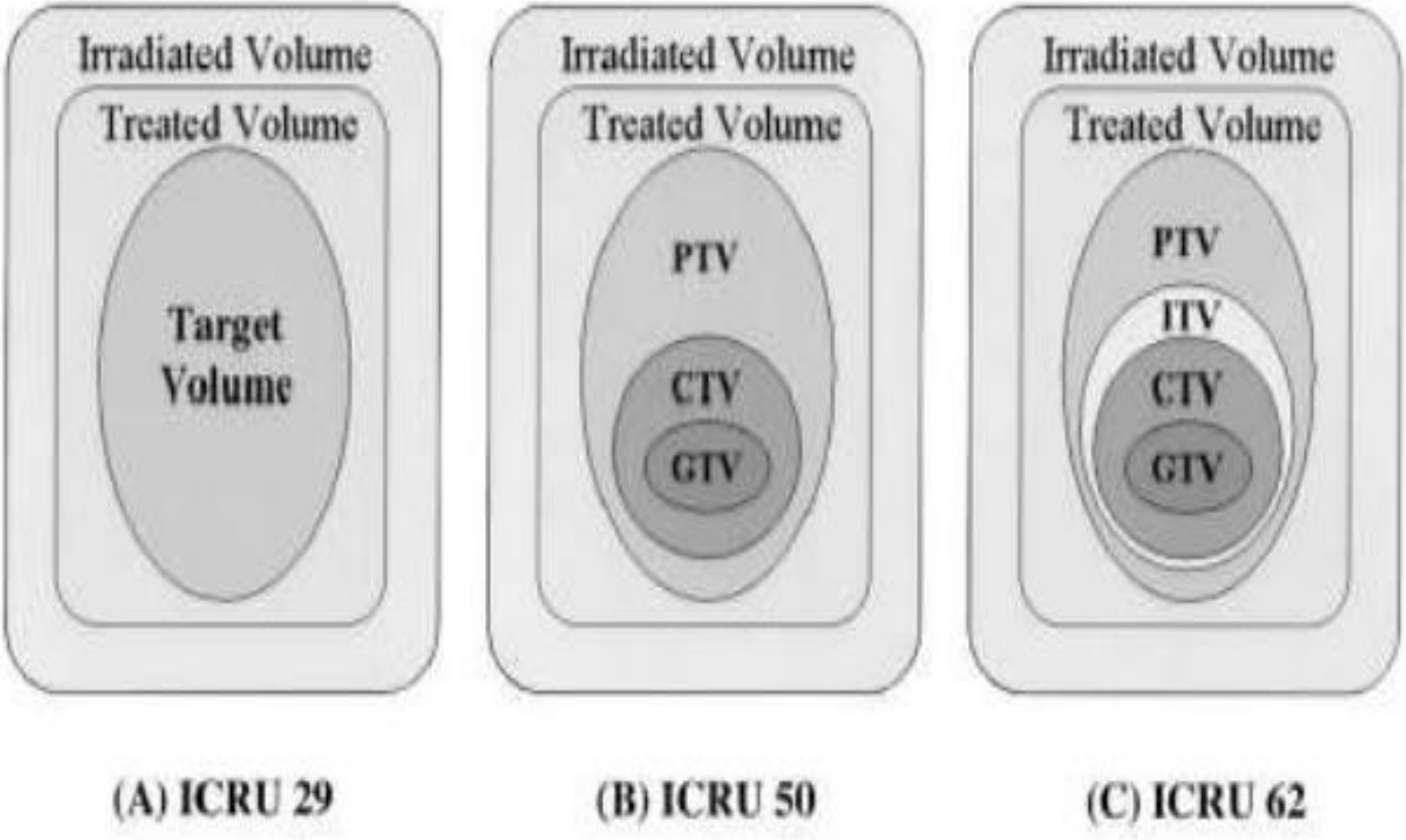
ICRU Report 91

Prescribing, Recording, and Reporting of Stereotactic Treatments with Small Photon Beams

CLASSIFICATION OF ORGANS AT RISK

- Classified as :
  - ✓ Serial – organ is a continuous unit and damage at one point will cause complete damage of the organ (spinal cord, digestive system). So even point dose is significant.
  - ✓ Parallel – organ consists of several functional units and if one part is damaged, the rest of the organ makes up for the loss (lung, bladder). Dose delivered to a given volume or average/mean dose is considered
  - ✓ Serial-parallel – kidney (glomerulus- parallel, tubules- serial), heart (myocardium- parallel, coronary arteries- serial).

TUMOR VOLUME DELINEATION



(A) ICRU 29 (B) ICRU 50 (C) ICRU 62

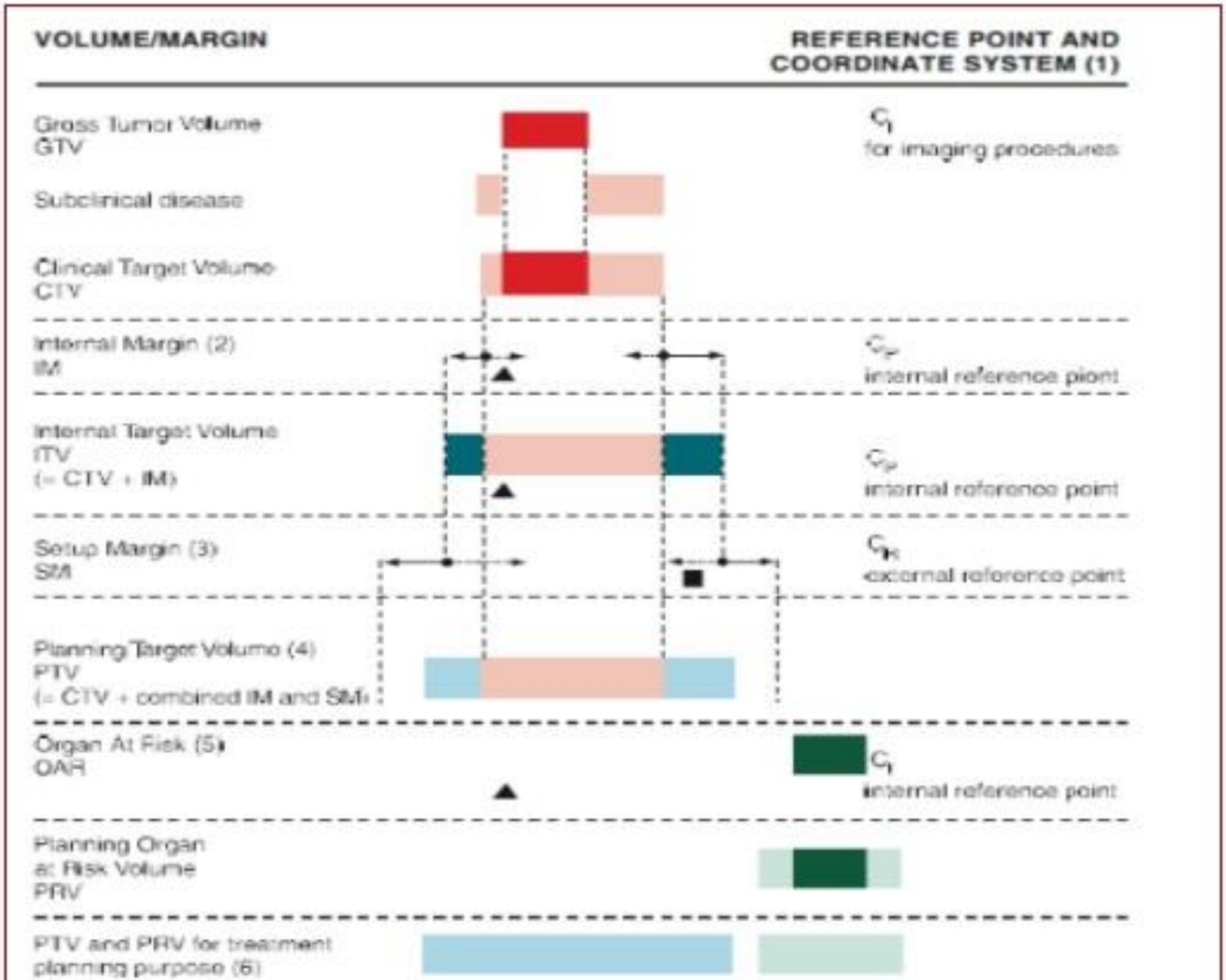


Fig. 3.21 Treatment volumes according to the ICRU-62 report

GRAPHICS

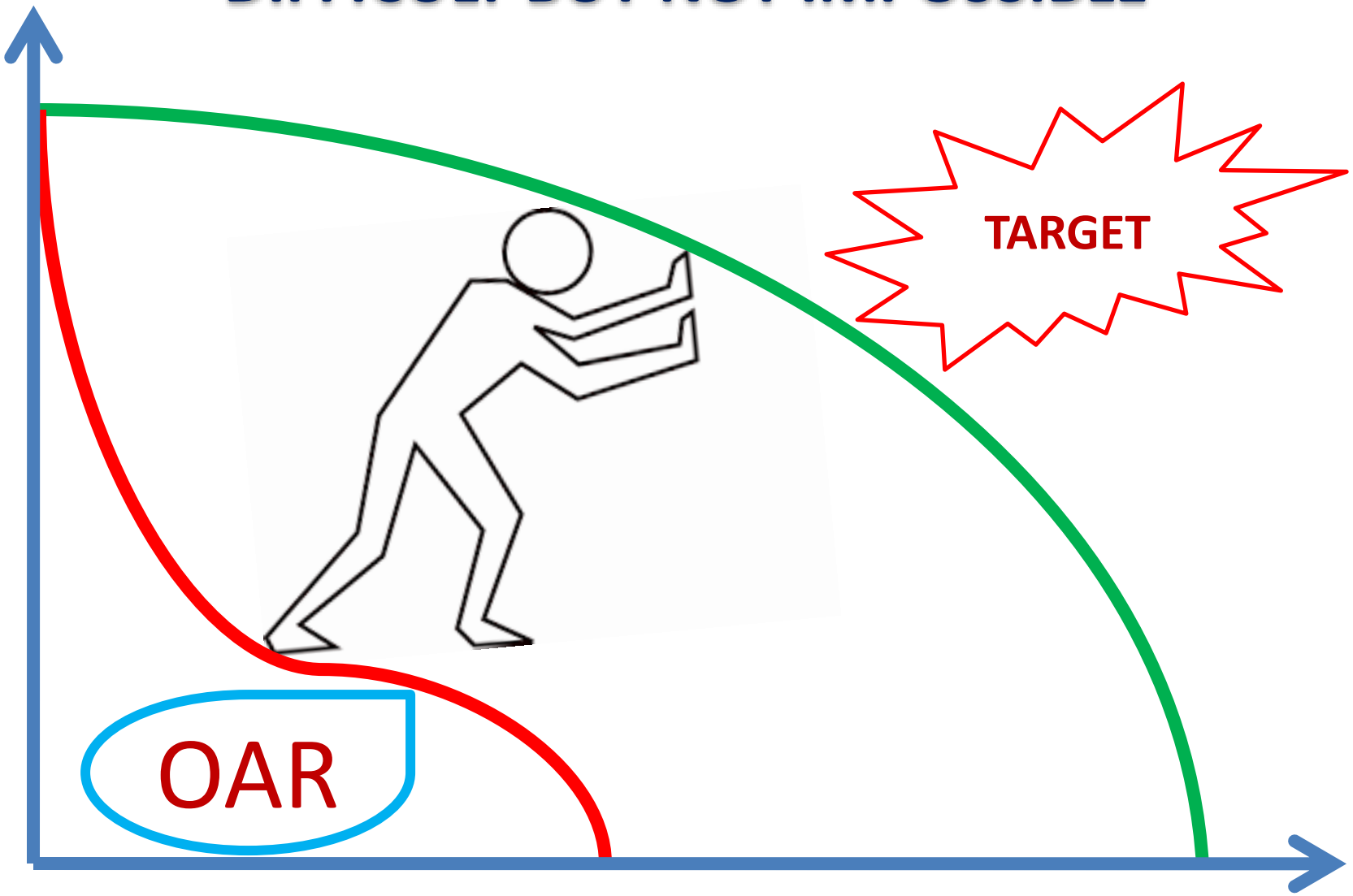
- These are used to delineate the different volumes and the other landmarks.

- These are in different colors for an easy and uniform interpretation.

- The convention recommended and used in ICRU 62 are:

  GTV - Dark Red
  CTV – Light Red
  ITV – Dark Blue
  PTV – Light Blue
  OR – Dark Green
  PRV – Light Green
  Landmarks - Black

PUSHING BACKWARD AND FORWARD AT A TIME DIFFICULT BUT NOT IMPOSSIBLE



SUMMARY

- ICRU REFINING US
- COMES WITH NEW REPORTS
- ORGANIZES US
- MANY ROLES BEYOND RADIATION
- CHARITY ORGANISATION-NON PROFITABLE
- DOING BETTER FOR BETTER TREATMENT

IGNORE *QUALIFIABLE* METRICS AND SPEND EFFORTS IN QUANTIFIABLE *MEASURES.* TO PROPERLY MEASURE SUCCESS, WE NEED TO FOCUS ON *OUTCOMES*.

LONG LIVE ICRU
LONG LIVE ICRO


ASSOCIATION OF RADIATION ONCOLOGISTS OF INDIA

Thank you for your attention!
Questions and comments are welcome!