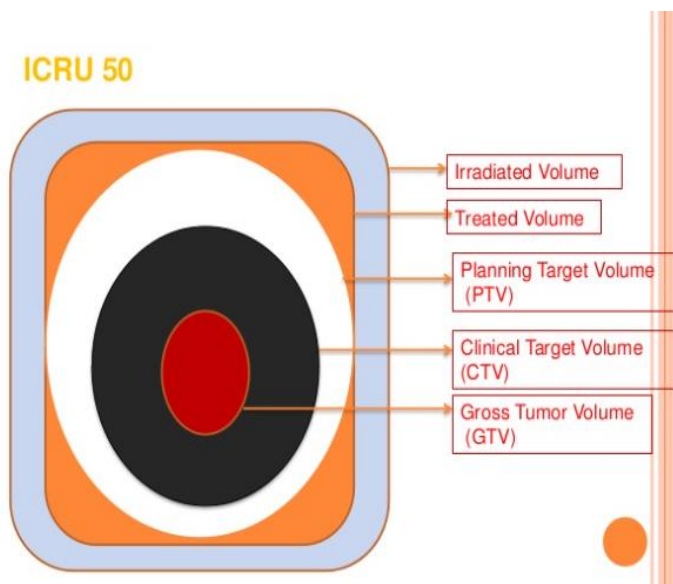


# Prescribing, Recording and Reporting Photon Beam Therapy Report 50

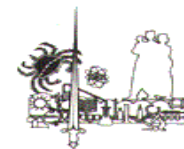


**Dr. Pooja Nandwani Patel**

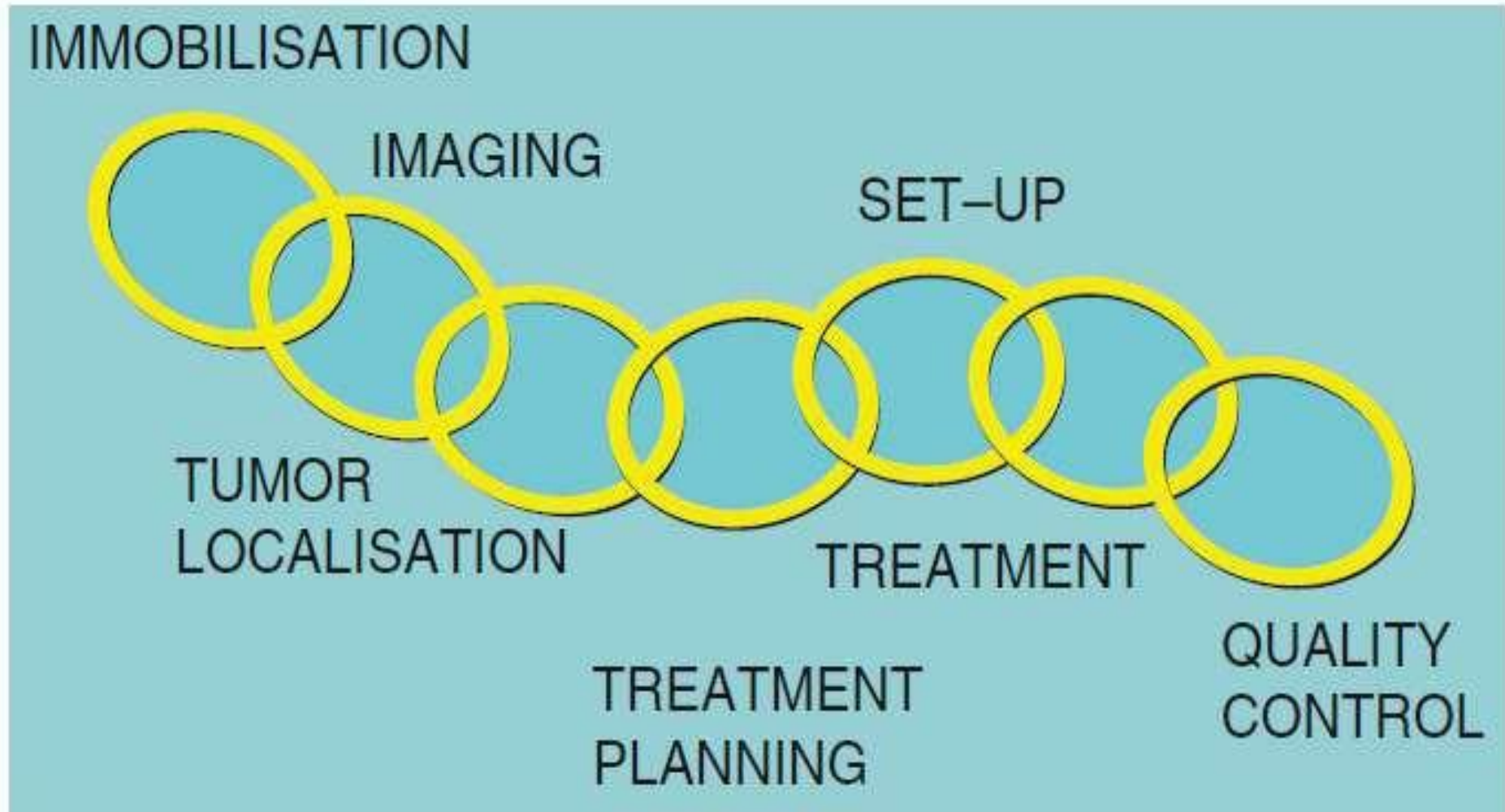
Associate Professor

Dept. of Radiation Oncology

GCRI, Ahmedabad



# STEPS IN RADIOTHERAPY



- When delivering a radiotherapy treatment, parameters such as volume and dose have to be specified for different purposes: prescription, recording, and reporting
- It is important that clear, well defined and unambiguous concepts and parameters are used for reporting purposes to ensure a common language between different centers

- originally known as the **International X-Ray Unit Committee**
- later named **International Committee for Radiological Units**
- 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
- Initially meetings were held every 3 years at ICR congresses with one physicist and one radiologist from each participating country

- 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"

# Principal objective of ICRU

**ICRU 50**

- Is to develop concepts, definitions and recommendations for the use of quantities and their units for ionizing radiation and its interaction with matter, in particular with respect to the biological effects induced by radiation

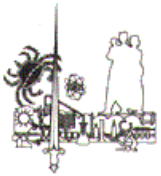
# Principal objective of ICRU

**ICRU 50**

The development of internationally accepted recommendations regarding:

- (1) quantities & units of radiation & 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

# Purpose



- To enable the radiation oncologist to maintain a consistent treatment policy and improve it in the light of experience
- To enable the radiation oncologist to compare the results of treatment with those of departmental colleagues
- To enable other radiation oncologists to benefit from the department's experience
- To compare with other centres



# History of ICRU

**ICRU 50**

## ICRU Report No: 29 (1978)

“Dose specification for reporting external beam therapy in photons and electrons

## ICRU Report – 50 (1993)

Supersedes and updates Report 29

Prescribing, Recording, and Reporting photon beam therapy

## ICRU Report – 62 (1999) Supplement to ICRU Report No: 50

## ICRU Report – 83 (2010)

Prescribing, Recording, and Reporting Photon-beam IMRT

- Even though published in the 2D era, it attempted to address spatial uncertainties by pointing out that the size and shape of a target volume may change during the course of a treatment and that one should take into account the following parameters when describing the target volume-
- 1. expected **movements** (e.g., caused by breathing) of those tissues that contain the target volume relative to anatomic reference points (e.g., skin markings, suprasternal notch)
- 2. expected **variation in shape and size** of the target volume during a course of treatment (e.g., urinary bladder, stomach)
- 3. inaccuracies or **variations in treatment setup** during the course of treatment

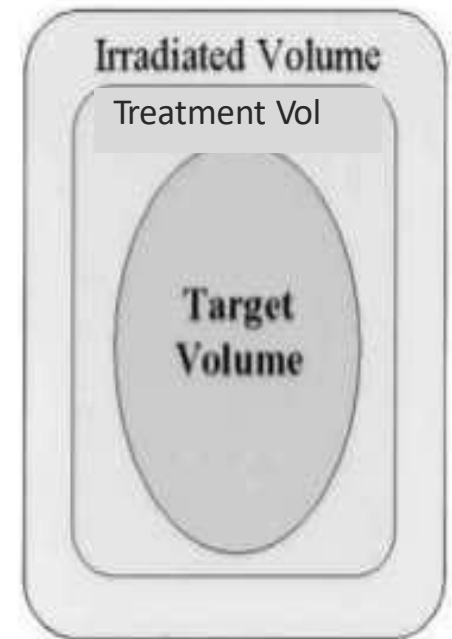
# Defined by ICRU 29

**ICRU 29**

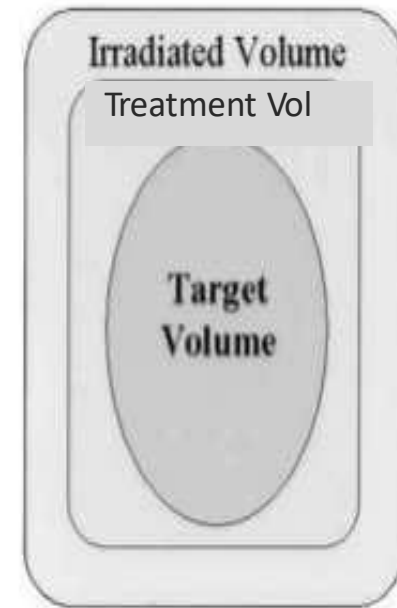
- Target Volume
- Treatment Volume
- Irradiated Volume
- Organs at Risk
- Hot Spot

# Target volume

- Volume containing those tissues that are to be irradiated to a specified absorbed dose according to a specified time-dose pattern



- **Treatment volume** –  
volume enclosed by the isodose surface  
representing the minimal target dose



- **Irradiated volume** –  
volume that receives a dose considered  
significant in relation to normal tissue  
tolerance (e.g., 50% isodose surface)

- **Defined organs at risk (OAR)** as radiosensitive organs in or near the target volume whose presence influences treatment planning and/or prescribed dose
- **Hot spot** - Tissues outside the target area that received a dose higher than 100% of the specified target dose, and was considered clinically meaningful only if the corresponding isodose curve enclosed an area of at least 2 cm<sup>2</sup> in a section

## **DRAWBACK**

- However, the report did not address the issues of coordinate systems (e.g., patient vs. treatment machine), and no attempt was made to define and explicitly separate the margins for the different types of uncertainties
- ICRU Report 29 recommendations were well suited for the technology of the 1970s and 1980s, using a conventional simulator to generate a planning radiograph for designing beam portals based on bony and soft tissue landmarks

# Prescribing, Recording, and Reporting Photon Beam Therapy

1993



INTERNATIONAL COMMISSION  
ON RADIATION UNITS  
AND MEASUREMENTS

- In 1993, the ICRU updated its recommendations for specifying dose/volume in Report 50, and were well suited for conformal therapy,
- Repeats previous recommendations, some clarified or modified




# ICRU REPORT - 50

## ICRU 50

### PRESCRIBING, RECORDING, AND REPORTING PHOTON BEAM THERAPY

When delivering a radiotherapy treatment, parameters such as volume and dose have to be specified for different purposes: prescription, recording, and reporting. The aims are –

- To have a consistent treatment policy and improve it in the light of experience
  - To be able to compare the results of treatment with those of departmental colleagues
  - Other radiation oncologists should be able to benefit from the department's experience
  - The results to be meaningfully compared with those of other centers, without having access to the complete data
- 

## AIM

- **Radical treatment of Malignant disease:-**
  - To achieve permanent tumor control
  - Volumes to be treated is tumor and the expected subclinical disease.
  
- **Palliative treatment of Malignant disease**
  - To decrease symptoms
  - May include all or only part of the tumor

\*Non malignant disease - may or may not include all of the affected tissues eg irradiation of dermatoses

## DESCRIBED VOLUMES

- Gross target volume
- Clinical target volume

Defined prior  
to T/t  
planning

- Planning target volume
- Organs at risk

During T/t  
planning

- Treated volume
- Irradiated volume

Depends on the  
T/t technique

# GROSS TUMOR VOLUME ( GTV )

## Definition

Gross demonstrable extent and location of the malignant growth.

- It consists of :
  - Primary tumor(GTV primary)
  - Metastatic lymphadenopathy(GTV nodal)
  - Other metastasis(GTV M)
- If the tumor has been removed prior to radiotherapy then no GTV can be defined.





## Determination of shape, size and location of the GTV

- Clinical examination

(Inspection, palpation, endoscopy)

- Various imaging techniques

- X-ray, CT

- USG

- MRI

- Radionucleotide methods like PET

- Reasons to describe GTV accurately

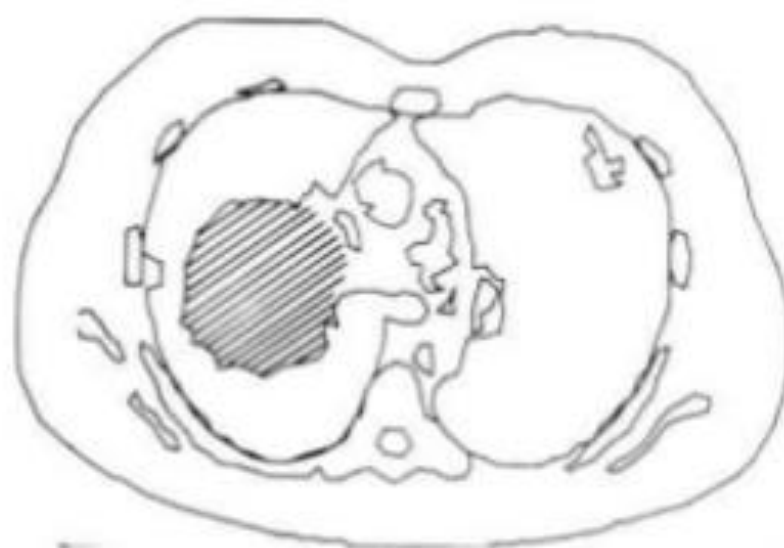
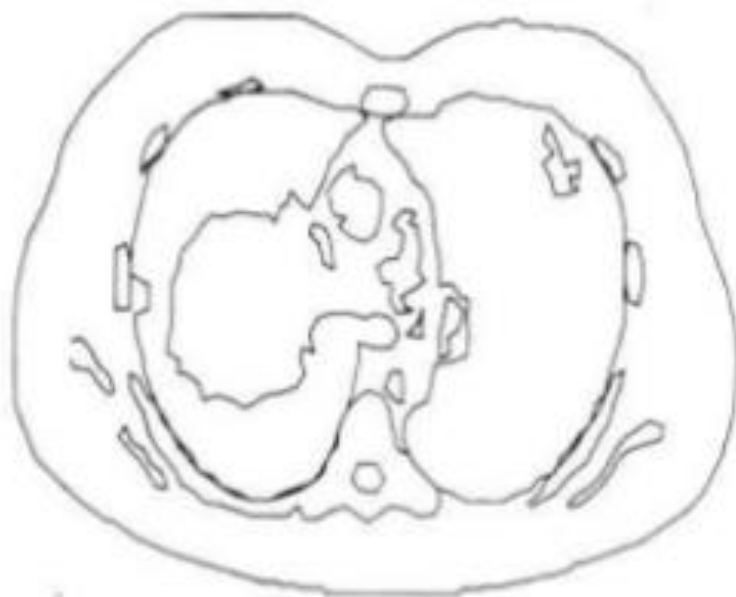
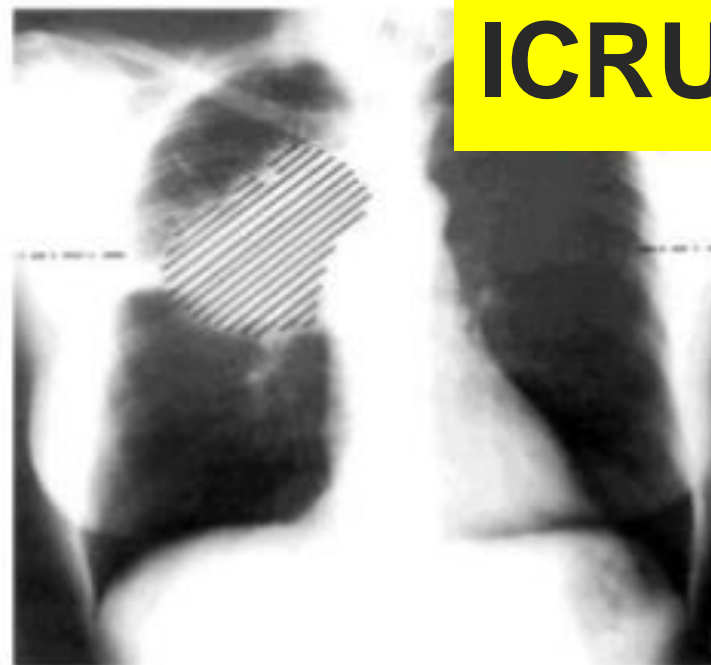
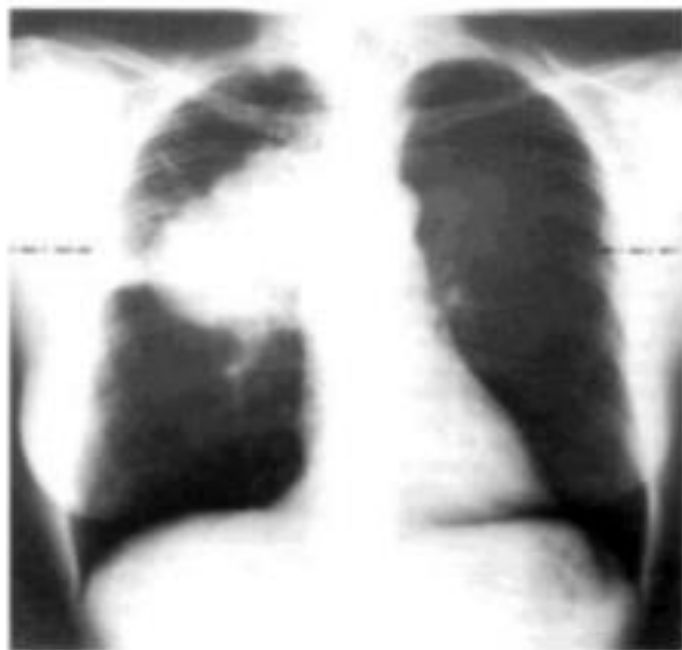
- Staging of the tumor according to the TNM.

- To define area requiring adequate dose delivery for treatment

- Regression of GTV used as predictive of tumor response



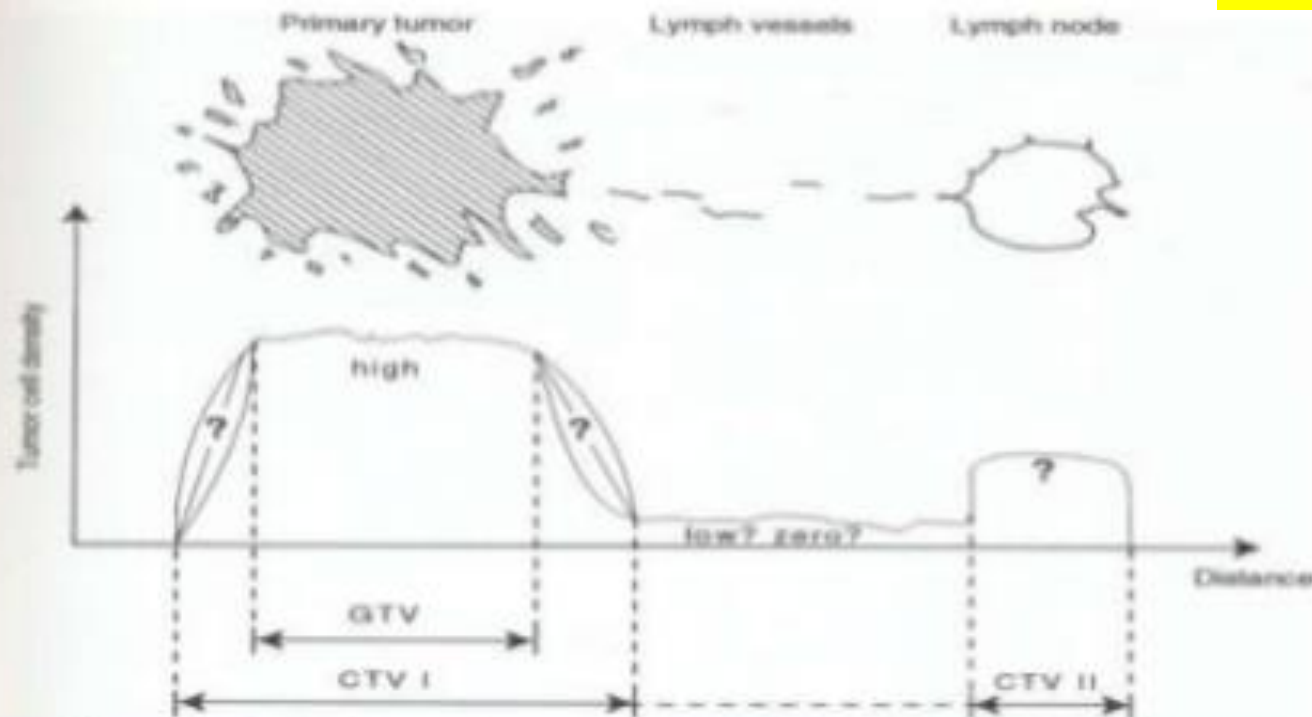
- Corresponds to those parts of the malignant growth where the tumor density is largest
- If the tumor has been removed prior to radiotherapy then no GTV can be defined



- tissue volume that contains a GTV and/or subclinical microscopic disease, which has to be eliminated



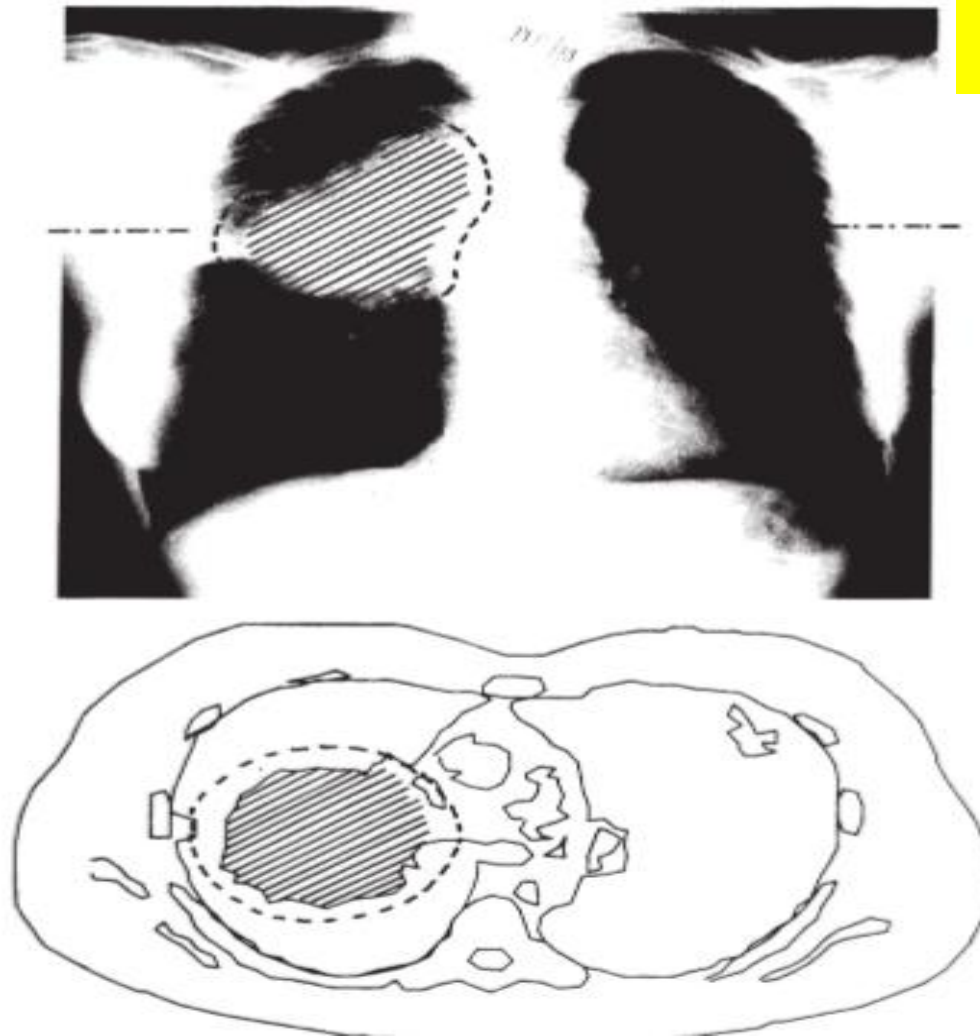
- In specifying the CTV, the physician must not only consider **microextensions** of the disease near the GTV, but also the **natural avenues of spread** for the particular disease and site, including lymph node, perivascular, and perineural extensions



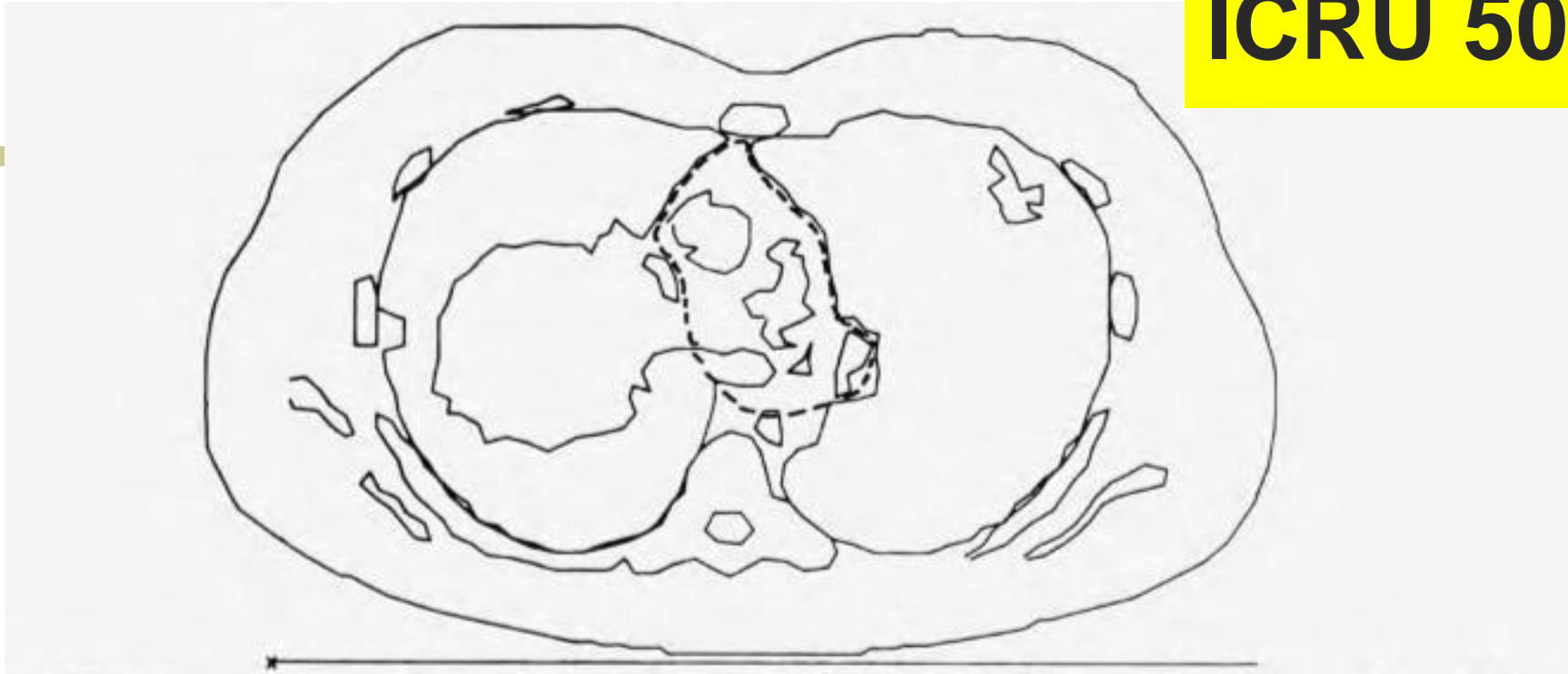
## 2 types of Subclinical extension:-

- Around the GTV-CTV I
- At a distance (Regional lymph nodes)-CTV II

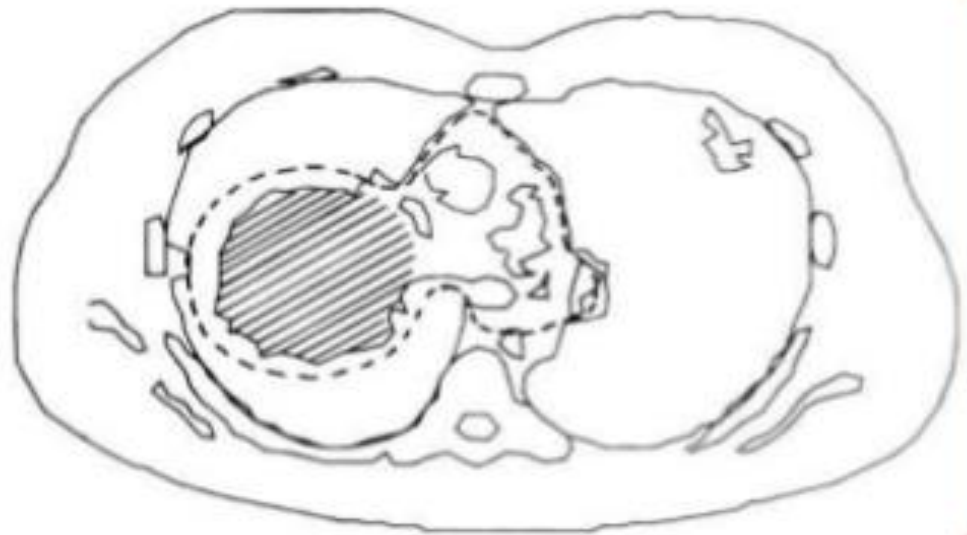
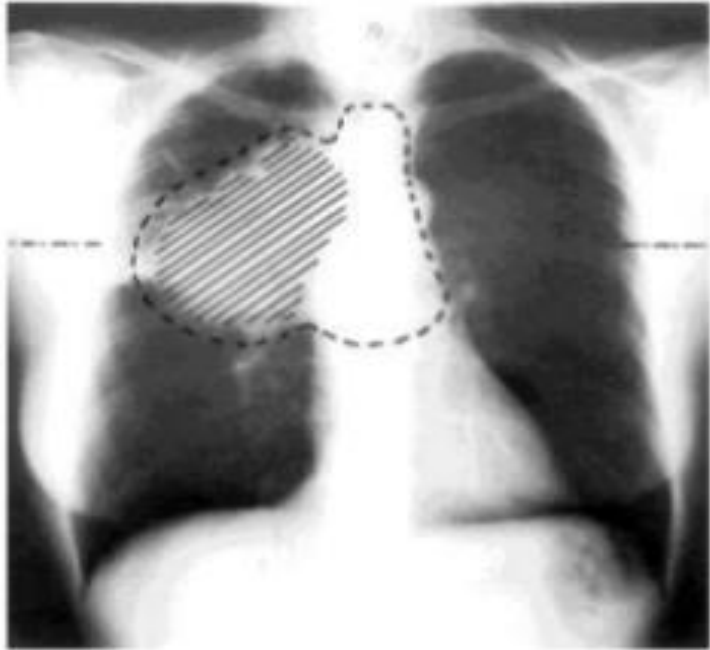




**Local subclinical involvement around GTV - CTV I**



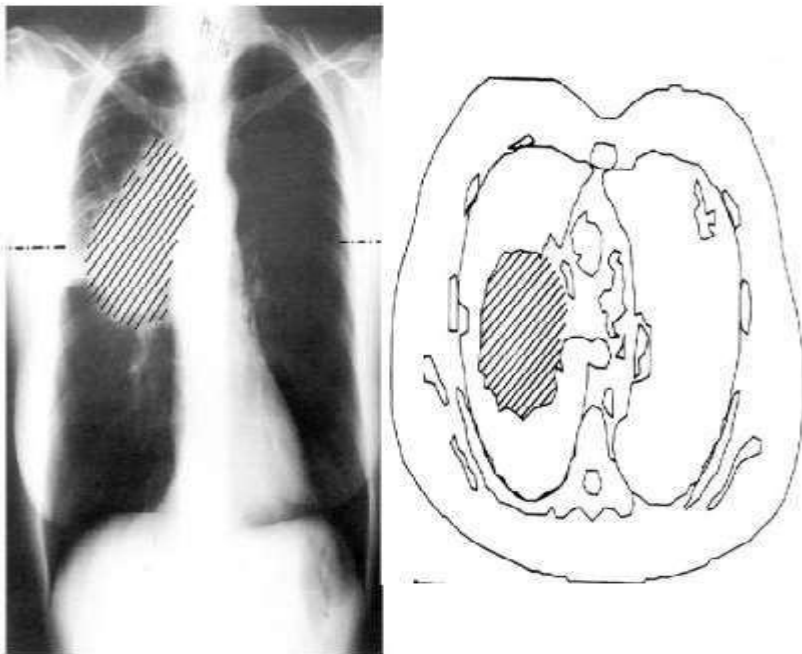
**Mediastinal lymph nodes & medial part  
of contralateral hilar region - CTV II**



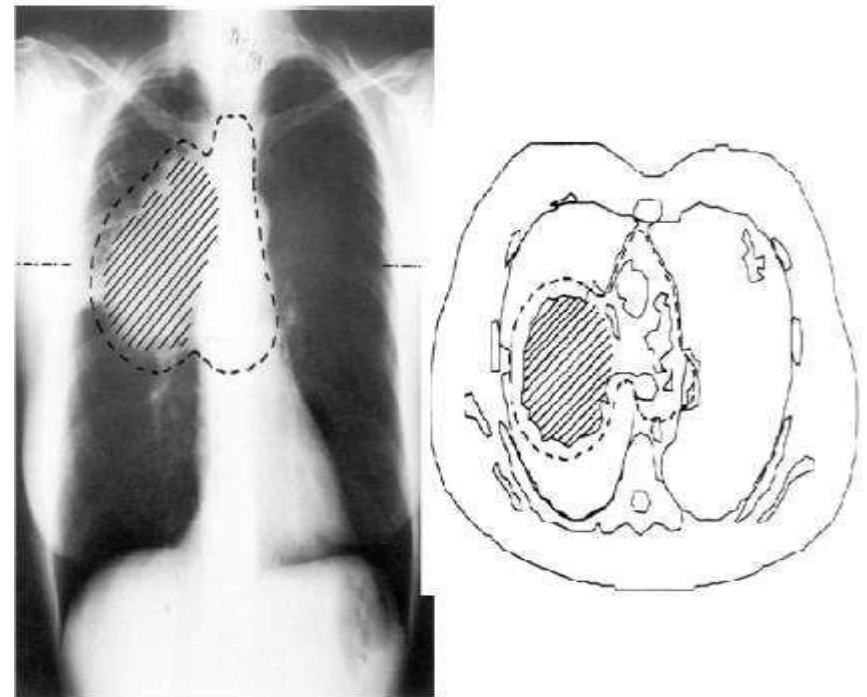
Combined CTV I + CTV II

The delineation of GTV and CTV are based on purely anatomic-topographic and biological considerations without regard to technical factors of treatment.

**GTV**



**CTV**



## **Importance of CTV**

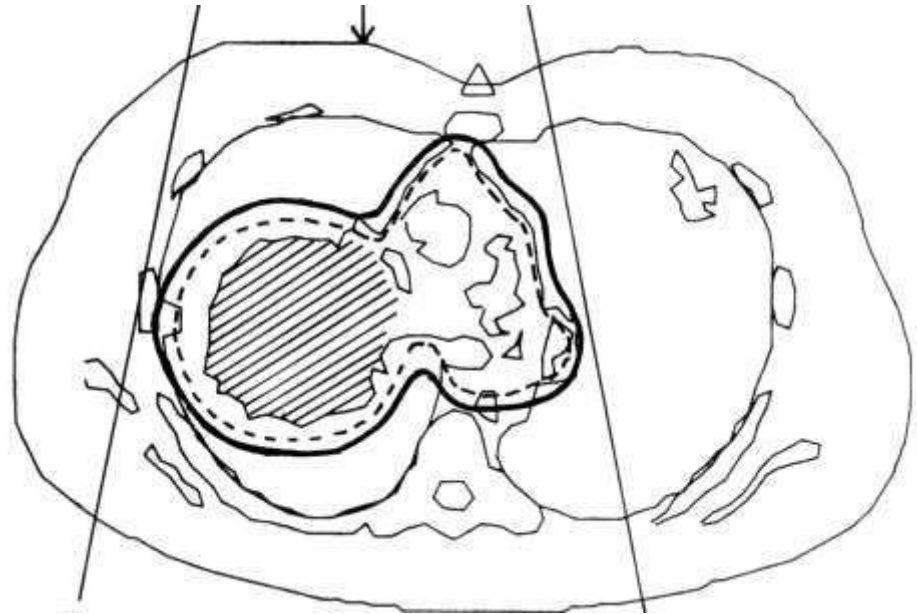
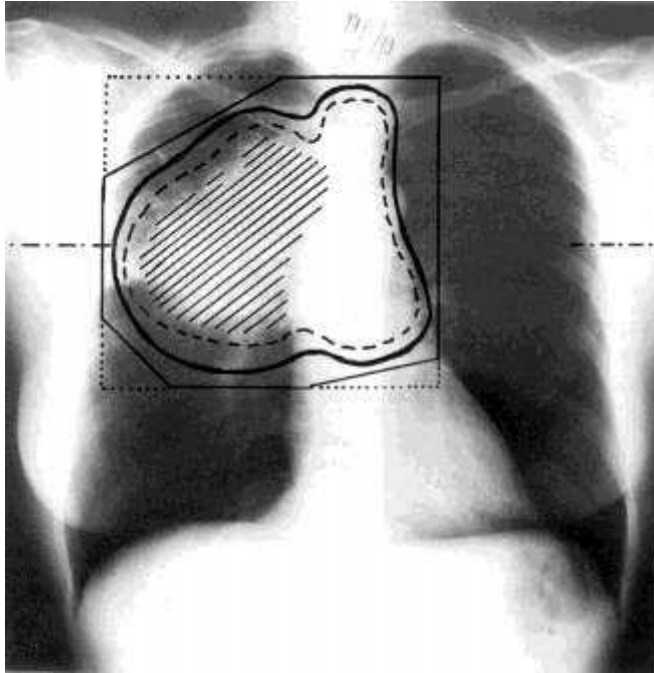
- If different doses are prescribed, this implies the definition of different CTV for different dose level. Eg. boost therapy, breast cancer
- If there is change in size, shape and location of CTV during treatment there may be need or replanning

- ❑ The PTV is a geometrical concept, and it is defined to select appropriate beam sizes and beam arrangements, taking into consideration the net effect of all the possible geometrical variations and inaccuracies in order to ensure that the prescribed dose is actually delivered to the CTV
- ❑ Affected by:
  - ❑ Size and shape of the GTV & CTV
  - ❑ Effects of internal motions of organs and the tumor
  - ❑ Treatment technique (beam orientation and patient fixation, daily setup errors)
  - ❑ Intrafractional errors (During a single session)
  - ❑ Interfractional errors (From one session to another)

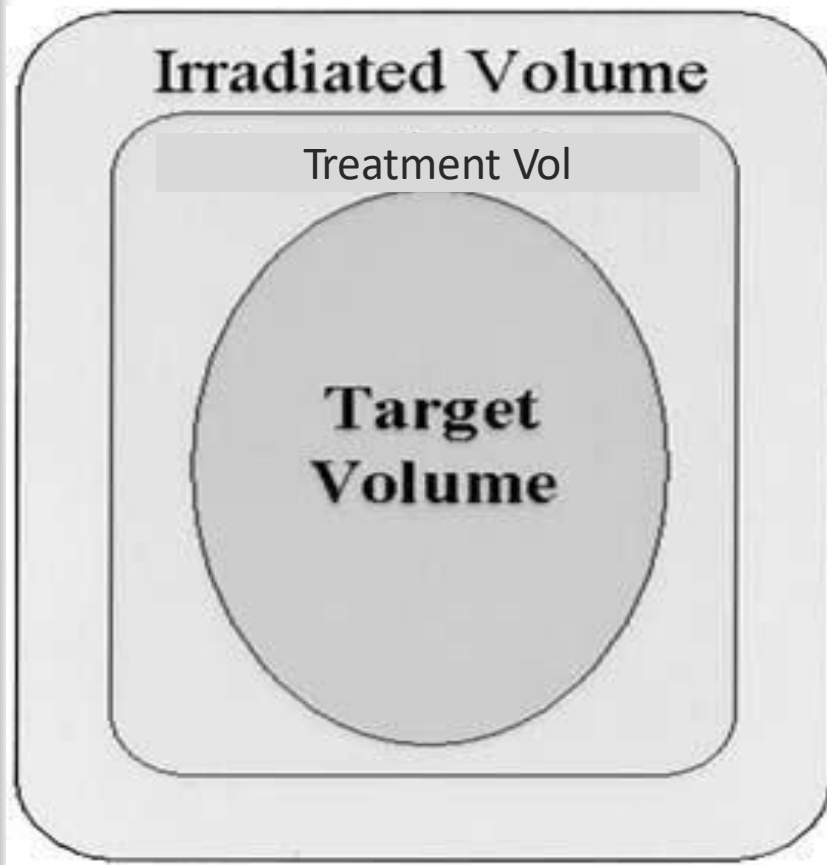


**PTV**

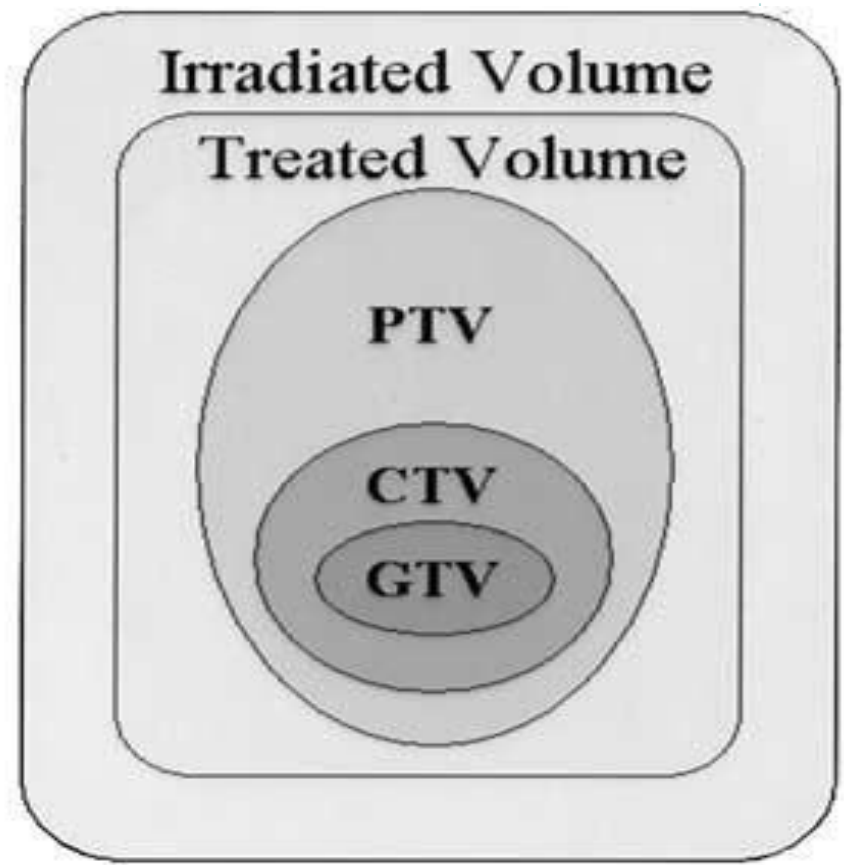
**ICRU 50**



- Multiple PTVs may be defined for a patient's radiation therapy treatment
- For example, it is common practice to plan a higher dose to PTV enclosing the GTV, and a lower dose to the PTV containing the CTV
- Such planning volumes are typically subscripted using the dose level prescribed; for example, PTVs for 66 Gy and 54 Gy can be represented as PTV<sub>66</sub> and PTV<sub>54</sub>



**(A) ICRU 29**



**(B) ICRU 50**

PTV (ICRU 50) synonymous - Target Volume (ICRU 29)

- Depending on clinical situation and chosen technique PTV could be very similar to CTV
- Eg
- Small skin tumors, pituitary tumors
- Larger - Eg Lung tumors

## TREATED VOLUME

### Definition:-

- It is the volume enclosed by an isodose surface that is selected and specified by the radiation oncologist as being appropriate to achieve the purpose of treatment (palliation or cure).
- Usually taken as the volume enclosed by the 95% isodose curve.
- Ideally dose should be delivered only to the PTV but due to limitations in the radiation treatment technique.



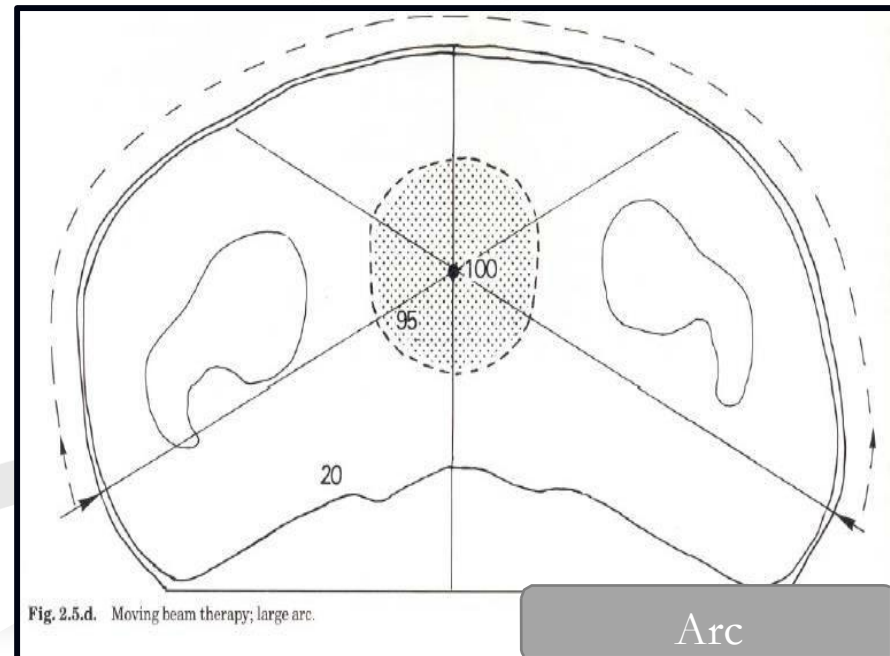
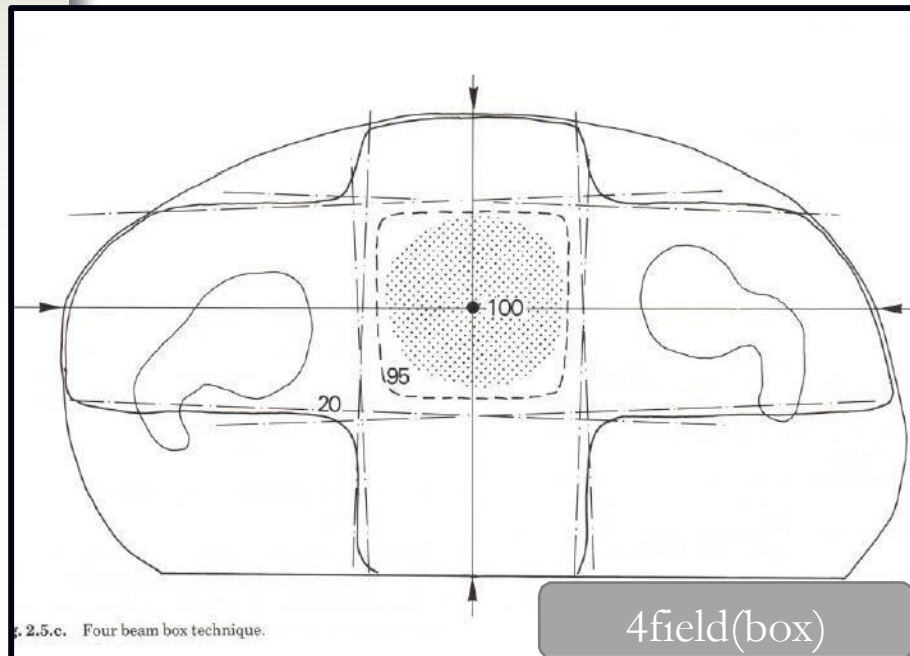
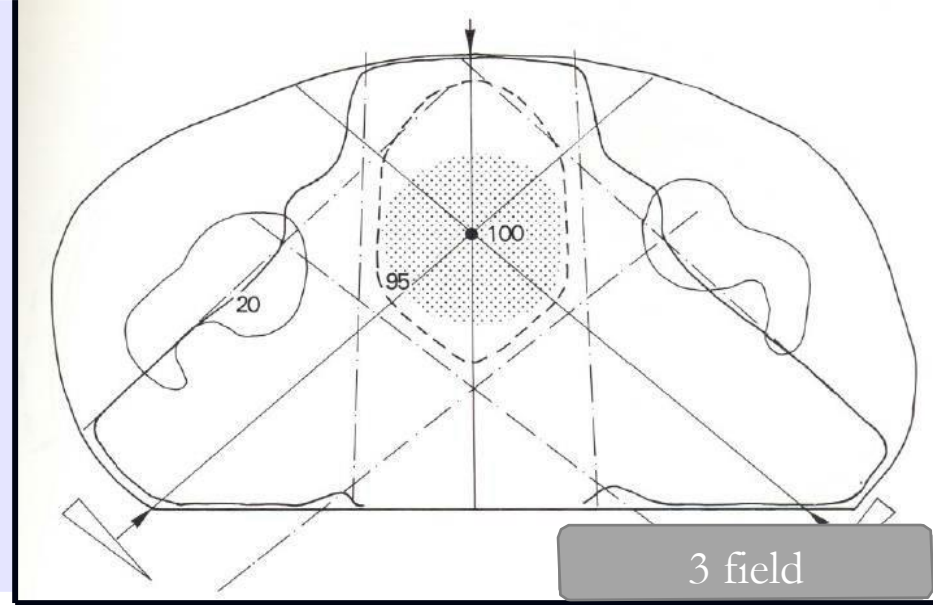
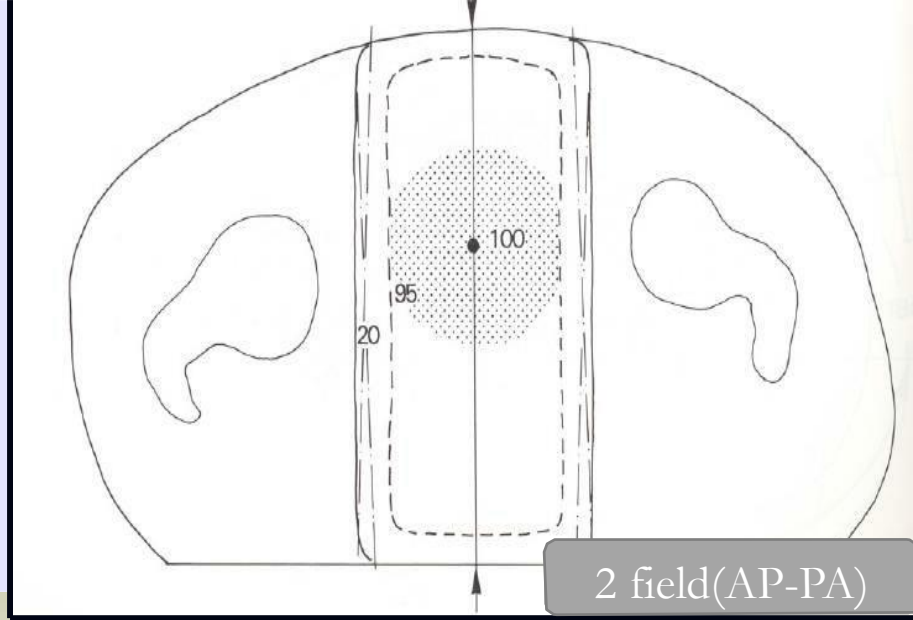


Fig. 2.5.c. Four beam box technique.

Fig. 2.5.d. Moving beam therapy; large arc.



## Reasons for identification of Treated Volume are :

1. The shape and size of the Treated Volume relative to the PTV is an important optimization parameter.
2. Recurrence within a Treated Volume but outside the PTV may be considered to be a “true”, “in-field” recurrence due to inadequate dose and not a “marginal” recurrence due to inadequate volume.

# **IRRADIATED VOLUME (IRV)**

---

- ❑ It is the volume that receives a dose considered significant in relation to normal tissue tolerance
- ❑ Usually taken as the volume enclosed by the 50% isodose curve
- ❑ It depends on the treatment technique used



- ICRU Report 50 retained the definition of the two dose volumes defined in ICRU Report 29
- changing the treatment volume name to **treated volume**, and refining the definition-- *volume enclosed by an isodose surface, selected and specified by the radiation oncologist as being appropriate to achieve the purpose of treatment (e.g., tumor eradication, palliation)*
- **irradiated volume** as that *tissue volume that receives a dose that is considered significant in relation to normal tissue tolerance*

- The **hot spot** definition was modified
  - volume outside the PTV that received a dose larger than 100% of the specified PTV dose  
;considered clinically meaningful only if the minimum diameter exceeded 15 mm (note: previously it had been 2 cm<sup>2</sup>)
  - However, if the hot spot occurs in a small organ, such as the optic nerve, a dimension smaller than the recommended 15 mm should be considered

## **ORGANS AT RISK ( OAR )**

- These are normal tissues whose radiation sensitivity may significantly influence the treatment planning and/or prescribed dose
- They may be divided into 3 classes :
  - Class I : Radiation lesions are fatal or result in severe morbidity
  - Class II : Radiation lesions result in mild to moderate morbidity
  - Class III : Radiation lesions are mild, transient, and reversible, or result in no significant morbidity

# Dose Homogeneity

- When the dose to a given volume has been prescribed, then the corresponding delivered dose should be as homogeneous as possible
- Some heterogeneity has to be accepted due to obvious technical reasons - should be kept within +7% and -5% of prescribed dose
- If such a degree of homogeneity cannot be achieved, it is the responsibility of the radiation oncologist to decide whether this can be accepted or not

# ICRU REFERENCE POINT

## ICRU 50

- It has to be selected according to the following general criteria :
- The dose at the point should be clinically relevant
- The point should be easy to define in a clear and unambiguous way
- The point should be selected so that the dose should be accurately determined
- The point should be in a region where there is no steep dose gradient

- Located firstly at the center or in the central parts of the PTV and secondly on or near the central axis of the beam
- Sometimes not in the centre of PTV then the place where the tumor density is at its maximum
- The dose at the ICRU Reference Point is the ICRU Reference Dose

## **$D_{\max}$ & Hot spot**

- ❑ One can identify the maximum dose within the PTV, and the maximum dose at tissue outside the PTV - Hot Spot
- ❑ In most cases, high dose to a volume with smallest diameter <15mm is not clinically meaningful in terms of normal tissue tolerance
- ❑ However, maximum dose assessment is important for organs at risk with small dimension (<15mm) such as optic nerve

# Minimum Dose ( $D_{\min}$ )

ICRU 50

- The minimum dose is the smallest dose in a defined volume
- In contrast to the situation with the maximum absorbed dose, no volume limit is recommended when reporting minimum dose
- The Minimum Planning Target Dose is the lowest dose in the Planning Target Volume.



# Average Dose ( $D_{\text{average}}$ )

ICRU 50

- The determination of the average, the median and modal doses is based on the calculation of the dose at each one of a large number of discrete points (lattice points), uniformly distributed in the volume in question
- The Average Dose is the average of the dose values in these lattice points and can be expressed by

- Equation

$$D_{average} = \frac{1}{N} \sum_V D_{ij,k}$$

- where N is the number of lattice points, i is the column index in this lattice, j is the row index, k is the level index, and  $D_{ij,k}$  is the dose at the lattice point  $ij,k$  located inside the volume V

## **Median Dose: $D_{\text{median}}$**

The median dose is the central value of the doses at all lattice points

## **Modal Dose: $D_{\text{modal}}$**

The dose that occurs most frequently at the lattice points

**\*\*** There may be more than one modal dose value, which then makes this concept useless for reporting purpose

- The level of completeness and accuracy of reporting therapeutic irradiation depends to a large extent on the situation in the department and on the aim of the treatment

- Level 1 –BASIC TECHNIQUE –
- Minimum standards, 2-D reporting (using depth dose tables)
- According to the recommendations of ICRU, as a basic requirement, the following doses should always be reported
  - the dose at ICRU reference point and its variation along central beam axis
  - the maximum dose to the PTV
  - the minimum dose to the PTV



- ✓ **Level 2 – ADVANCED TECHNIQUE** -prescribing and reporting state-of-the-art techniques (using computational dosimetry and 3D imaging)
  - ✓ Dose distribution computed for planes
- ✓ **Level 3 – DEVELOPMENTAL TECHNIQUE** -optional research-and-development reporting (using techniques for which reporting criteria are not yet established)
  - ✓ Dose distributio computed for volumes

[Home](#)[About ICRU](#)[Commissioners](#)[Activities](#)[Reports](#)[Related Orgs](#)[ICRU News](#)[Contact ICRU](#)

## 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](#)

[ICRU Report 89, Prescribing, Recording, and Reporting Brachytherapy for Cancer of the Cervix](#)

### 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 Lecture](#)

[H.H. Rossi Lecture given by Hans Menzel](#)

### 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 diagnosis and therapy, radiation science and technology, and radiation protection of individuals and populations.

[ICRU at a Glance \(PDF\) »](#)  
[More About ICRU »](#)

Activate Windows  
Go to Settings to activate Windows.

**CONTACT:**

**Thomas (Rock) Mackie**  
(Secretary)

**David Schauer**  
(Executive Secretary)

**Laura Atwell**  
(Assistant Executive Secretary)

# International Commission on Radiation Units and Measurements

7910 Woodmont Avenue, Suite 400, Bethesda, MD 20814-3095, USA

Tel: +1-301-657 2652 • Fax: +1-301-907 8768

Web: [www.icru.org](http://www.icru.org) • Email: [icru@icru.org](mailto:icru@icru.org)

## HISTORY

The ICRU (originally known as the International X-Ray Unit Committee and later as the International Committee for Radiological Units) 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. 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. 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. The Chairman was nominated by the ICR host country. A permanent Commission was elected in 1953.

L S Taylor (USA) served ICRU as a member [1928 – 1934] and then Secretary [1934 – 1953], first permanent Chairman [1953 – 1969] and then Honorary Chairman [1969 until his death in 2004]. Subsequent ICRU Chairmen have been: H O Wyckoff (USA) [1969 – 1985]; A Allisy (France) [1985 – 1997]; A Wambersie (Belgium) [1997 – 2006]; and P M DeLuca, Jr (USA) [2006 – 2009]. H-G Menzel (Germany) is the current Chairman.

## 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)

## FUNDING

Income is currently derived mainly from the sale of ICRU Reports. Financial



A Wambersie (Belgium) [1997 – 2006]; and P M DeLuca, Jr (USA) [2006 – 2009]. H-G Menzel (Germany) is the current Chairman.

## 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.

## AIMS

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

## 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*

## FUNDING

Income is currently derived mainly from the sale of ICRU Reports. Financial support is provided by the International Atomic Energy Agency and there are also contributions from national and international organisations and professional societies, as well as commercial companies. Indirect monetary support is provided by organizations that host meetings and subsidize personnel who are members of ICRU (salaries and travel expenses) to participate in ICRU activities. All Commissioners, Report Committee members and consultants serve without compensation. Funds are expended for administrative purposes, to maintain a part-time secretariat and to provide reimbursement for travel expenses.

## REPORT COMMITTEES

The Commission is assisted at any given time by several Report Committees, composed of expert voluntary members who are selected to produce reports on specific topical subjects. Voluntary consultants with specialized knowledge of particular issues are often appointed to assist the Report Committees. These ICRU reports are premier international authoritative reference sources for medical radiation procedures and for providing specifications and measuring standards in industrial, environmental and other uses of radiation and in radiation protection.

Two reports per year are published as the *Journal of the ICRU* by Oxford University Press. ICRU recommendations are often adopted by governments, national statutory bodies and international associations and organizations.

## ICRU REPORTS

([www.jicru.oxfordjournals.org](http://www.jicru.oxfordjournals.org))

OXFORD  
UNIVERSITY PRESS

## RECENTLY PUBLISHED REPORTS

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).

## 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 Imaging)

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)

## ICRU REPORTS

([www.jicru.oxfordjournals.org](http://www.jicru.oxfordjournals.org))

OXFORD  
UNIVERSITY PRESS

### 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)

### REPORTS IN PREPARATION

- Prescribing, Recording, and Reporting Ion-Beam Therapy
- Prescribing, Recording, and Reporting Stereotactic Treatments with Small Photon Beams



## ICRU Commission Meeting 31 March – 4 April, 2017 Mexico City, Mexico



- Bioeffect Modeling and Equieffective Dose Concepts in Radiation Therapy
- Operational Quantities for External Radiation Exposure
- Monitoring of Radiation Releases into the Environment
- Retrospective Assessment of Individual Doses for Acute Exposures to Ionizing Radiation

### EVOLUTION OF RADIATION UNITS (ICRU RECOMMENDATIONS)

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 <sup>-1</sup>			1950
Activity	A	3.7 × 10 <sup>10</sup> s <sup>-1</sup>	curie	Ci	1953
Absorbed dose	D	100 erg g <sup>-1</sup>	rad	rad	1953
Fluence	Φ	cm <sup>-2</sup> or m <sup>-2</sup>	(reciprocal area)	(SI)	1962
Dose equivalent	H	100 erg g <sup>-1</sup>	röntgen equivalent man	rem	1971
Absorbed dose	D	J kg <sup>-1</sup>	gray	Gy (SI)	1974
Activity	A	s <sup>-1</sup>	becquerel	Bq (SI)	1974
Dose equivalent	H	J kg <sup>-1</sup>	sievert	Sv (SI)	1977

# ICRU Reports

ICRU Reports are distributed by the ICRU Publications' office. Information on prices and how to order may be obtained from:

ICRU Publications  
7910 Woodmont Avenue, Suite 800  
Bethesda, Maryland 20814  
U.S.A.  
Phone: (301) 657-2652  
FAX: (301) 907-8768  
Email: [icru@icru.org](mailto:icru@icru.org)  
On line: <http://www.icru.org>

Copies of the reports may also be purchased from the following:

Mrs. Brigitte Harder  
Konrad-Adenauer-Straße 26  
D-37075 Göttingen  
Germany  
Phone (0551) 22612

Kazuya Yamashita, Ph.D.  
The Japanese Society of Radiological Technology  
Nijyo Plaza, 88 Nishinokyo,  
Kitatsuboi-cho,  
Nakagyo-ku, Kyoto 604  
Japan

Prof. André Wambersie  
Unité de Radiobiologie et Radioprotection  
UCL-Cliniques St. Luc  
Avenue Hippocrate, 54.69  
B-1200 Brussels, Belgium  
Phone (32) 51 20 54 69

Dr. Minoru Takada  
Japan Radioisotope Association  
28-45, Honkomagome 2-chome  
Bunkyo-ku Tokyo 113, Japan

Dr. Torgil Möller  
Regionala Tumörregistrat  
Lasarettet  
22 185 Lund  
Sweden

Binders for ICRU Reports are available. Each binder will accommodate from six to eight Reports, carry the identification, "ICRU Reports", and come with label holders which permit the user to show the Reports contained in each binder.

# ICRU 50

The following bound sets of ICRU Reports are also available:

- Volume I. ICRU Reports 10b, 10f
- Volume II. ICRU Reports 12, 13, 15, 16, 17, 18, 20
- Volume III. ICRU Reports 22, 23, 24, 25, 26
- Volume IV. ICRU Reports 27, 28, 30, 31, 32
- Volume V. ICRU Reports 33, 34, 36
- Volume VI. ICRU Reports 37, 38, 39, 40, 41
- Volume VII. ICRU Reports 42, 43, 44
- Volume VIII. ICRU Reports 45, 46, 47
- Volume IX. ICRU Reports 48, 49, 50, 51
- Volume X. ICRU Reports 52, 53, 54, 55

(Titles of the individual Reports contained in each volume are given in the list of Reports set out above.)

The following ICRU Reports are now superseded and/or out of print:

<i>ICRU Report No.</i>	<i>Title and Reference*</i>
1	<i>Discussion on International Units and Standards for X-ray work, Br. J. Radiol. 23, 64 (1927).</i>
2	<i>International X-Ray Unit of Intensity, Br. J. Radiol. (new series) 1, 363 (1928).</i>
3	<i>Report of Committee on Standardization of X-ray Measurements, Radiology 22, 289 (1934).</i>
4	<i>Recommendations of the International Committee for Radiation Units, Br. J. Radiol. 22, 500 (1929).</i>

...

...

10a

The currently available ICRU Reports are listed below.

<i>ICRU Report No.</i>	<i>Title</i>
10b	<i>Physical Aspects of Irradiation (1964)</i>
10f	<i>Methods of Evaluating Radiological Equipment and Materials (1963)</i>
12	<i>Certification of Standardized Radioactive Sources (1968)</i>
13	<i>Neutron Fluence, Neutron Spectra and Kerma (1969)</i>
15	<i>Cameras for Image Intensifier Fluorography (1969)</i>
16	<i>Linear Energy Transfer (1970)</i>
17	<i>Radiation Dosimetry: X Rays Generated at Potentials of 5 to 150 kV (1970)</i>
18	<i>Specification of High Activity Gamma-Ray Sources (1970)</i>
20	<i>Radiation Protection Instrumentation and Its Application (1970)</i>
22	<i>Measurement of Low-Level Radioactivity (1972)</i>

## 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**

**ICRU Report 89, Prescribing, Recording, and Reporting Brachytherapy for Cancer of the Cervix**

## ICRU Report 92: IN PREPARATION

## Prescribing, Recording and Reporting Ion Beam therapy

# Take home message

## ICRU 50

- For nearly 90 years ICRU has established international standards for radiation units and measurements
- Precise for each specific segment
- Refer according to your interest and need!!!!



The image features a series of concentric shapes. At the center is a solid red circle. Overlaid on this red circle is the text 'THANK YOU' in a bold, dark grey, sans-serif font. A thin horizontal line is positioned directly beneath the text. Surrounding the red circle is a thick black ring. This is followed by a white ring, then a cyan ring, and finally an outermost yellow ring. All these rings are contained within a square frame with rounded corners. The overall design is minimalist and modern.

**THANK YOU**