

# Σύγχρονες Πρακτικές Ακτινοπροστασίας Ασθενών και Προσωπικού στην Ακτινοθεραπεία

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Προϊσταμένη Τμ. Ιατρικής Φυσικής ΓΝ Πατρών «ο Άγιος Ανδρέας»



# ΑΚΤΙΝΟΠΡΟΣΤΑΣΙΑ – ΑΣΦΑΛΕΙΑ

Τι απαιτεί η νέα τεχνολογία ;

## ΒΑΣΙΚΕΣ ΑΡΧΕΣ ΑΚΤΙΝΟΠΡΟΣΤΑΣΙΑΣ

- Αιτιολόγηση
- Βελτιστοποίηση
- Περιορισμός δόσης

## ΕΚΘΕΣΗ ΣΕ ΑΚΤΙΝΟΒΟΛΙΑ

- ✓ Προσωπικού
- ✓ Κοινού
- ✓ Ασθενών

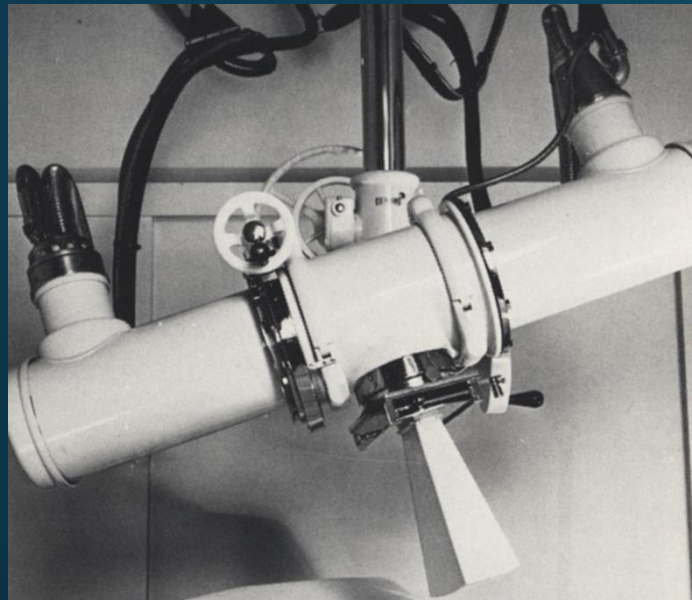
# ΕΞΕΛΙΞΗ ΑΚΤΙΝΟΘΕΡΑΠΕΙΑΣ

1895 :Roentgen - Ανακάλυψη ακτίνων Χ.

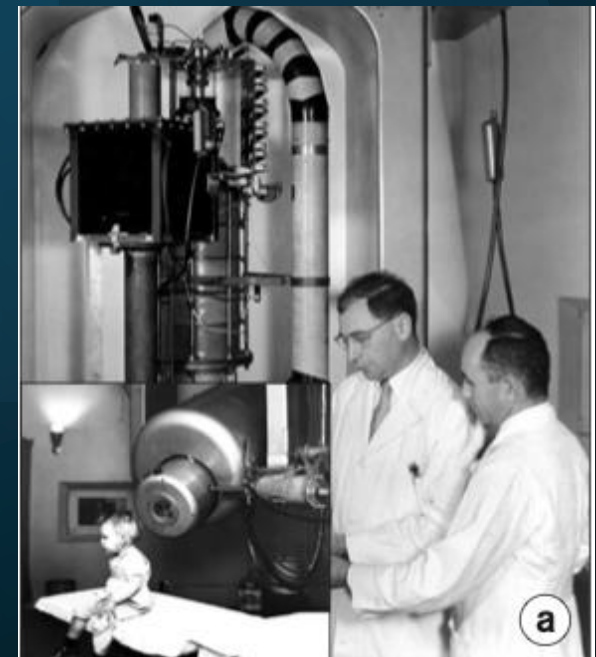
1900-1930



Orthovoltage ERA (1930-1950)



Megavoltage ERA (1950-1980)



2D - 3D

3D Conformal

Brachytherapy

IMRT / VMAT / Tomotherapy

FFF beams

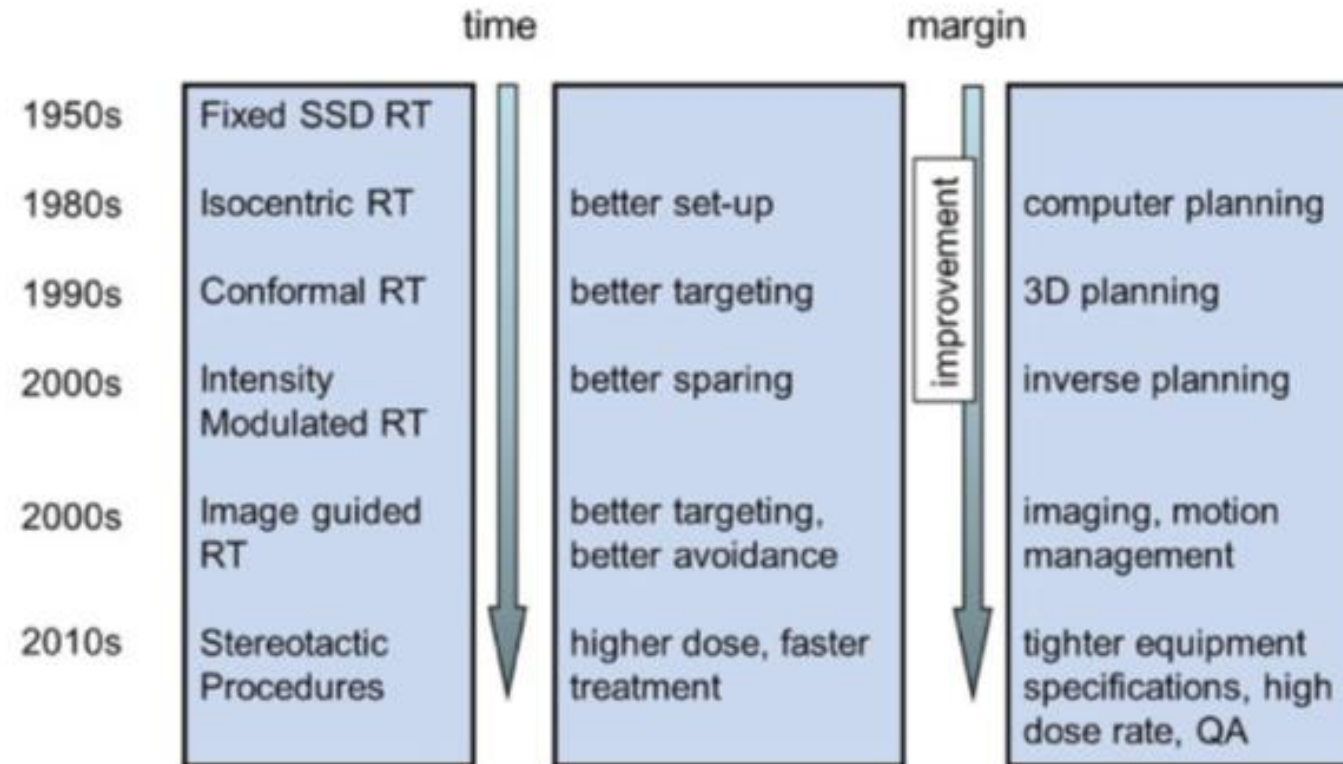
SRS- SBRT (Cyber Knife, Gamma Knife, Linac based)

Intraoperative Radiotherapy

Particle Therapy

Flash therapy

# Evolution of external beam radiotherapy



*Fig 1. Advances in radiation treatment technology in recent decades*

Advanced  
Image Guidance  
(IGRT) – Motion  
management

The diagram consists of six blue circles arranged in two rows of three. Each circle contains white text. The circles are interconnected by a network of thin white lines, forming a hexagonal grid with additional diagonal connections. The background is a dark blue gradient with a large, faint, light blue circular shape on the right side.

Artificial  
intelligence &  
Data Science

Dosimetric and  
Machine Quality  
Assurance

Inverse planning  
and dose  
optimization

Adaptive  
radiation  
therapy

Surface Guided  
Radiation  
Therapy



# SAFETY Culture

Advanced  
Image Guidance  
(IGRT) – Motion  
management

Dosimetric and  
Machine Quality  
Assurance

Inverse planning  
and dose  
optimization

Surface Guided  
Radiation  
Therapy



*“The phrase “radiation safety culture” rather than “radiation protection culture” is used as safety goes beyond protection.”*

Safety is not just the sum of rules, policies, procedures and processes. The real building blocks of safety are trust, communication and culture.

Committees Risks Guidelines Audits Education  
Training Collaboration Protection Regulations  
Issues Management Empowerment Programmes  
Information International Professionals Diversity Media  
Champions **Communication** Standards  
Nurses Teamwork Organizations Staff Enforcement Doses  
Resources Curricula Quality Patients Groups  
Research Referrers Optimization Attitude Satisfaction  
Leadership Engagement Justification Physicists  
**Awareness**

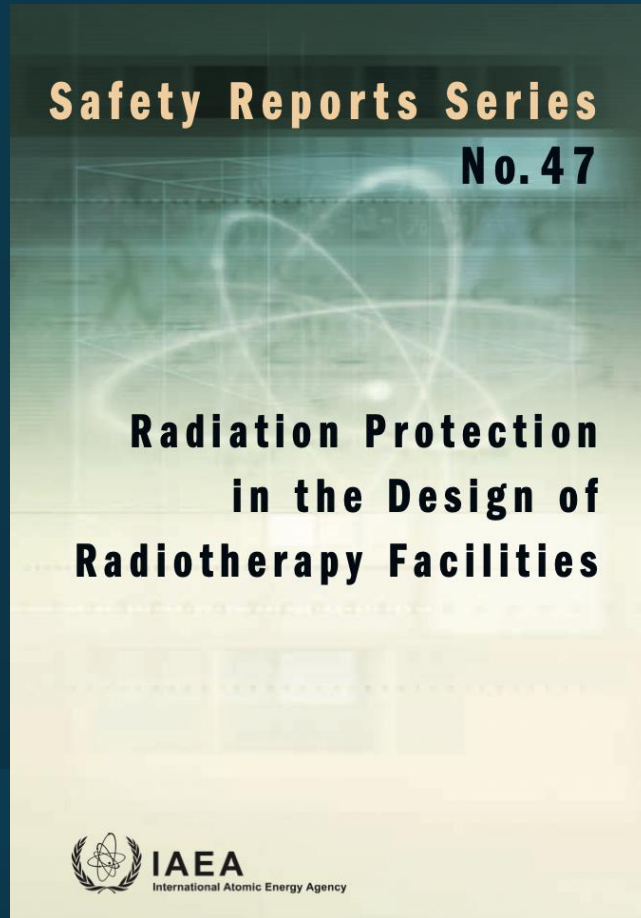
2024

# Πού εμπλέκεται ο Ακτινοφυσικός ?

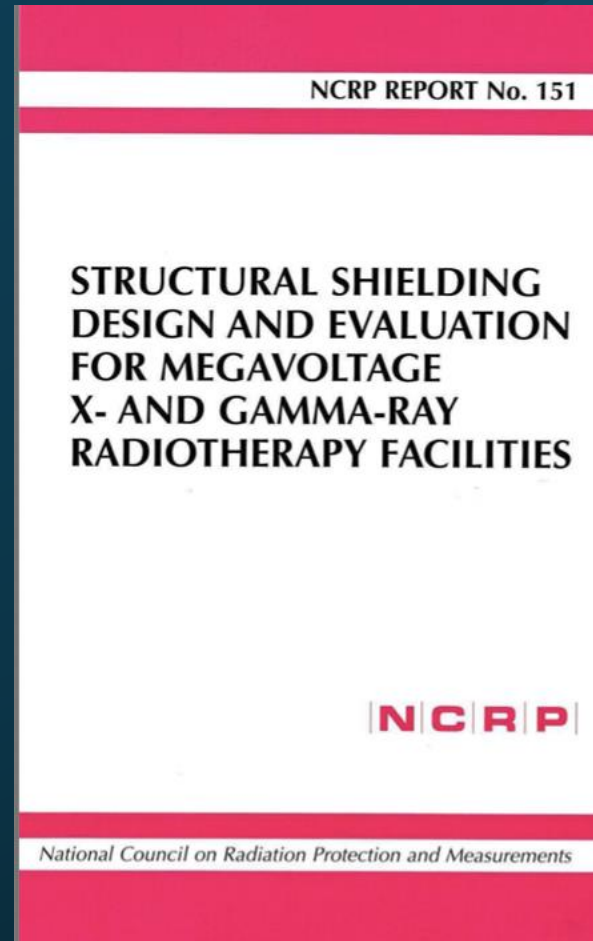
- ✓ Σχεδιασμός ( .. Αιτιολόγηση!)
- ✓ Εγκατάσταση
- ✓ Παραλαβή (Acceptance test)
- ✓ Commissioning
- ✓ Λειτουργία – κλινική πράξη

ΣΕ ΚΑΘΕ ΖΗΤΗΜΑ  
ΑΚΤΙΝΟΠΡΟΣΤΑΣΙΑΣ  
ΚΑΙ ΑΣΦΑΛΕΙΑΣ !!

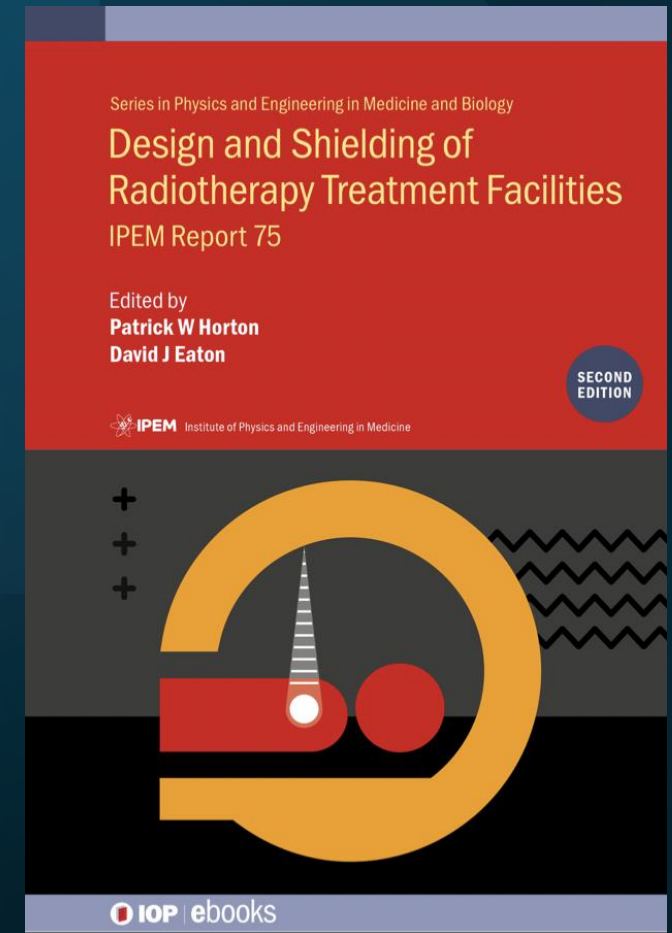
2006



2005



2017



# European BSS

## (COUNCIL DIRECTIVE 2013/59/EURATOM)

17.1.2014

EN

Official Journal of the European Union

L 13/1

### II

(Non-legislative acts)

## DIRECTIVES

### COUNCIL DIRECTIVE 2013/59/EURATOM

of 5 December 2013

laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom

THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Atomic Energy Community, and in particular Articles 31 and 32 thereof,

Having regard to the proposal from the European Commission, drawn up after having obtained the opinion of a group of persons appointed by the Scientific and Technical Committee from among scientific experts in the Member States, and after having consulted the European Economic and Social Committee,

Having regard to the opinion of the European Parliament

(3) Directive 96/29/Euratom establishes the basic safety standards. The provisions of that Directive apply to normal and emergency situations and have been supplemented by more specific legislation.

(4) Council Directive 97/43/Euratom<sup>(3)</sup>, Council Directive 89/618/Euratom<sup>(4)</sup>, Council Directive 90/641/Euratom<sup>(5)</sup> and Council Directive 2003/122/Euratom<sup>(6)</sup> cover different specific aspects complementary to Directive 96/29/Euratom.

(5) As recognised by the Court of Justice of the European Union in its case-law, the tasks imposed on the

# IAEA Safety Standards

for protecting people and the environment

## Radiation Protection and Safety in Medical Uses of Ionizing Radiation

Jointly sponsored by



Specific Safety Guide

No. SSG-46



2018

Παρέχει Οδηγίες :

- Σχεδιασμό χώρων ακτινοθεραπευτικού τμήματος
- Σχεδιασμό/υπολογισμό των θωρακίσεων
- Χαρακτηριστικά συνοδού ακτινολογικού εξοπλισμού
- Χαρακτηριστικά συστημάτων σχεδιασμού θεραπείας
- Χαρακτηριστικά βοηθητικού εξοπλισμού
- Πρωτόκολλα ελέγχων –Καταγραφή Διαδικασιών
- Απαραίτητο προσωπικό
- Συντήρηση

### ΑΚΤΙΝΟΠΡΟΣΤΑΣΙΑ ΠΡΟΣΩΠΙΚΟΥ

- Ταξινόμηση περιοχών, κανόνες και διαδικασίες, εκπαίδευση
- Εκτίμηση δόσης προσωπικού (monitoring, investigation levels, εγκυμοσύνη)

### ΑΚΤΙΝΟΠΡΟΣΤΑΣΙΑ ΑΣΘΕΝΩΝ

- ΑΙΤΙΟΛΟΓΗΣΗ όλων των διαδικασιών
- ΒΕΛΤΙΣΤΟΠΟΙΗΣΗ προστασίας και ασφάλειας

## IAEA Safety Standards

|                                                                                                 |     |
|-------------------------------------------------------------------------------------------------|-----|
| 5. SPECIFIC RECOMMENDATIONS FOR RADIATION PROTECTION AND SAFETY IN RADIATION THERAPY . . . .    | 202 |
| General (5.1–5.9) . . . . .                                                                     | 202 |
| Safety of medical radiation facilities and medical radiological equipment (5.10–5.92) . . . . . | 204 |
| Occupational radiation protection (5.93–5.188) . . . . .                                        | 223 |
| Radiation protection of individuals undergoing medical exposure (5.189–5.281) . . . . .         | 241 |
| Radiation protection of the public (5.282–5.296) . . . . .                                      | 265 |
| Prevention and mitigation of accidents (5.297–5.323) . . . . .                                  | 268 |
| Safety in the transport of radioactive material (5.324–5.326) . . . . .                         | 275 |

No. SSG-46



2018

Παρέχει Οδηγίες :

- Σχεδιασμό χώρων ακτινοθεραπευτικού τμήματος
- Σχεδιασμό/υπολογισμό των θωρακίσεων

...δού ακτινολογικού εξοπλισμού  
...ημάτων σχεδιασμού θεραπείας  
...ητικού εξοπλισμού  
...-Καταγραφή Διαδικασιών  
...κό

ΣΤΑΣΙΑ ΠΡΟΣΩΠΙΚΟΥ

... κανόνες και διαδικασίες,

...ωπικού (monitoring,  
...γκυμοσύνη)

## ΑΚΤΙΝΟΠΡΟΣΤΑΣΙΑ ΑΣΘΕΝΩΝ

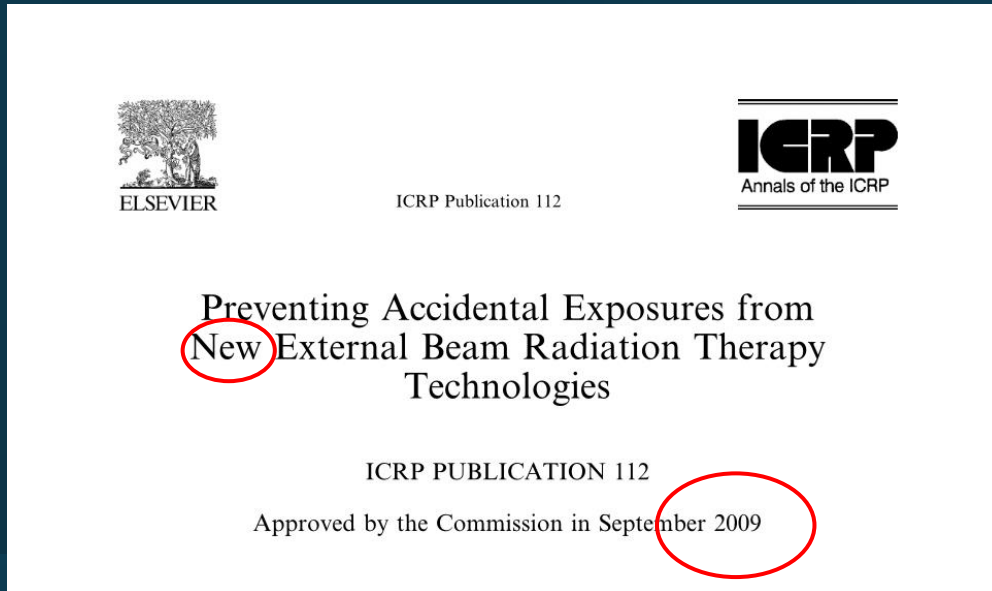
- ΑΙΤΙΟΛΟΓΗΣΗ όλων των διαδικασιών
- ΒΕΛΤΙΣΤΟΠΟΙΗΣΗ προστασίας και ασφάλειας

5.264. Minimization of the likelihood of unintended or accidental medical exposures in radiation therapy can be brought about by:

- (a) The introduction of safety barriers at identified critical points in the process, with specific quality control checks at these points. Quality control should not be confined to radiological equipment physical tests or checks, and can include actions such as checks of the treatment plan or dose prescription by independent professionals.
- (b) Actively encouraging a culture of always working with awareness and alertness.
- (c) Providing detailed protocols and procedures for each process.
- (d) Providing sufficient staff who are educated and trained to the appropriate level, and an effective organization, ensuring reasonable patient throughput.
- (e) Continuous professional development and practical training and training in applications for all staff involved in the preparation and delivery of radiation therapy.
- (f) Clear definitions of the roles, responsibilities and functions of staff in the radiation therapy facility that are understood by all staff.

# Τι μπορεί να πάει στραβά?

*“Disseminating the knowledge and lessons learned from accidental exposures is crucial in preventing re-occurrence.”*



*“New technologies are meant to bring substantial improvement to radiation therapy. However, this is often achieved with a considerable increase in complexity, which in turn brings opportunities for new types of human error and problems with equipment.”*

## ΕΡΩΤΗΣΕΙΣ - ΚΛΕΙΔΙΑ

1. «Μπορούν τα διδάγματα από τις παλαιότερες τεχνικές να εφαρμοστούν στις νέες? »
2. «Υπάρχουν νέα διδάγματα από τις νέες τεχνολογίες? »
3. «Μπορούμε να προβλέψουμε **ΤΙ ΘΑ ΠΑΕΙ ΣΤΡΑΒΑ ?**  
**Πόσο πιθανό είναι ? Τι οικονομικά εφικτές λύσεις έχουμε για την πρόληψη ?** »

- “Decision to implement a new technology should be based on **an evaluation of the expected benefit**, rather than being driven by technology itself. A step-by-step approach should be followed to ensure a safe implementation”.
- “Certain safety-critical tasks, such as calibration, beam characterization, complex treatment planning and pretreatment verification, require **a substantial increase in staff allocation**”.
- **“Independent verification** of beam calibration remains essential.”
- **“Investigating discrepancies in dose measurements** before applying the beam to patient treatments”
- “Programmes for purchasing, acceptance testing and commissioning **should not only address treatment machines** but also treatment planning systems, radiation therapy information systems, imaging equipment used for radiation therapy, software, procedures and entire clinical processes.”
- **“Devices and processes** should be **re-commissioned** after equipment modifications including software upgrades and updates.”
- **“Protocols** for treatment prescription, reporting and recording, **should be revised** to accommodate new technologies”
- “When conventional tests and checks are not applicable or not effective for new technologies, the safety philosophy should aim at finding measures to maintain the required level of safety. This may require **the design of new tests or the modification and validation of the old ones.**”

# ICRP TG 116



DRAFT REPORT FOR CONSULTATION: DO NOT REFERENCE

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## Annals of the ICRP

ICRP PUBLICATION XXX

### Radiological Protection Aspects of Imaging in Radiotherapy

Editor-in-Chief  
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Associate Editor  
K. NAKAMURA

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The International Commission on Radiological Protection

by



Please cite this issue as 'ICRP, 20xx. Radiological protection aspects of  
imaging in radiotherapy. ICRP Publication XXX. Ann. ICRP xx(x).'

- ✓ CLINICAL **JUSTIFICATION** FOR IMAGING IN RADIOTHERAPY
- ✓ THE PROCESS OF **OPTIMISATION** OF IMAGING
- ✓ EVALUATION AND **MANAGEMENT OF DOSES** FROM IMAGING
- ✓ QUALITY ASSURANCE **AND AUDITS**
- ✓ **AVOIDANCE OF ERRORS** ORIGINATING FROM IMAGING
- ✓ EDUCATION AND **ONGOING TRAINING** OF STAFF
- ✓ **RECOMMENDATIONS TO IMPROVE RADIOLOGY**

«A **medical physicist** with training in diagnostic radiology dosimetry and optimisation techniques, should be available in every facility to perform imaging dosimetry measurements, assist in patient dose audits and advise on optimisation»

# ICRP TG 157

2024

## Annals of the ICRP

ICRP PUBLICATION 157

### Ethics in Radiological Protection for Patients in Diagnosis and Treatment

Editor-in-Chief  
C.H. CLEMENT

Associate Editor  
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F. Fahey, C. Kurihara-Saio, B. Le Guen, J. Malone, L. Reid,  
M. del Rosario Perez, F. Zölzer

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ICRP Publication 157. Ann. ICRP 53(3).'

## ΒΑΣΙΚΕΣ ΑΡΧΕΣ ΑΚΤΙΝΟΠΡΟΣΤΑΣΙΑΣ

- Αιτιολόγηση
- Βελτιστοποίηση
- Περιορισμός δόσης

## ΒΑΣΙΚΕΣ ΗΘΙΚΕΣ ΑΞΙΕΣ (ICRP)

- Σεβασμός (dignity)
- Ωφελιμότητα και μη βλαπτικότητα (Beneficence and non-maleficence)
- Σύνεση (Prudence)
- Δικαιοσύνη (Justice)

## ΔΙΑΔΙΚΑΣΤΙΚΕΣ ΑΡΧΕΣ ΓΙΑ ΠΡΑΚΤΙΚΗ ΕΦΑΡΜΟΓΗ ΤΩΝ ΑΝΩΤΕΡΩ:

- Ανάληψη ευθύνης (Accountability)
- Διαφάνεια (Transparency)
- Συμπερίληψη (Inclusiveness)

## ΠΑΡΑΔΕΙΓΜΑ : John Conway, 40ετών, Ca προστάτη (πρώιμο στάδιο)

Επιλογή θεραπείας : High-dose radiotherapy

- Σχεδιασμός θεραπείας με γεμάτη κύστη. Οδηγία για πόση 6 ποτηριών νερού πριν τη θεραπεία.
- Τοπικό πρωτόκολλο τμήματος : Verification images τις 3 πρώτες ημέρες θεραπείας, τροποποίηση ανάλογα με τα ευρήματα, επανάληψη εβδομαδιαία. ( στην περίπτωση του John δεν ελήφθησαν εβδομαδιαίες απεικονίσεις)
- Ο John υπέφερε από οξείες παρενέργειες και είχε δυσκολία να ακολουθήσει το πρωτόκολλο πόσης νερού. Είναι πιθανό η θέση του προστάτη σε σχέση με τα γειτονικά όργανα να μεταβλήθηκε κατά τη θεραπεία.

Table 7.2. Ethical compliance evaluation of John Conway's scenario.

|                | Dignity/<br>autonomy | Beneficence/<br>non-maleficence | Prudence/<br>precaution | Justice/<br>solidarity | Transparency/<br>accountability/<br>honesty | Inclusiveness/<br>empathy |
|----------------|----------------------|---------------------------------|-------------------------|------------------------|---------------------------------------------|---------------------------|
| Compliance     | 😊                    | 😊                               | –                       | 😊                      | –                                           | 😊                         |
| Non-compliance | 😞😞                   | 😞😞                              | 😞😞                      | 😞😞                     | 😞😞                                          | –                         |

## ΠΑΡΑΔΕΙΓΜΑ : John (πρώτο στάδιο)

Επιλογή θεραπείας

-Σχεδιασμός θ

- Τοπικό π  
με τα ε  
απεικ

- Ο Joh  
Είναι

ΜΗΧΑΝΗΜΑΤΑ ΥΨΗΛΗΣ ΤΕΧΝΟΛΟΓΙΑΣ  
ΑΔΥΝΑΤΟΥΝ ΝΑ ΠΡΟΣΦΕΡΟΥΝ  
ΑΠΟΤΕΛΕΣΜΑΤΙΚΗ ΘΕΡΑΠΕΙΑ ΧΩΡΙΣ  
ΤΗΝ ΚΑΤΑΛΛΗΛΗ ΕΚΠΑΙΔΕΥΣΗ ΚΑΙ ΤΗΝ  
ΥΙΟΘΕΤΗΣΗ ΚΟΥΛΤΟΥΡΑΣ ΑΣΦΑΛΕΙΑΣ  
ΜΕΤΑΞΥ ΤΟΥ ΠΡΟΣΩΠΙΚΟΥ → ΜΗ  
ΣΥΜΜΟΡΦΩΣΗ ΩΣ ΠΡΟΣ ΤΗΝ  
ΑΝΑΛΗΨΗ ΕΥΘΥΝΗΣ (Accountability)  
ΤΗΣ ΔΙΟΙΚΗΣΗΣ ΚΑΙ ΤΩΝ ΥΠΕΥΘΥΝΩΝ  
ΕΚΠΑΙΔΕΥΣΗΣ.

στην τη θεραπεία.

είας, τροποποίηση ανάλογα  
σαν εβδομαδιαίες

υτόκολλο πόσης νερού.  
ε κατά τη θεραπεία.

Table 7.2. Eth

|                | Dignity/<br>autonomy | non- |    | ness/<br>empathy |
|----------------|----------------------|------|----|------------------|
| Compliance     | 😊                    | 😊    | -  | 😊                |
| Non-compliance | 😞😞                   | 😞😞   | 😞😞 | -                |



*Σας ευχαριστώ για την προσοχή σας!*