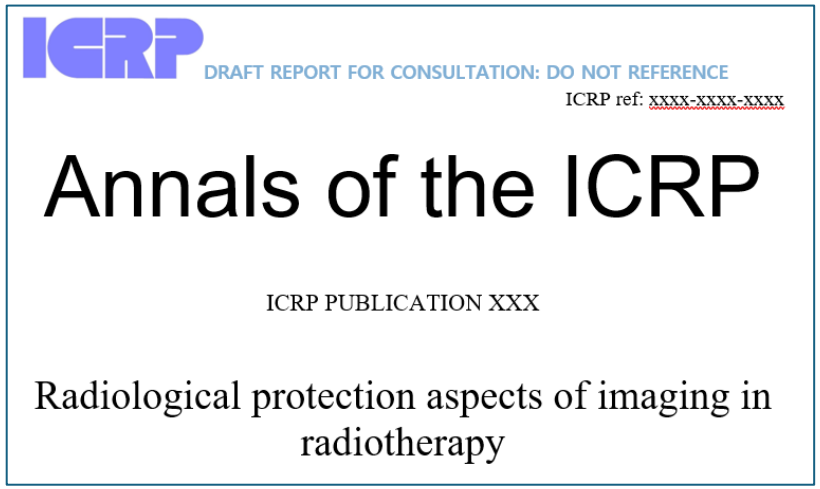
Impact of the Recommendations



Tomas Kron

Medical Physics ‘old hand’

ICRP novice

What makes ICRP generate ‘impact’?

- Based on quality data wherever possible (> 400 references in TG 116 report)
- Authoritative expert opinions
- Topics’ relevance not diminishing with time
- Contents applicable internationally
- Generally pragmatic so easy to implement in standards and guidelines

My home institution:

Peter MacCallum Cancer Centre, Melbourne

- 5 campuses, about 8000 RT patients per year, 16 Varian linacs with CBCT, 1 GammaKnife, 4 SXRT units, HDR, LDR and eBrachytherapy
- 7 CT scanners (one dual energy), 1 PET/CT, access to MRI
- Cancer Imaging including Nuclear Medicine with > 1000 Theranostics procedures per year
- Physical Sciences Department including both Therapy and Imaging Physics

Main campus Melbourne

- COI: Research collaborations with Varian Medical Systems, Vison RT and RefleXion

Imaging in the External Beam Radiotherapy Patient Pathway

Typical patient pathway

Imaging specific to Radiotherapy

More and new imaging:
- *Multimodality*
- *Adaptation*
- *Motion management*

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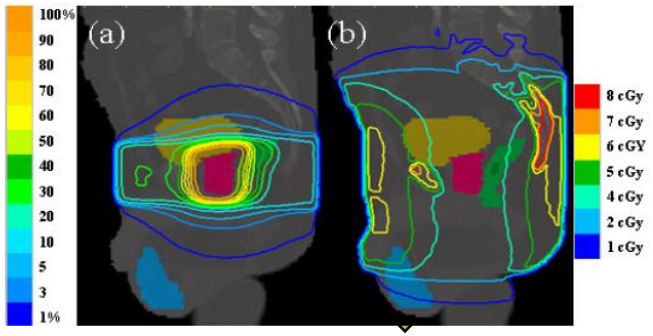


Clinical evaluation

Therapeutic decision

Patient set-up/immobilisation ← *Fiducial marker implantation under image guidance*

Motion management ← *Fluoroscopy* *4DCT*

Imaging for planning ← *CT* *MRI* *PET CT*

Treatment planning

Plan selection/QA

Simulation, mock session ← *CBCT* *Optical guidance*

Image guidance ← *CBCT* *kV planar imaging* *EPI* *MRI* *US*

Treatment

Monitoring during treatment ← *4D CBCT* *kV on line imaging* *CINE EPI*

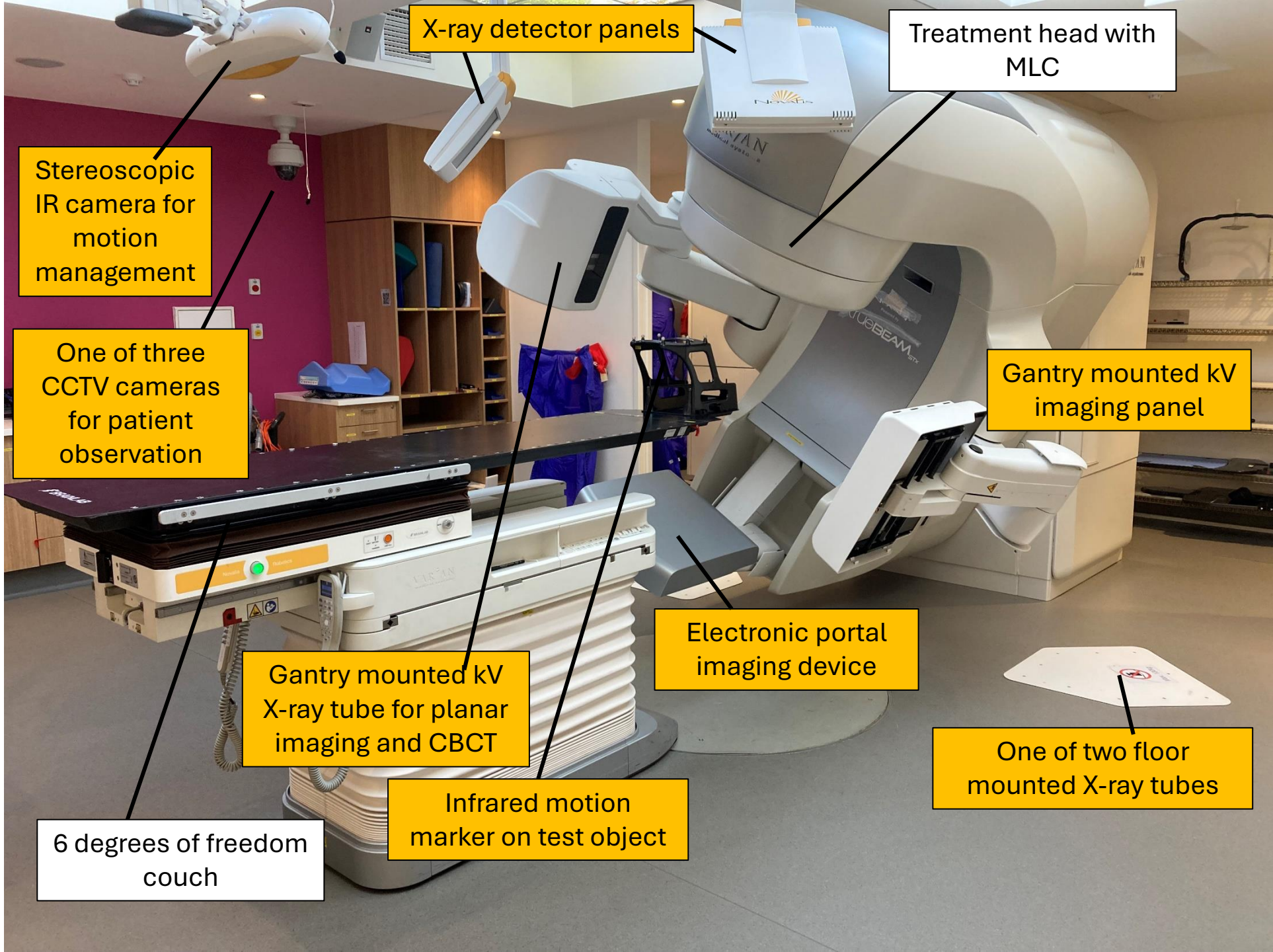
Adaptation ← *Re-imaging as required*

Follow up

A typical linac in our centre

What additional new imaging will be there tomorrow?

Impact needs to be seen in the context of concepts rather than specific technologies



Annals of the ICRP

ICRP PUBLICATION XXX

Radiological protection aspects of imaging in radiotherapy

Editor-in-Chief
C.H. CLEMENT

Associate Editor
K. NAKAMURA

Authors on behalf of ICRP
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Impact via:

- Information sharing, education
- Providing background and motivation for training and actions within clinical environment
- Recommendations
  - Health professionals (n=17)
  - Equipment vendors and software manufacturers (n=8)
  - Regulators (n=4)

Health professionals involved in radiotherapy processes

1. Justification and optimisation of imaging should be a recognised part of radiotherapy processes considering the treatment objective and written explicitly into practices (including the choice of the imaging modality, and definition of the imaging frequency and quality).
2. Optimisation of image quality and dose should be a part of the purchasing, acceptance, commissioning and quality assurance process for all imaging equipment that uses ionising radiation in radiotherapy.
3. Imaging optimisation teams comprising radiation oncologists, RTTs, and medical physicists should be established in each radiotherapy facility to review imaging protocols at regular intervals.
4. Resources should be allocated in a radiotherapy department for image dose assessment and optimisation of radiological protection for imaging.
5. Radiotherapy centres should employ or have access to a suitably qualified medical physicist with diagnostic imaging specialisation who should assist in review of imaging protocols and optimisation of radiological protection aspects and be involved in patient dose audit and QA activities.
6. Wherever possible dose records should be included in the DICOM information of medical images, in particular all CT data sets.
7. Imaging dose, volume and frequency for image guidance should be reviewed and documented for all radiotherapy protocols.
8. The justification of imaging dose, volume and frequency should be documented for each individual patient by the radiological medical practitioner involved in the patient's care.
9. Radiotherapy centres involved in radiotherapy of children should develop specific protocols for paediatric imaging.
10. Guidelines should be developed for the use of repeat imaging for example after patients have been moved.
11. There should be a move towards the inclusion of doses from MV imaging explicitly into treatment plans. Doses from kV imaging used as part of the radiotherapy treatment process should be considered in protocols and reported.
12. Consideration should be given to the development of guidance about when the dose from imaging procedures should be included in treatment plans.
13. A QA program should be in place for all imaging equipment used in radiotherapy. If the imaging involves ionising radiation the QA activities should include a dose measurement confirming the accuracy of displayed values and a quality check after any relevant technology change and at least on an annual basis.
14. Systems for periodic audit of patient imaging doses should be established under the guidance of qualified medical physicists. In the short to medium term this may be accomplished through measurement of the CBDI described in this publication.
15. Results from dose surveys should be taken into consideration, when optimising imaging protocols and lead to the establishment of dose reference levels (DRLRTs).
16. The image optimisation team should develop a system for capture of the reasons for repeat imaging so that reject analysis audits can be performed. Corrective actions identified in these audits and follow-up audits should be implemented to reduce the number of repeat images, and hence optimise patient doses.
17. Curricula and syllabi for training and education of radiotherapy professionals should include knowledge and skills in diagnostic imaging, including techniques for optimisation of radiological protection. Special training of staff should be provided in respect of paediatric imaging where applicable.

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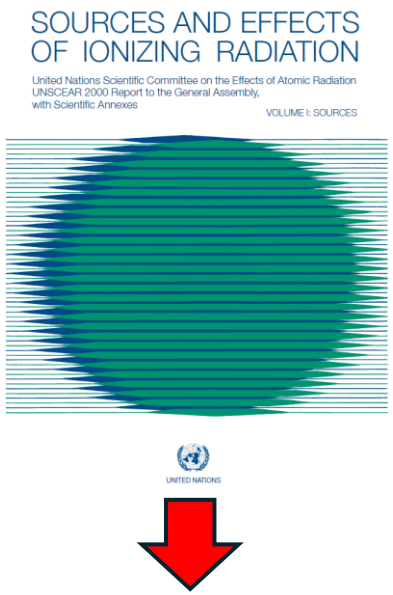
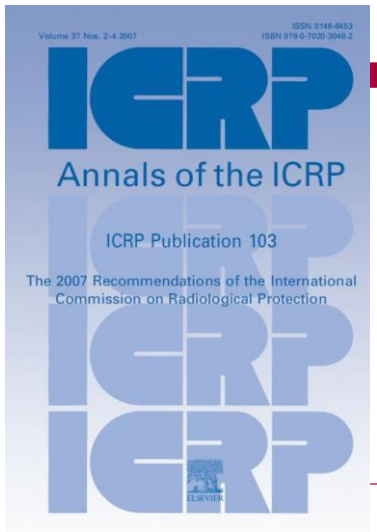
Scientific literature and experiments





IAEA Safety Standards
for protecting people and the environment

Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards

Jointly sponsored by
EC, FAO, IAEA, ILO, OECD/NEA, PAHO, UNEP, WHO

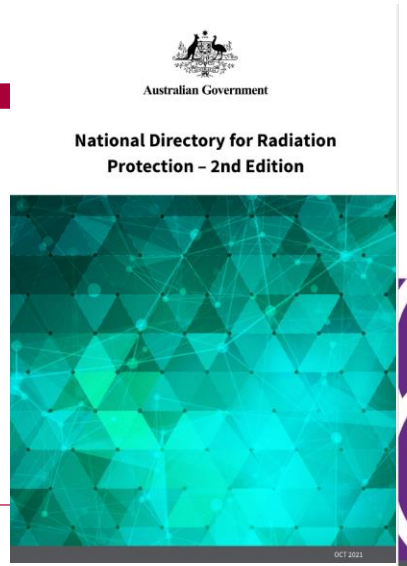
General Safety Requirements Part 3
No. GSR Part 3

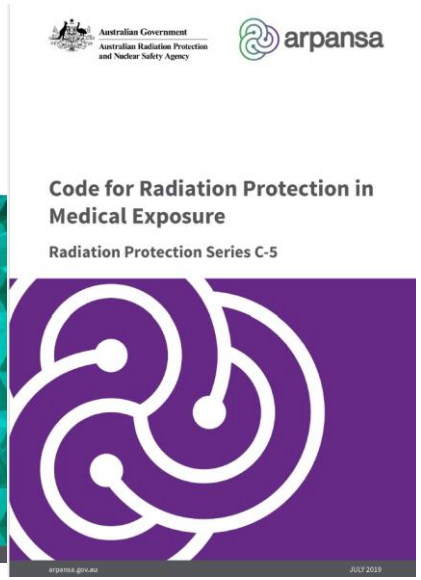
ICRP

DRAFT REPORT FOR CONSULTATION: DO NOT REFERENCE

13. RECOMMENDATIONS TO IMPROVE RADIOLOGICAL PROTECTION FOR IMAGING IN RADIOTHERAPY

(473) Actions are required by radiotherapy department staff and managers to optimise radiological protection of patients for imaging procedures in radiotherapy. However, there are a number of recommendations discussed in this report that are difficult if not impossible unless there are developments in imaging equipment, particularly in respect to the documentation of imaging doses. Therefore, equipment vendors will perform essential roles in any improvements and regulators will perform a key role in promoting radiological protection. In this final section recommendations are set out relating to the different groups involved.





Authorised Version No. 001
Radiation Regulations 2017
S.R. No. 83/2017
Authorised Version as at 27 August 2017

TABLE OF PROVISIONS

Authorised by the Chief Parliamentary Counsel
i

Authorised Version No. 032
Radiation Act 2005
No. 62 of 2005
Authorised Version incorporating amendments as at 1 March 2019

TABLE OF PROVISIONS

Authorised by the Chief Parliamentary Counsel
i

From recommendations to standards, national code of practice to act of parliament (in < 20 years)

Equipment vendors and software developers

1. Vendors should include displays of measurable dose quantities (e.g. CTDIw,IEC) linked to the exposure factors used for all imaging systems. These should be in terms of quantities that can be linked to dose measurements, the accuracy of which can be confirmed through verification. Records of dose quantities should be included in the DICOM information of medical images. In the longer term, consideration should be given to display of a dose quantity, such as the CBDI described in this publication for use in patient dose surveys.
2. Specifications for equipment provided for tender and purchasing considerations should include information about doses delivered in imaging procedures and possibilities for optimisation of radiological protection.
3. Factory settings and imaging protocols supplied by vendors should include consideration of optimisation of radiological protection. Vendors should provide users with imaging protocols optimised for paediatric radiotherapy.
4. Features to facilitate optimisation of radiological protection for imaging procedures performed on individual patients through adjustment of parameters such as exposure factors, and field sizes should be included in all therapy imaging equipment, together with the ability for radiotherapy centres to create local protocols to meet their clinical needs.
5. There should be facilities to enable the exposure arcs in CBCT to be limited to protect radiosensitive organs.
6. Vendors should provide treatment planning systems with the possibility of calculating dose distributions from kV imaging.
7. Vendors should include automatic tools to optimise radiation dose to patients being imaged on CBCT devices. Such a tool might take the form of an automatic exposure control.
8. Vendors should provide training for staff in use of imaging equipment that includes methods and techniques for optimisation of radiological protection.

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Therapy catches up with Imaging

Regulators and professional bodies

1. Regulators should link authorisation of imaging equipment in radiotherapy to requirements modelled on diagnostic imaging.
2. Regulatory agencies and/or professional organisations should consider developing national DRLRTs for imaging in radiotherapy to promote optimisation of radiological protection. The uptake of DRLRTs in radiotherapy should be encouraged at a minimum for imaging used for treatment planning purposes but would also have benefits for treatment imaging in particular if CBCT is used.
3. Regulators should provide requirements on education, training and competences in imaging for professionals involved in radiotherapy.
4. Professional bodies should provide certification and accreditation in imaging for professionals involved in radiotherapy and encourage a strong safety culture.

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Imaging and Therapy

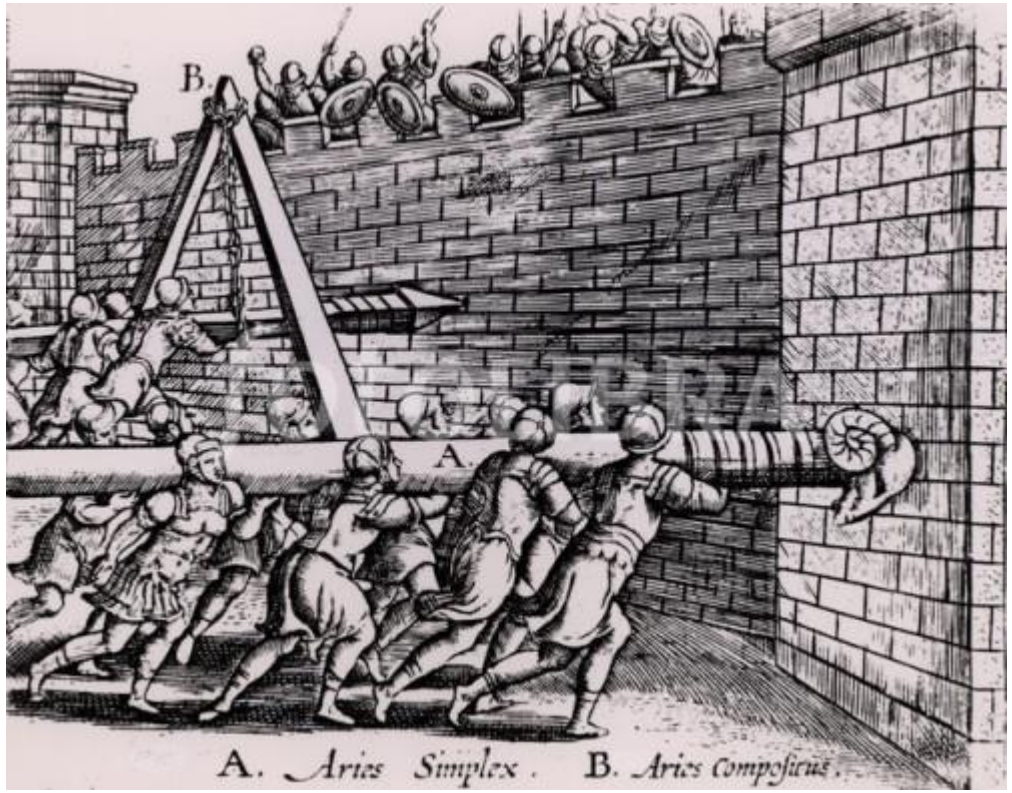
Summary

- The report is written keeping in mind how it can directly help improving radiological protection (here in the context of radiotherapy patients)
- Imaging dose is not always low in radiotherapy, often is distributed in non-targeted health structures and rarely documented or optimised
- The recommendations aim to be pragmatic but create tasks not only for the practitioner but also for manufacturers, professional organisations and governments (eg regulators)

Thank you

RT Manufacturers' inertia

ICRP TG 116



Wall of RT communities' complacency on low doses

Ground of common good