Radiation Protection in Medicine Committee 3

By an ersatz* of Jean-Marc Cosset

*Le Robert: *« Ce qui remplace qqn en moins bien »*

« Ou comment présenter 70 diapos sans réellement les comprendre »
Ou, Jean-François sait convaincre.

Radiation Protection in Medicine Committee 3

La gazette de Genève: tsunami sur le lac, Fred Mettler démissionne; Claire Cousins le remplace

Radiation Protection in Medicine ça bosse au Comité 3

- ICRP publication 97: prevention of High-dose-rate, Brachytherapy accidents (2005)
- ICRP publication98; Radiation safety aspects of brachytherapy for prostate cancer using permanently implanted sources(2005)

Radiation Protection in Medicine Committee 3 Traductions françaises

- Aujourd'hui (ou presque) disponible, la traduction française de la CIPR 85; *Avoidance of radiation injuries from medical interventional procedures*

Radiation Protection in Medicine Committee 3 Traductions françaises

- Forte demande pour
- la publication 93 « *Managing patient dose in digital radiology* »
- La publication 94 « *Release of patients after therapy with unsealed sources* »
- Et la 97 « *Prevention of high-dose-rate brachytherapy accidents* »

Le message de Jean-Marc: Radiation Protection issues of modern Radiotherapy techniques

An ICRP Committee 3 Task Group,

With participation of ICRU

Là commencent les 70 diapos de Jean-Marc

ICRP/ICRU Task Group

- **Chairman** : JM Cosset (C 3)
- **Full members** :
- Luis Pinillos-Ashton (C 3)
- William Morgan(C 1)
- André Wambersie (ICRU)
- Lawrence Dauer (USA)
- Nirmal Gupta (UK)
- David Followill (USA)

Introduction

- Previous ICRP document on this topic : ICRP 44, released in 1985 …
- Since that time , a number of new techniques have emerged,
- *Some of them having already been introduced in (more or less) routine practice…*

Introduction

- The Radioprotection issues raised by modern ***Brachytherapy*** techniques will ***not*** be considered here
- Since two ICRP recommendations have just been released on those topics ; ***High dose rate*** (ICRP 97, Luis Pinillos-Ashton) and ***Permanent implants for prostate Brachytherapy*** (ICRP 98, Jean-Marc Cosset)
- The present document will only focus on the problems raised by ***external Radiotherapy***

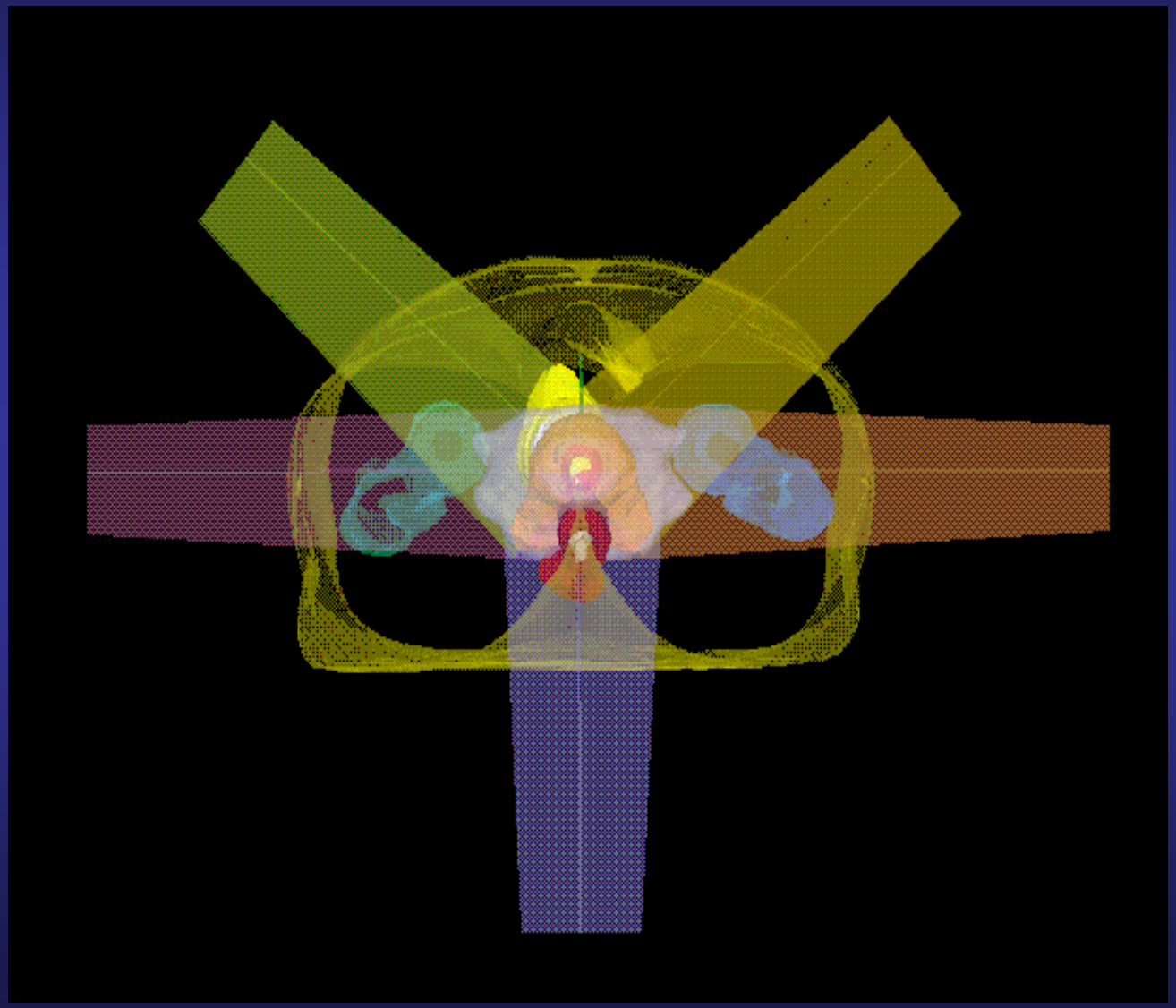
Introduction

- Most of those new techniques or procedures for external RT raise new and specific problems .
- Most of the newly introduced procedures for external RT have been designed to better « conform » (thus, the fashionable « conformal radiotherapy ») the irradiated volume to the precise shape of the tumor.

Introduction

- However, to achieve this task, those new procedures frequently use an increased number of beams …
- Therefore significantly increasing the volume of healthy tissues or organs receiving « low doses » (in the vocabulary of radiation oncologists) …

TECHNIQUES 5 FAISCEAUX



Introduction

- A reminder : what is a « low dose » for a radiation oncologist ?
- For somebody delivering some 70 to 80 Gy to his target volume, the volume encompassed by the 5% isodose is considered to receive a « low » dose …
- However, it represents **3.5 to 4 Gy** !
- Therefore well above the 0.1 Gy dose sometimes presented as a « threshold » below which the carcinogenic risk could be negligible (?)…

Introduction

- 2/ In some other cases, although the risk of second cancers cannot serve as an argument to dismiss the new technique(s),
- The carcinogenic risk must be kept in mind when designing the protocol ,
- And particularly when defining the population to be treated (children ?…).

Discussion of a new title :

- New proposed title ; ***“Evaluation and management of second Cancer risk in Radiotherapy in the XXIth century”.***

Clinical data

- 1/ Actually, most available clinical data are not able to detect any increase of a second cancer risk *in areas located far away from the beams* (when compared with either the general population, or non-irradiated patients of the same kind….).
- So, when some models calculate a doubling of the risk in those areas, it would mean *zero (or a very minor risk ?) x 2*, resulting in either zero (or a doubling of a very minor risk ?…).

Clinical data

- A number of clinical data shows that the vast majority of radio-induced second cancers occur *at the border of the target volumes*, or in a “high-dose” region receiving grossly between 10 Gy and the prescribed dose to the target volume (40 to 80 Gy…).

Clinical data

- 2/ Clinical Radiotherapy data are in good agreement with the Atomic bomb survivors data (see Preston 2003) for emphasizing ***the role of age (+++)***,
- probably one of the main parameters to be considered throughout all this document.

Clinical data

3/ Some clinical data suggest that dose ***fractionation*** (a constant feature in radiotherapy) could play some “protective” role (?) against secondary cancers

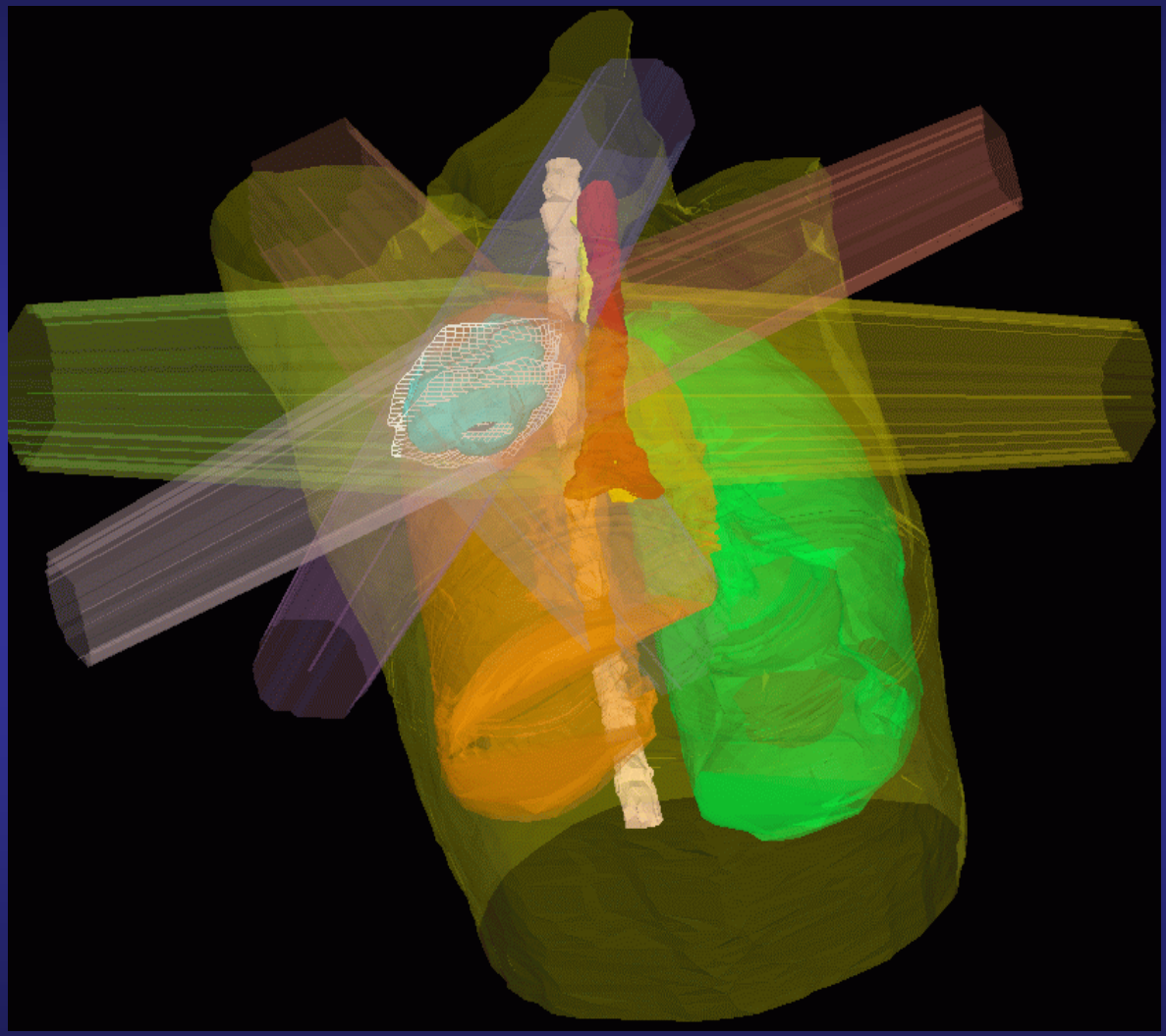
(with much less cancers observed after radiotherapy than was actually predicted from the atomic bomb survivors experience …).

Clinical data

4/ Other clinical data suggest that the risk of second cancer could be different from one (primary) cancer type to another, maybe due to a specific *susceptibility* of some cancer patients ; this is particularly true for some pediatric cancers, but maybe not only (see also ICRP 79).

Conformal Radiotherapy

- Takes advantage of :
- 3D reconstruction of the target volume
- Multi-leaf collimators
- 3D treatment planning system (TPS)
- A (usually) larger number of beams (than with conventional RT)
- To better adapt the treated volume to the tumor (and to its possible extensions)



Conformal Radiotherapy

- A possible « negative » point :
- The larger number of beams may lead to an increased irradiation at « low » (see above) doses of healthy surrounding tissues
- With a theoretical increased risk of secondary tumors in those areas (to be calculated or estimated in each case)

Conformal Radiotherapy

- This possibly « negative » point has to be balanced against a number of « positive » ones :
- A/ The reduction in the volume of normal tissues receiving high doses, with therefore a reduction of second cancers in those areas !

Conformal Radiotherapy

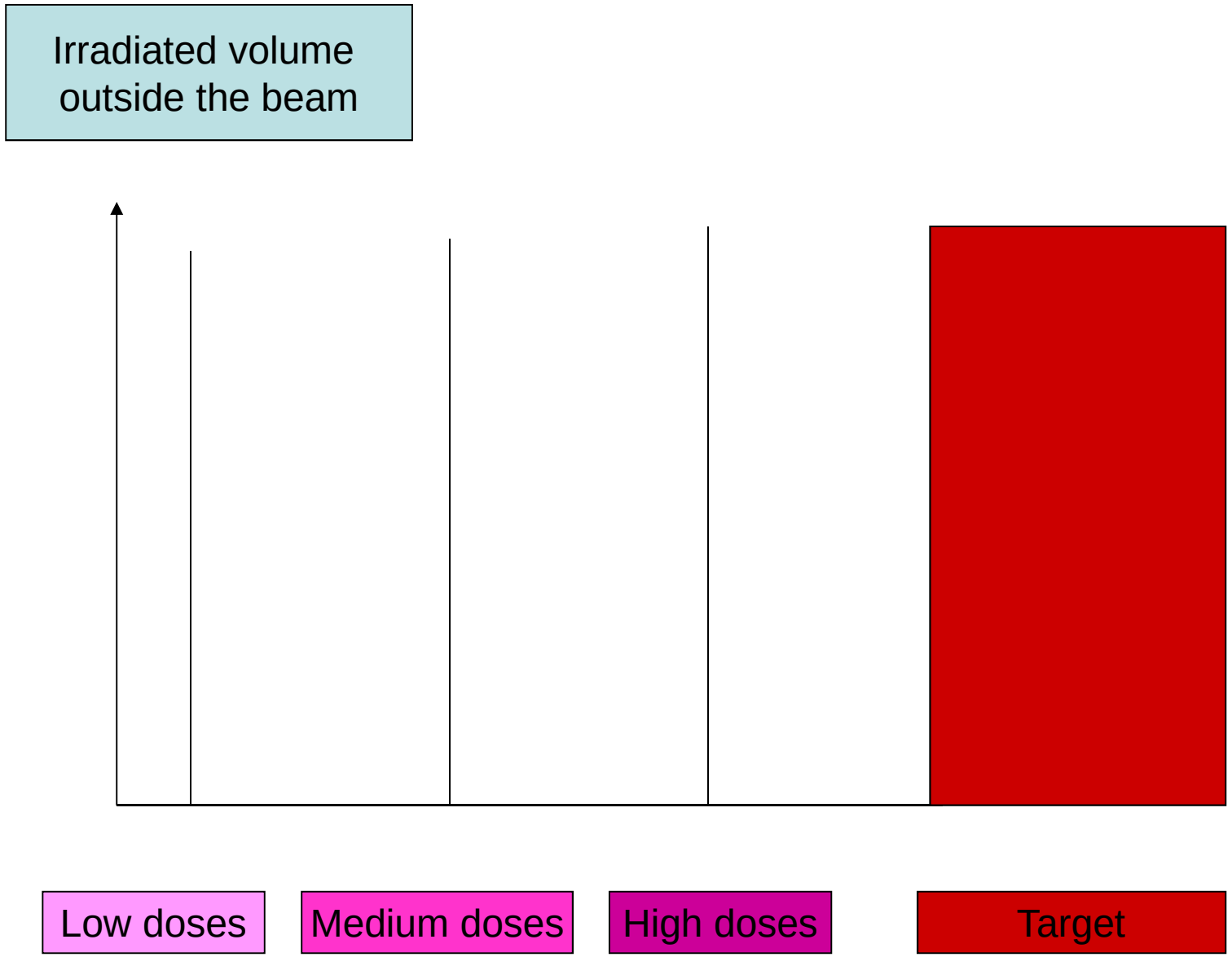
- Consequently , one can expect a reduction in the number of radio-induced ***sarcomas*** , occurring « in-field »
- And also a reduction in the number of the radio-induced cancers emerging in the «high» dose volumes

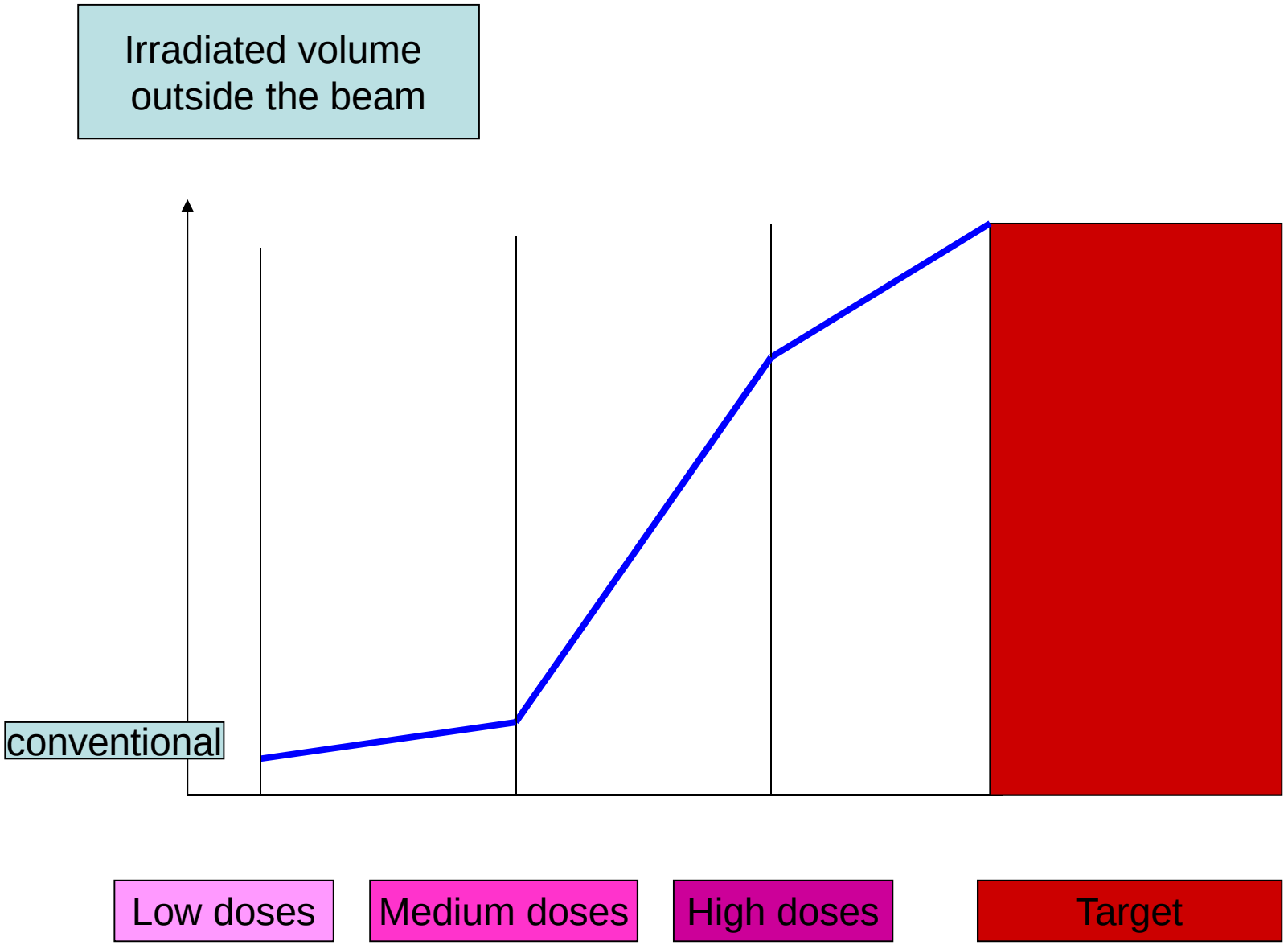
Conformal Radiotherapy

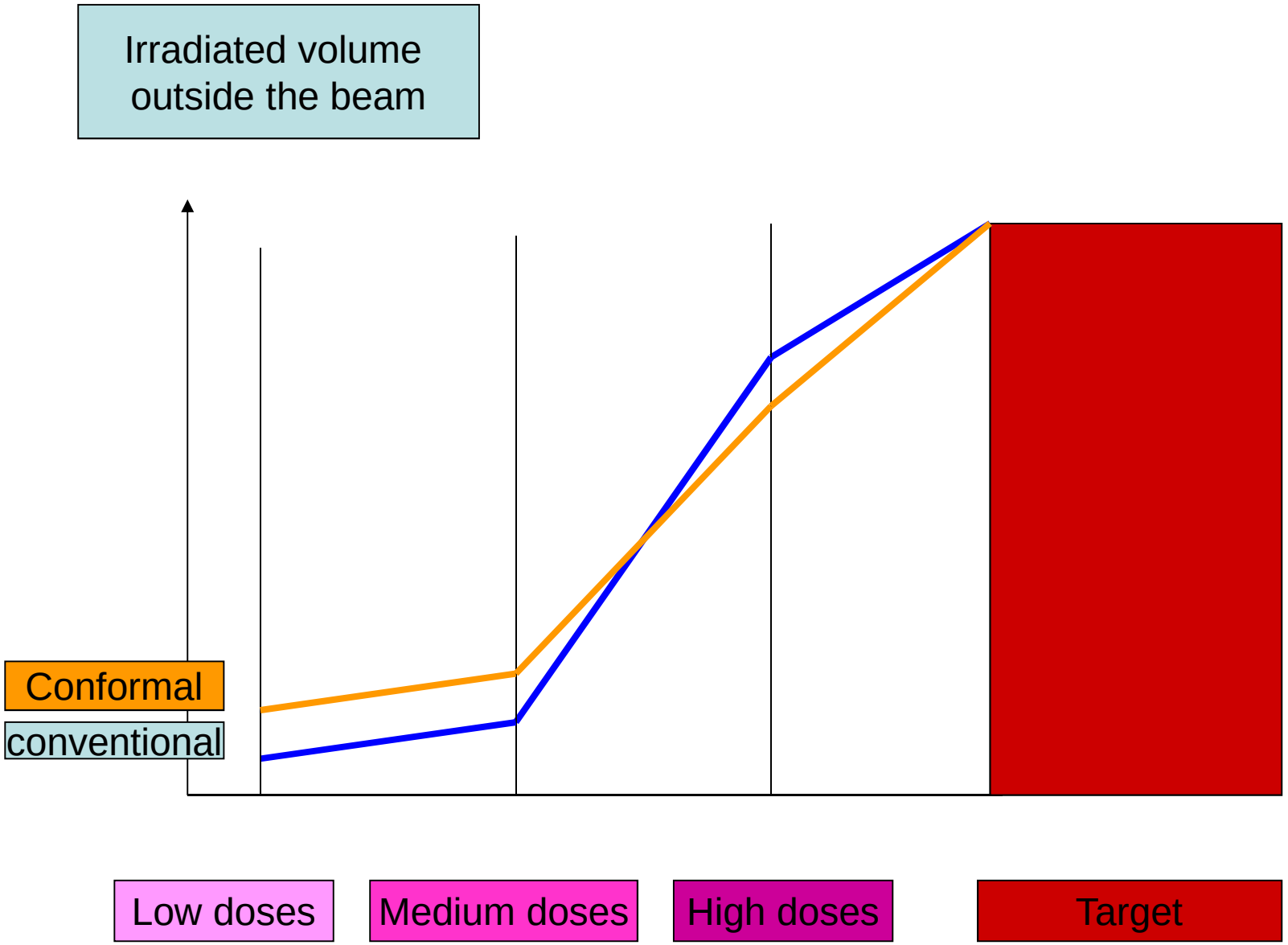
- Therefore , for the carcinogenic risk linked to conformal RT , one must consider (for each case ?) :
- The potential (theoretical ??) increase in risk related to the irradiation of a larger volume at low doses
- The potential decrease in risk related to the irradiation of a smaller volume at medium-high dose …

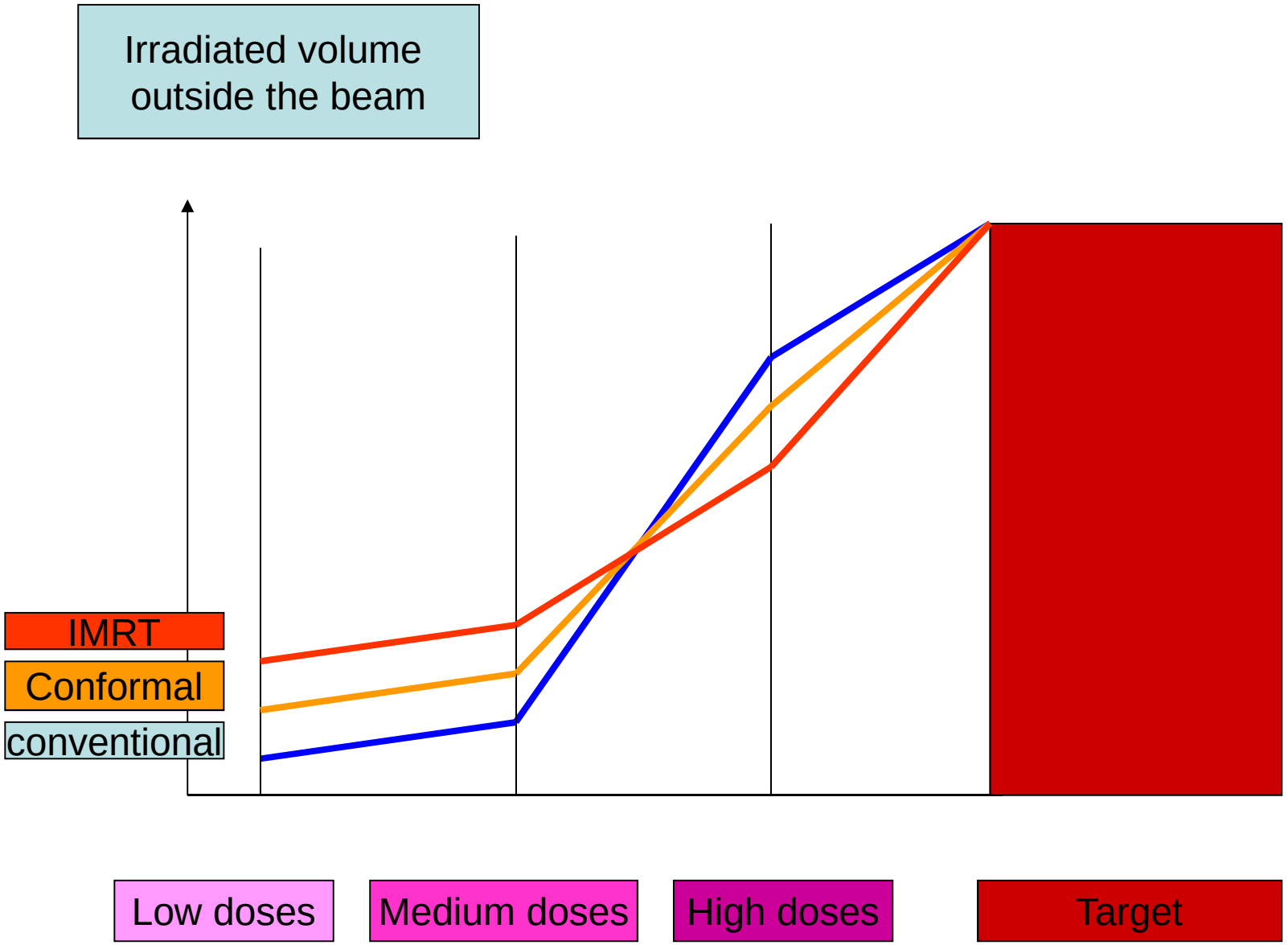
Conformal Radiotherapy

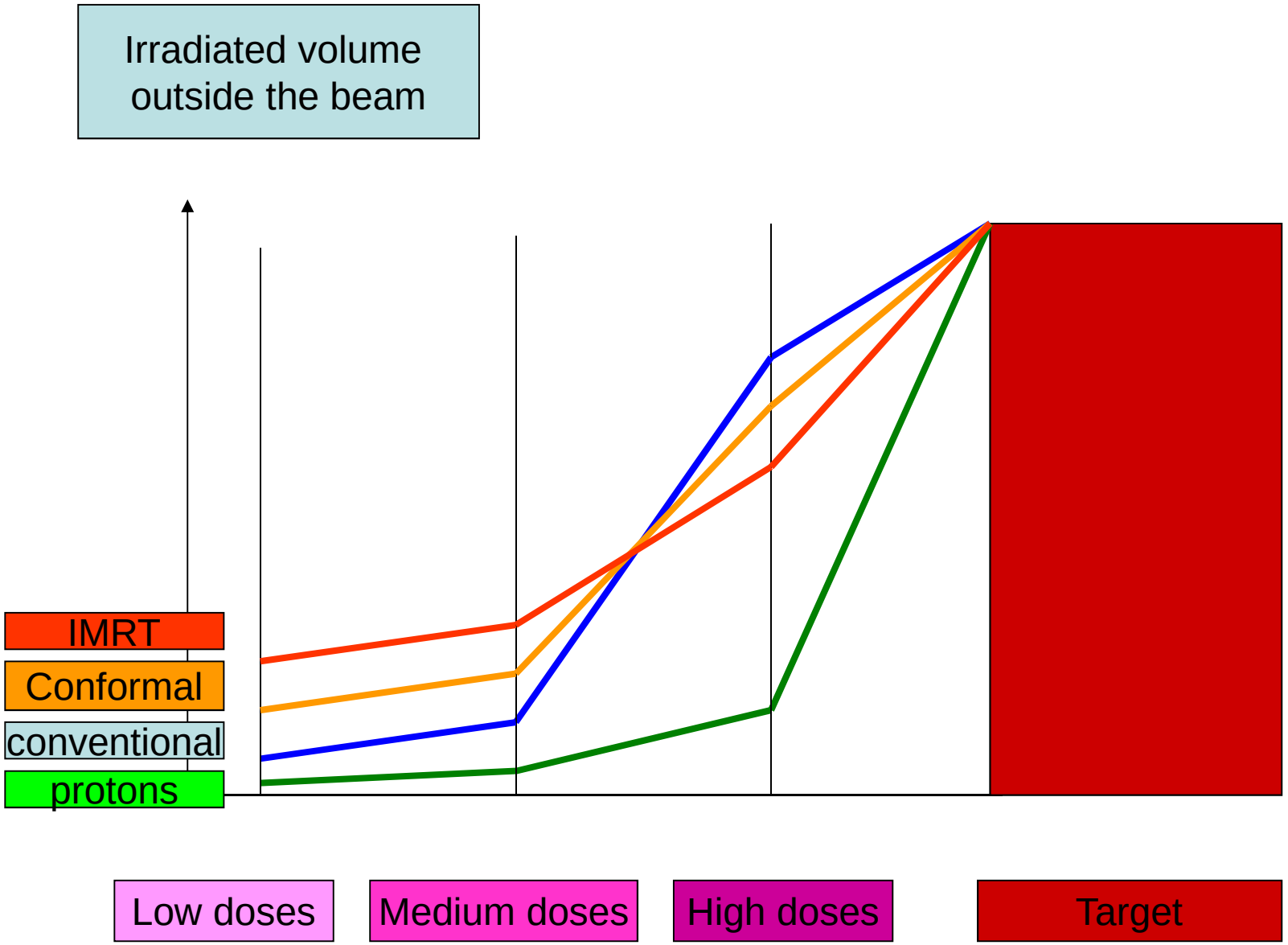
- «Positive »points :
- Decrease in toxicity of the irradiation (Largely recognized by the radiotherapeutic community, and demonstrated in a number of randomized trials)
- Conformal RT allowed **dose escalations**
- Example of prostate cancer ;Dose could be increased from 65 to 72-78 Gy, and sometimes more …
- Without increase in toxicity (Beckendorf)
- And with a better tumor control

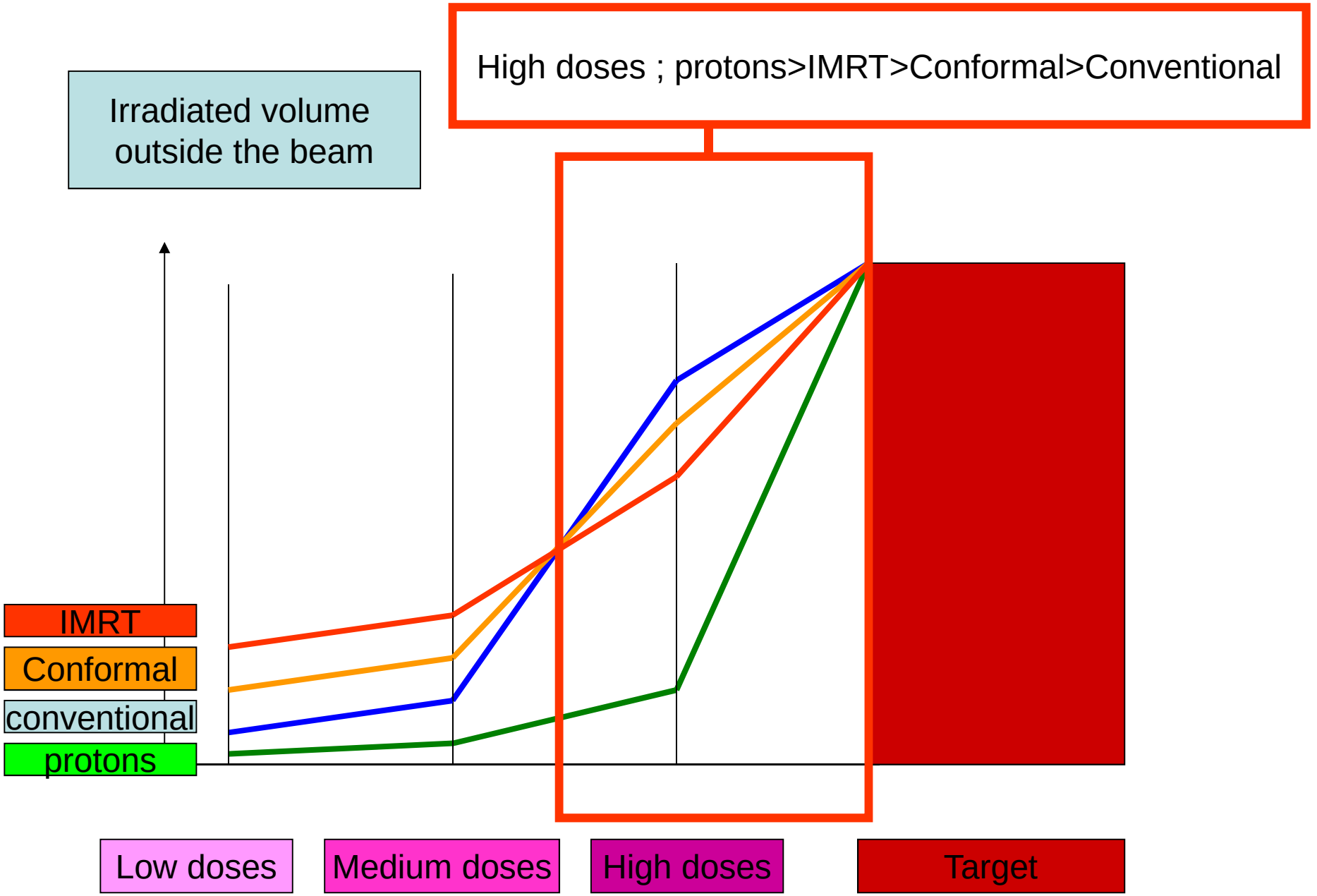

Irradiated volume outside the beam
Low doses
Medium doses
High doses
Target

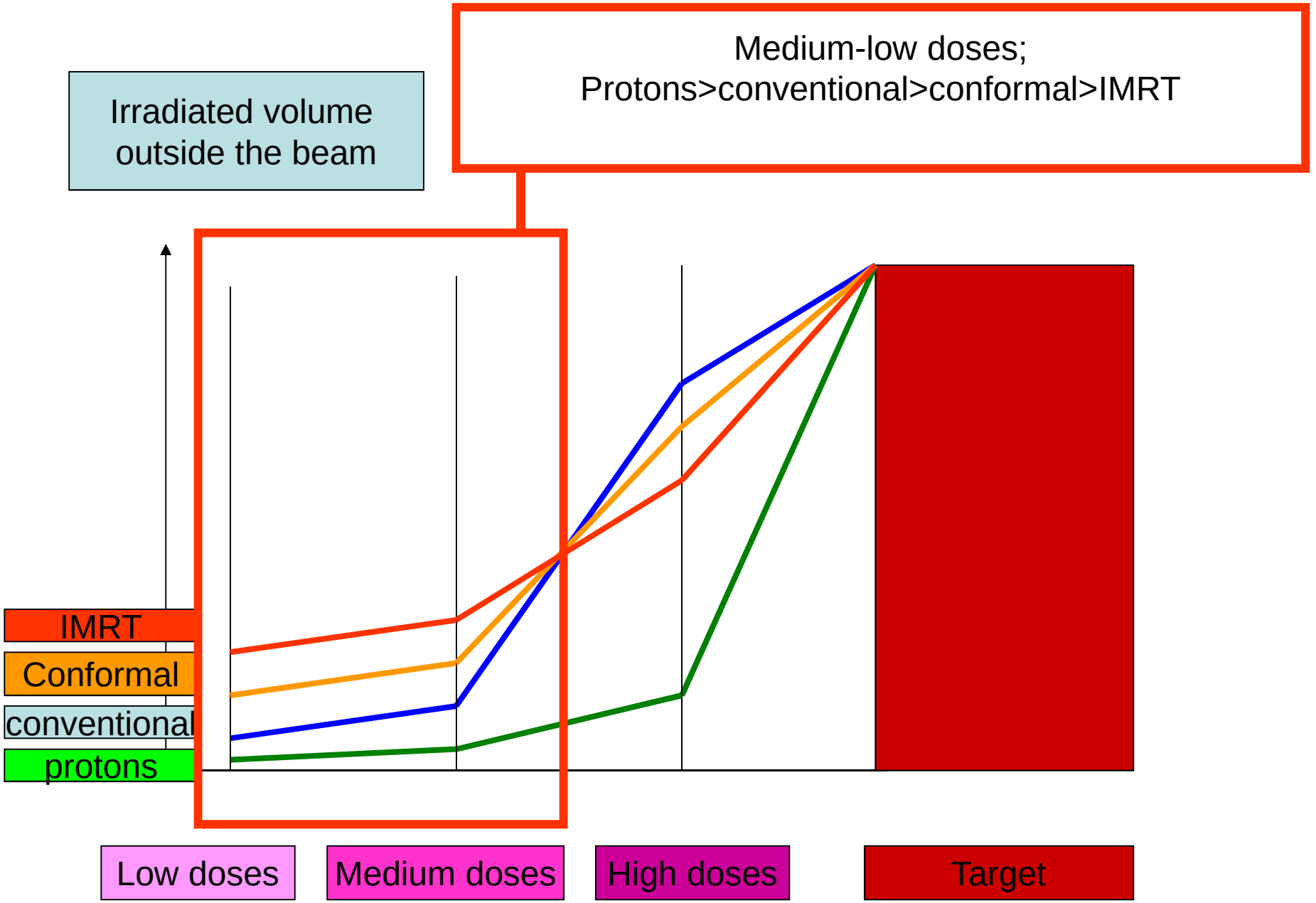

Irradiated volume
outside the beam
conventional
Low doses
Medium doses
High doses
Target


Irradiated volume
outside the beam
Conformal
conventional
Low doses
Medium doses
High doses
Target


Irradiated volume
outside the beam
IMRT
Conformal
conventional
Low doses
Medium doses
High doses
Target


Irradiated volume outside the beam
IMRT
Conformal
conventional
protons
Low doses
Medium doses
High doses
Target


High doses ; protons>IMRT>Conformal>Conventional
Irradiated volume outside the beam
IMRT
Conformal
conventional
protons
Low doses
Medium doses
High doses
Target


Irradiated volume outside the beam
Medium-low doses;
Protons>conventional>conformal>IMRT
IMRT
Conformal
conventional
protons
Low doses
Medium doses
High doses
Target

The « optimization » principle : ICRP 73 and European Directive 97/43

- *« For radiotherapeutic purposes, exposures of target volumes shall be individually planned ; taking into account that doses of non-target volumes and tissues shall be as low as reasonably achievable and consistent with the intended radiotherapeutic purpose of the exposure. »*

Risk models and radiobiological aspects

- Available data : Il y a plethore (HM comment)
- The results of such an analysis are rather confusing…
- Brenner adequately mentions in his last 2006 paper "*The large discrepancies between the current standard model(s)… and recent second cancer data*"…
- This confusion culminated recently in an exchange of letters in the Red Journal (2006).

Risk models and radiobiological aspects

- A number of pending questions :
- Should we include age ?
- Should we include « cell killing » at high doses ?
- Should we include fractionation ? (repair ?)
- Should we include genetic susceptibility ?
- Should we include repopulation ?
- The answer is probably « Yes » for each,
- But how ??

Synthesis and recommendations

- In this part, the second cancer risk in low-dose areas, which was our initial concern, has to be put in perspective and balanced with a number of positive aspects;
- the ***now recognized increased anti-cancer efficacy of some new techniques***
- the possible ***decrease in the second cancer risk in the (reduced) high dose regions***
- ***the decrease in toxicity attached to those new techniques***

Synthesis and recommendations

- One of the main recommendations should probably be directed to the management of ***children patients***, for whom the second cancer risk could still be underestimated by the current models (because susceptibility is not taken enough into account ?),
- While this type discussion for elderly patients could be irrelevant, since they are less prone to develop a radio-induced cancer and since a large percentage of them will not live long enough to observe its emergence ….

To summarize:

- We have to find out what could be the right position between ;
- An unreasonably reassuring statement ; *« Let’s go, there’s no risk at all … »*
- An unreasonably scaring position ; *« Those techniques are awfully carcinogenic ! »*