

Will innovation change compliance in radiotherapy treatments?

- INNOVATION IN INTERVENTIONAL RADIOOTHERAPY -

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Gemelli

Fondazione Policlinico Universitario Agostino Gemelli IRCCS
Università Cattolica del Sacro Cuore



ART

Advanced Radiation
Therapy

Interventional Radiotherapy

INTERACTS

Active Teaching School



Interventional Oncology Center
Centro di Oncologia Interventistica

Will innovation change compliance in radiotherapy treatments?



to change

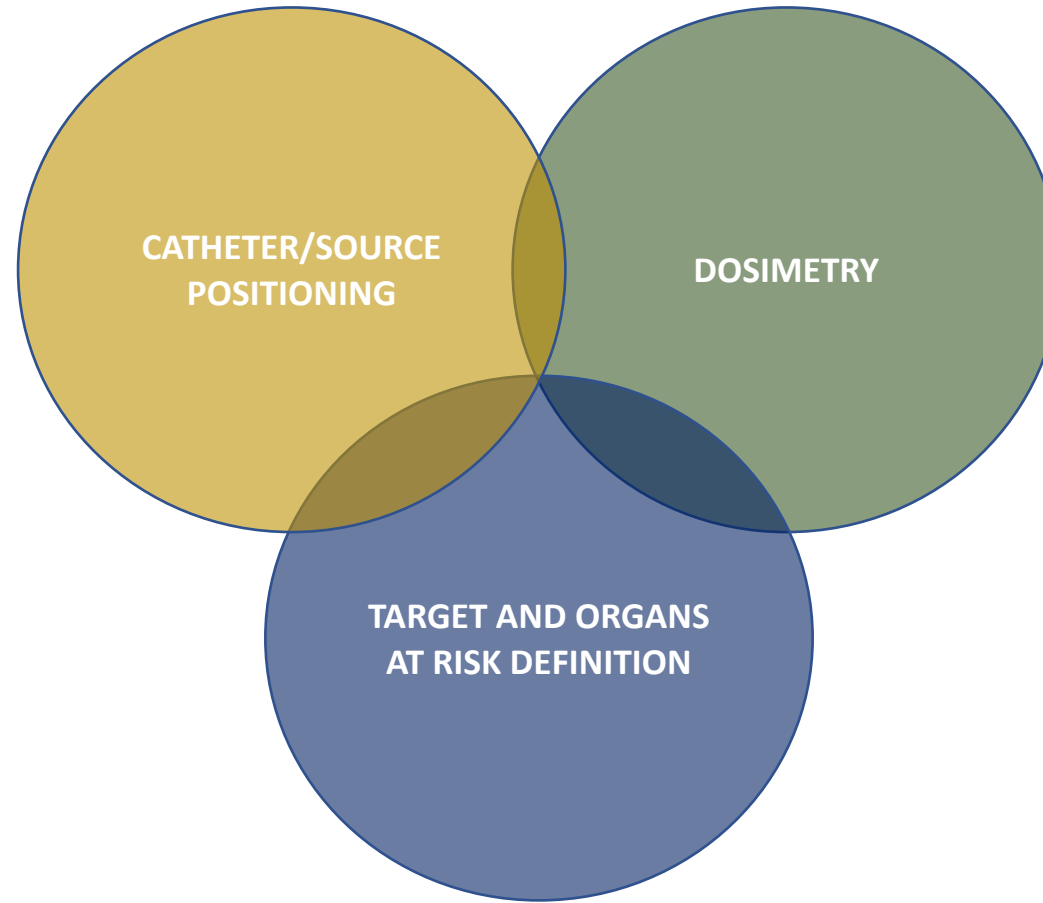


or

NOT to change



from CURIETHERAPY/BRACHYTHERAPY to INTERVENTIONAL RADIOOTHERAPY



Minimal Invasive Interventional Oncology: The New Frontier of Precision Medicine

1D



1D



CURIETHERAPY

1D



CURIETHERAPY

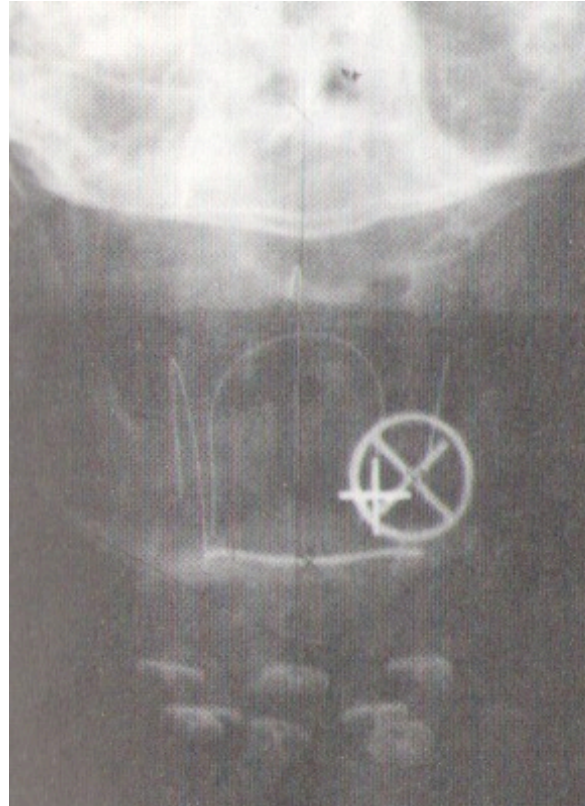
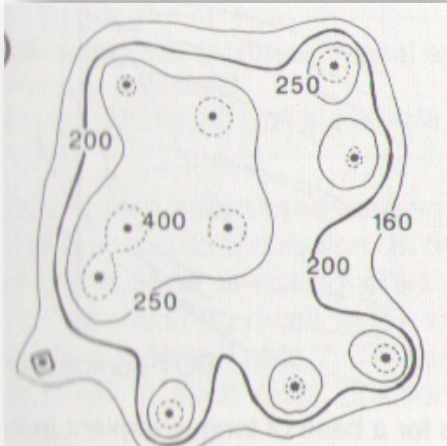
1D



BRACHYTHERAPY

1D

2D



BRACHYTHERAPY

1D

2D



TARGET

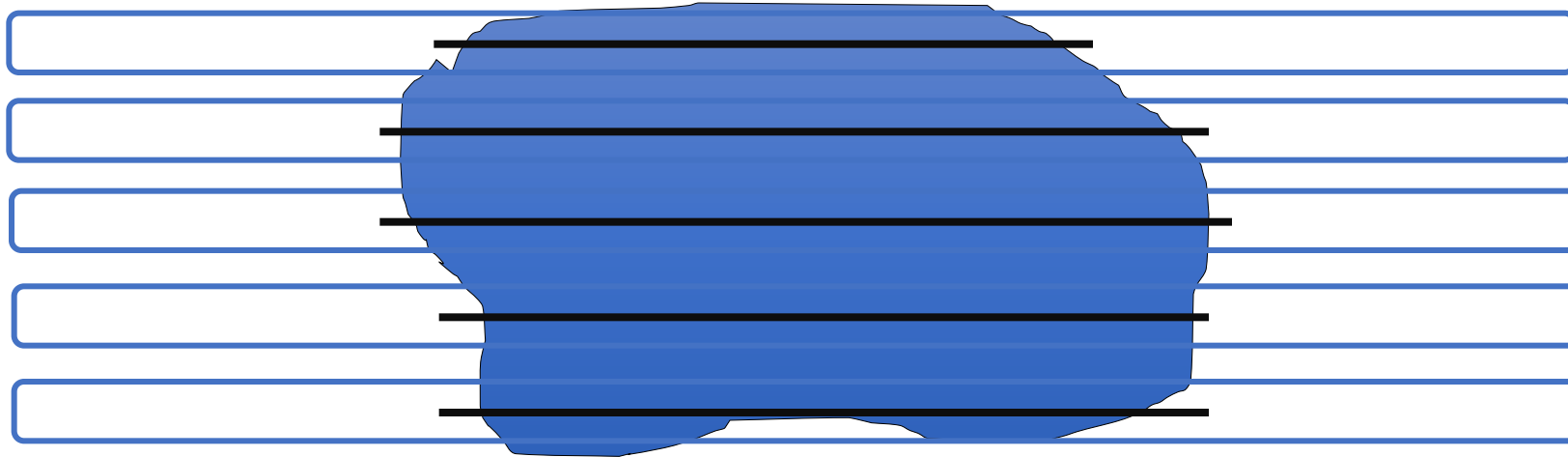
BRACHYTHERAPY

1D

2D



BRACHYTHERAPY

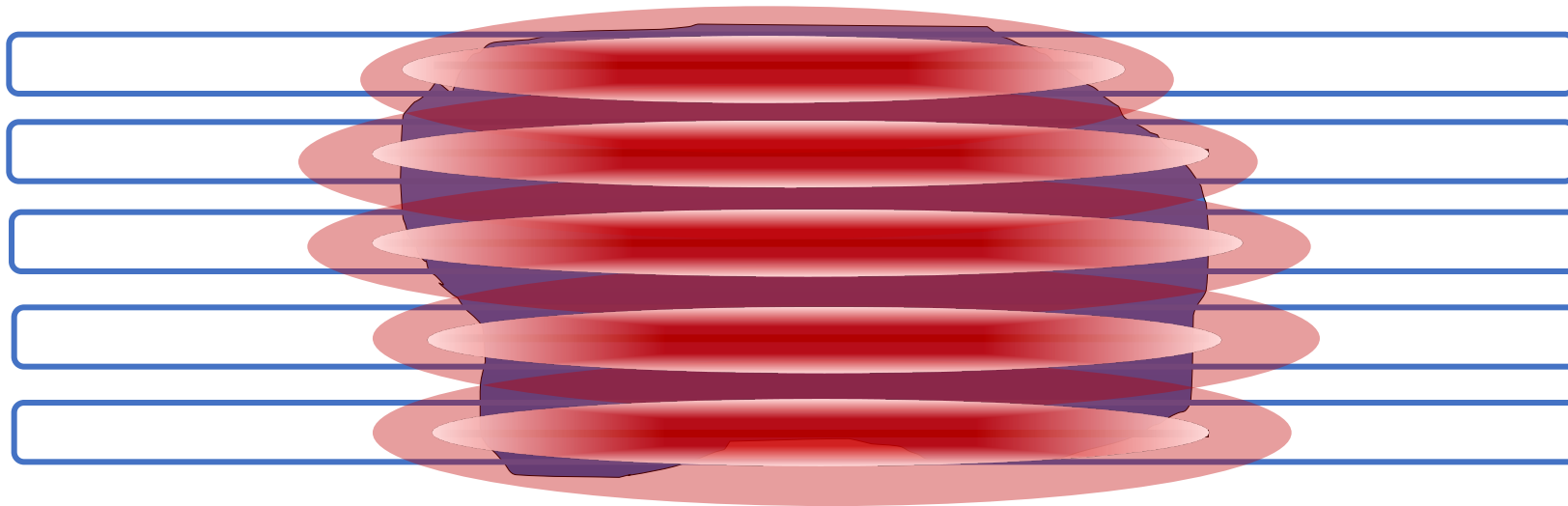


linear sources

BRACHYTHERAPY

1D

2D



linear sources

BRACHYTHERAPY

1D

2D

Table 9.1 Results for treatment of mobile-tongue cancer

Authors	N Pts	TNM - Stage	Treatment	Brachy	Survival %	Local control %	Complications %
Akine [1]	224	I, II	BT, Cryo, S	LDR	72	BT 90, Cryo 89, S 84	
Benk [2]	110	II	A 85, B 25	LDR	DFS: A42, B 24	A 88, B 36	I II 35, III 5
Bolla [3]	218	T1, T2 T3	B	LDR	T1 66, T2 51, T3 27	T1 62, T2 53, T3 30	
Decroix [5]	602	T1 96, T2 289, T3 217	A 312, B 148, C 67, D 69	LDR	T1 80, T2 56, T3 25	76	STN 24 ORN 13
Fujita [6]	207	T1 93, T2 114	A 127, B 80	LDR	T1 83, T2 69	T1 93, T2 77	11
Gerbaulet [7] Haie [9]	269	T1 83, T2 148, T3 38	A 194, B 75	LDR	T1 T2 T3 A 62, B 30	T1 T2 T3 A 87, B 49	STN 11 ORN 13
Hareyama [10]	130	T1, T2, T3	A 99, B 31			T1-2 92, T3 71	STN 20 ORN 13
Inoue [11]	29	T1, T2, T3	LDR/HDR	15/14		86/100	
Lefebvre [14]	283	T1 81, T2 170, T3 32	A	LDR		T1 87, T2 84, T3 62	
Mahe [15]	24	T1 T2 ≤ 3, N0	A	LDR		92	STN 16
Mazeron [17]	166	T1 N0 70, T2 N0 83, T1-T2 N1-N2 13	A	LDR	T1 N0 52, T2 N0 44, T1-T2 N1-N2 8	T1 N0 87, T2 N0 92, T1-T2 N1-N2 69	
Pernot [24]	147	T2 N0	A 70, B 77	LDR	A 62, B 35	A 90, B 51	
Pernot [25]	448	T1 125, T2 186, T3 123, T4 4	A 181 B 267	LDR	T1 69, T2 41, T3 25	T1 93, T2 65, T3 49	
Shibuya [28]	370	I 90, II 280	A, B		I 84, II 75	Spf 85, exoph 79, infiltr 45	Gr2 38, Gr3 4
Wendt [30]	103	T1, T2, T3	A 18 C 8 B1 RT <40Gy 31 B2 RT >40 Gy 46	LDR	A 89, C57 B1 78 B2	A 65 C 28 B1 92 B2 69	ORN A 0 C 0 B1 4 B2 17



BRACHYTHERAPY

1D

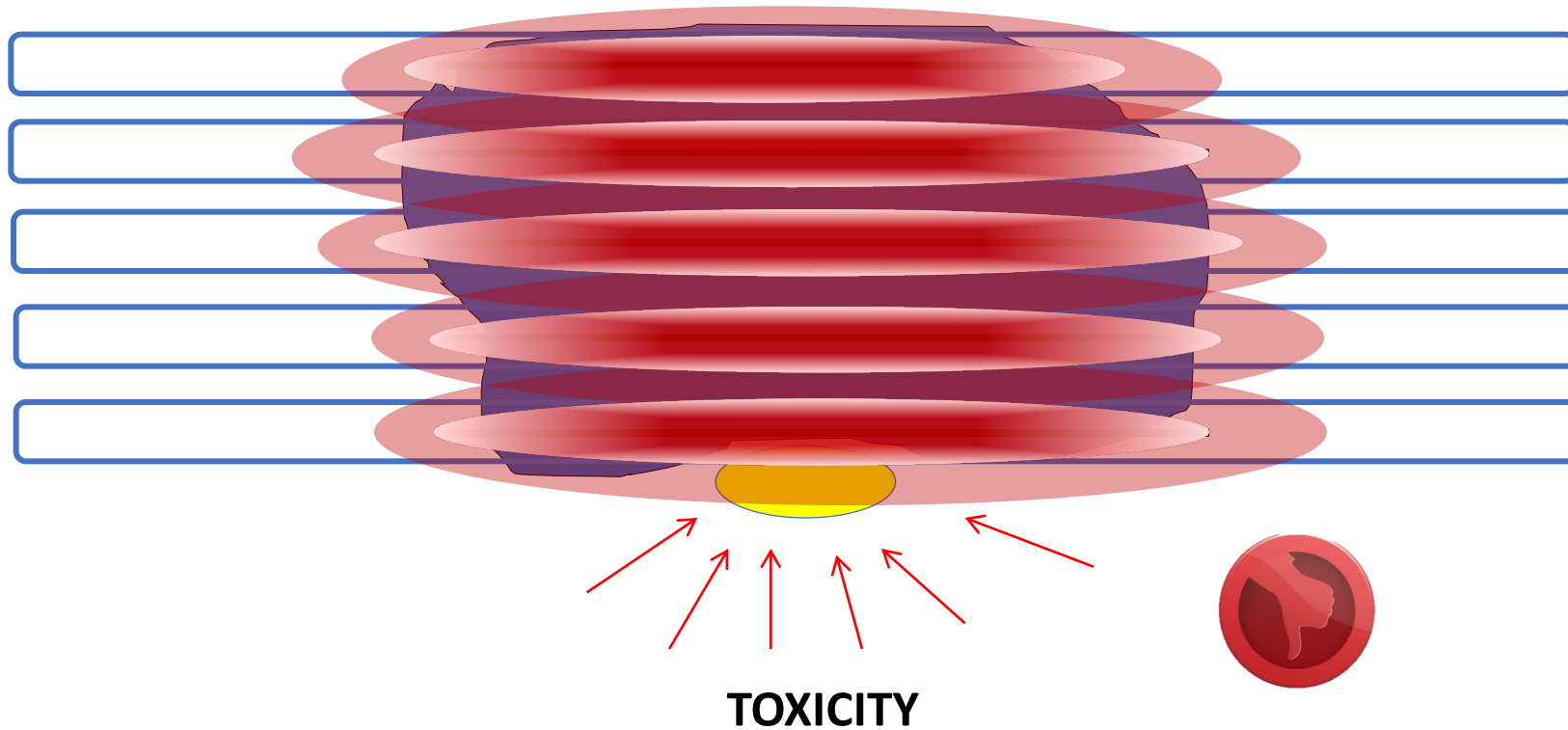
2D



BRACHYTHERAPY

1D

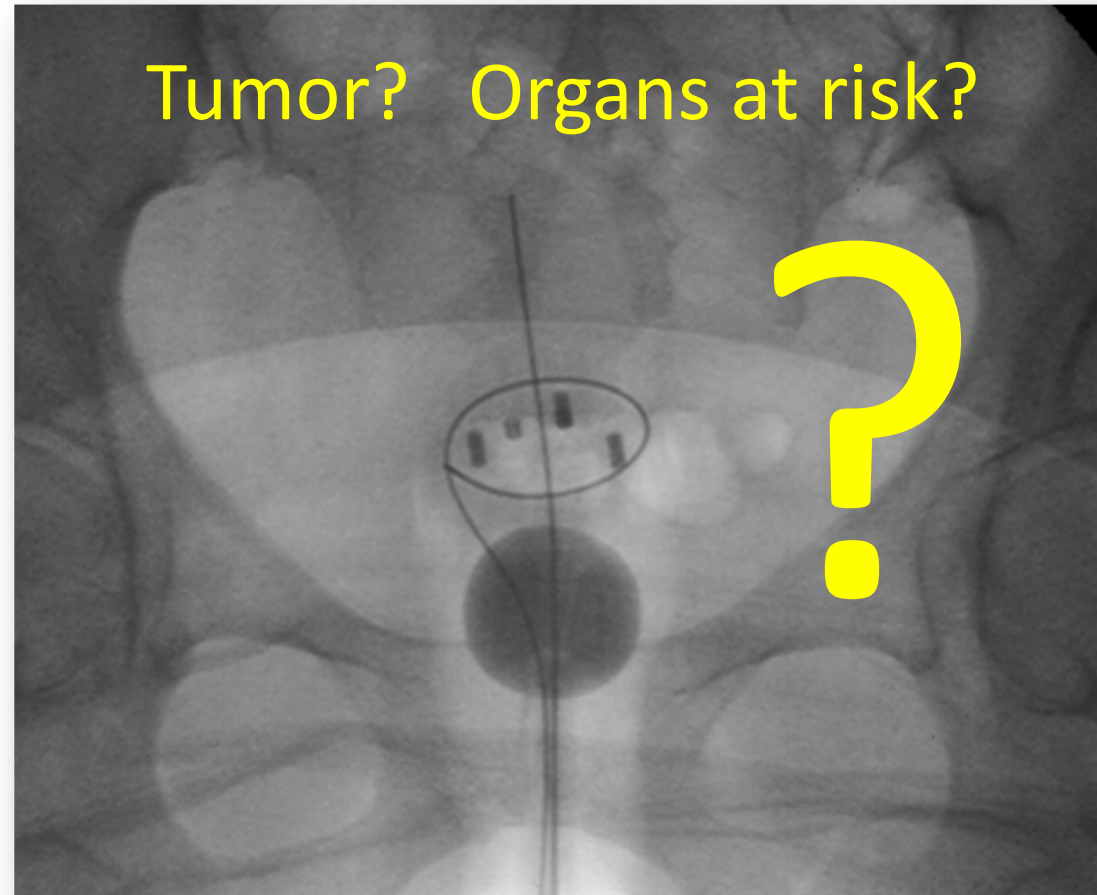
2D



BRACHYTHERAPY

1D

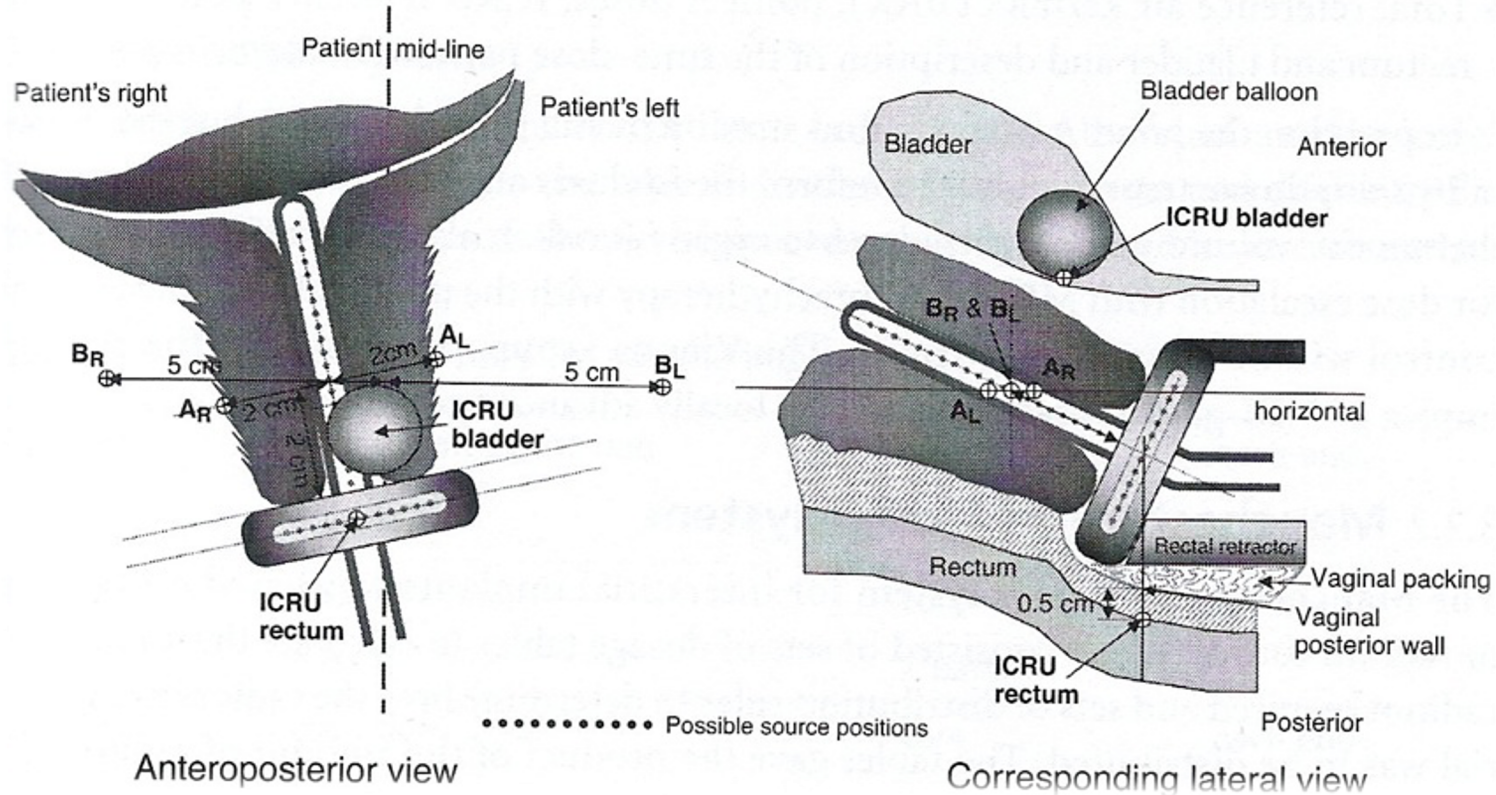
2D



BRACHYTHERAPY

1D

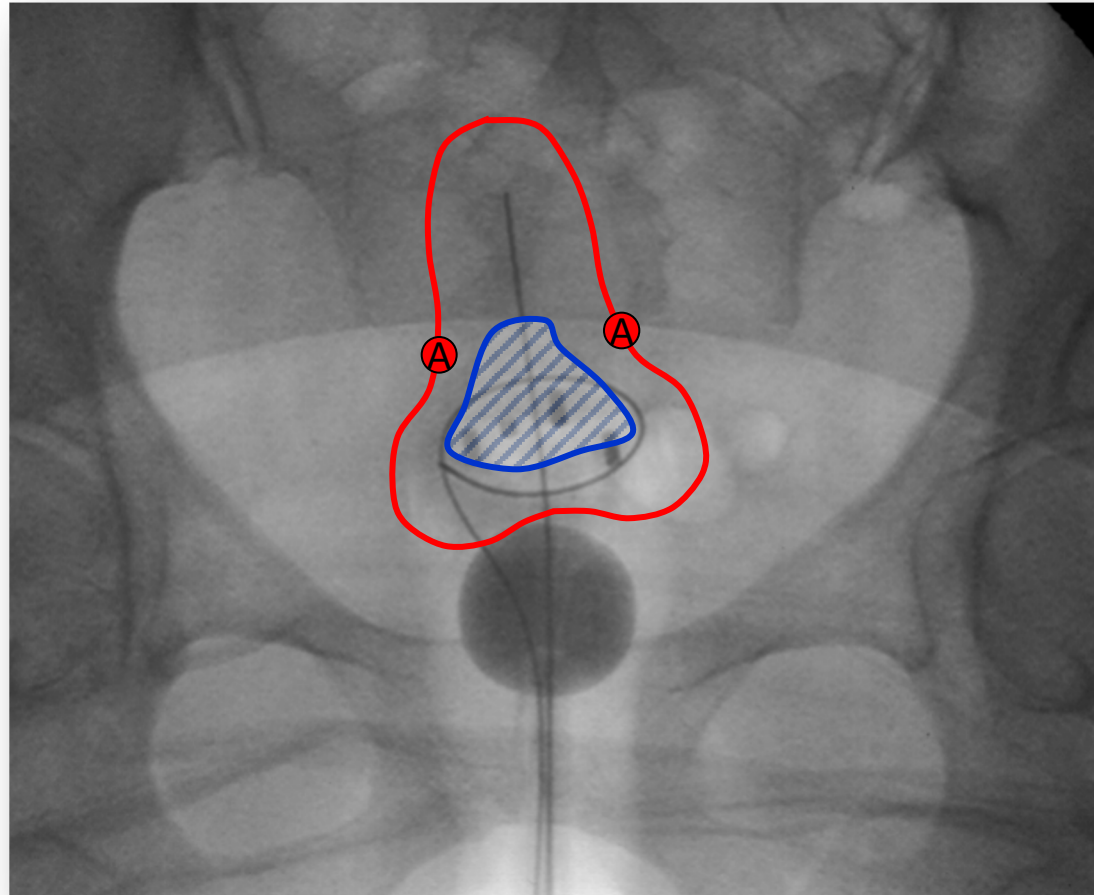
2D



BRACHYTHERAPY

1D

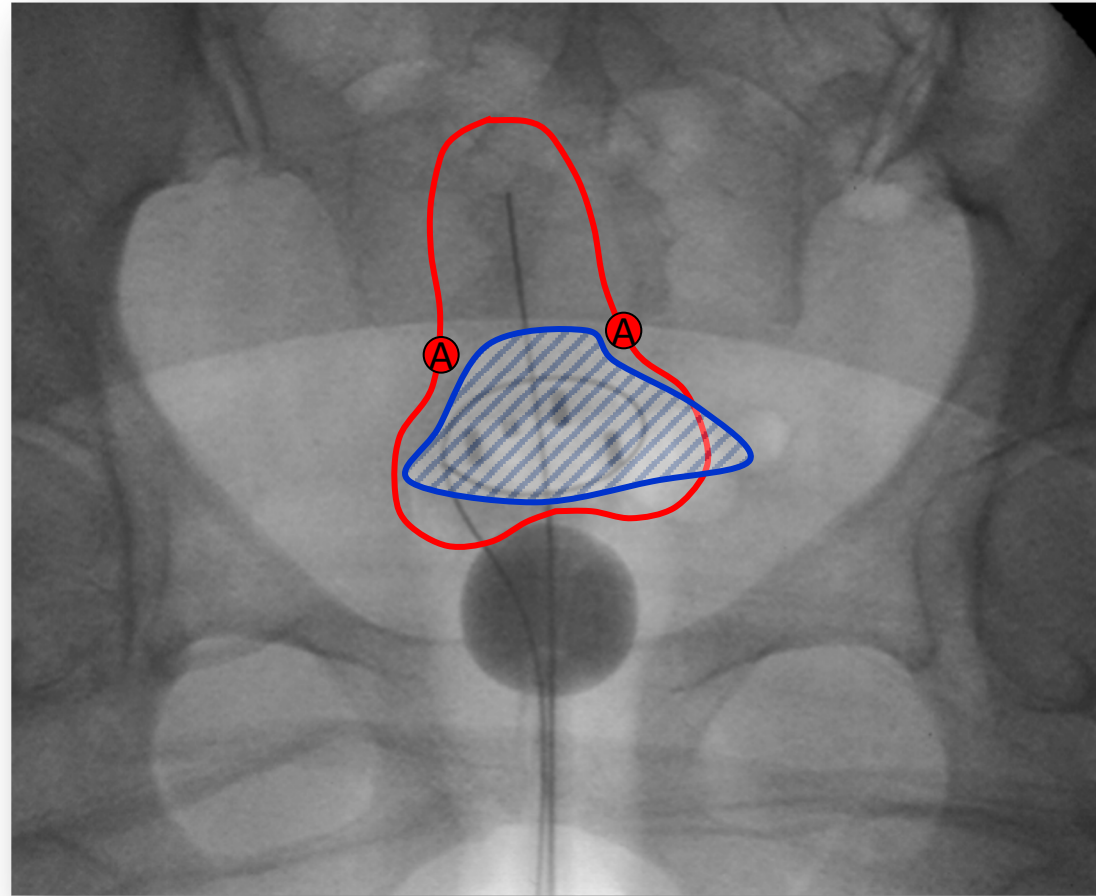
2D



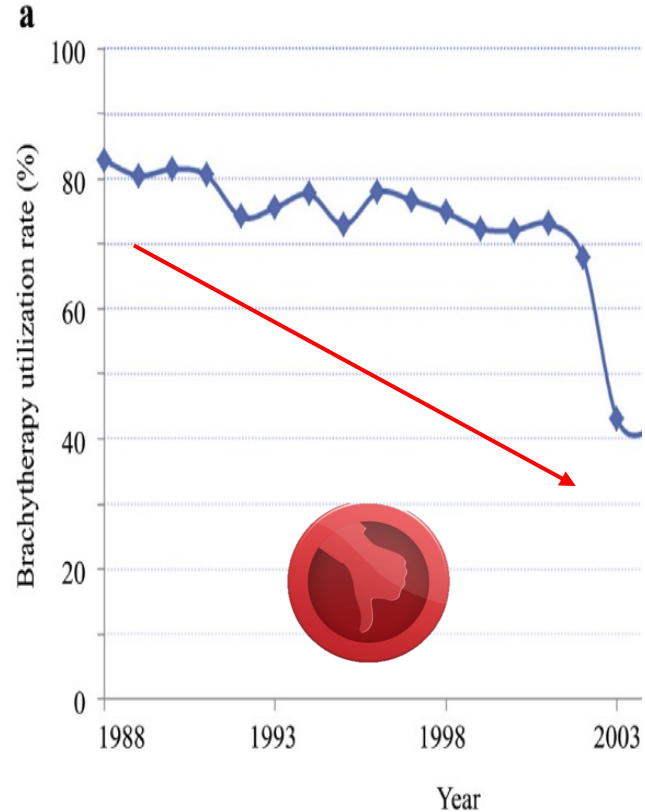
BRACHYTHERAPY

1D

2D



BRACHYTHERAPY



RX EXPOSURE OF OPERATORS

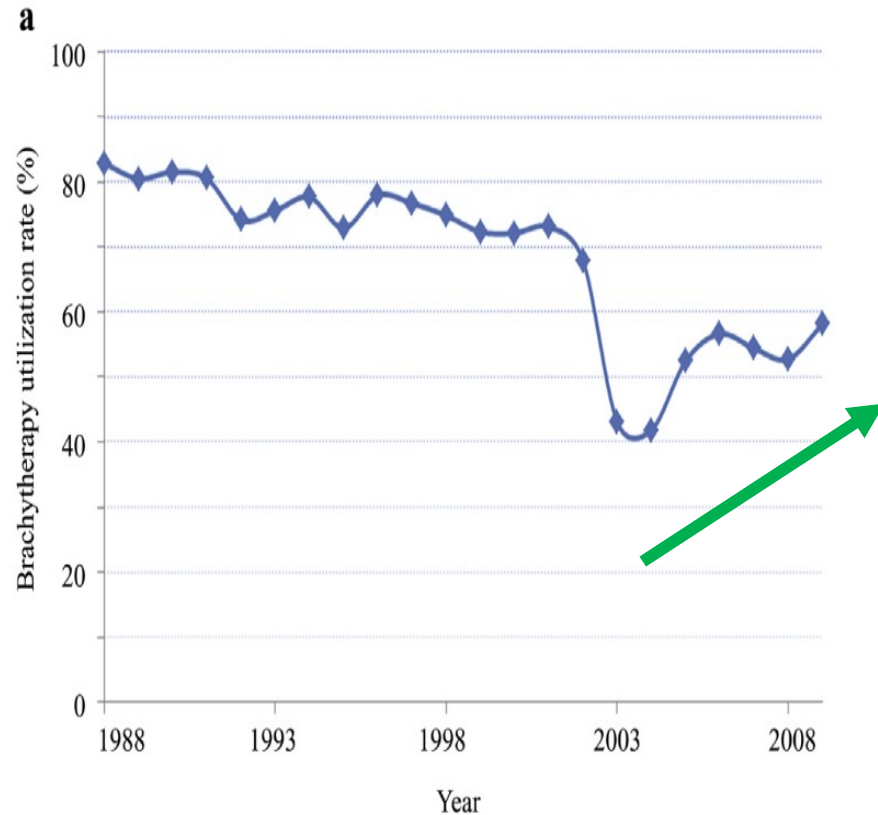
DOSIMETRIC DIFFICULTIES

PREPARATION OF THE RADIOACTIVE
MATERIAL FOR EACH PATIENT

IMPLANT SYSTEMS

NO CT/MRI COMPATIBLE APPLICATORS

INTERVENTIONAL RADIOOTHERAPY

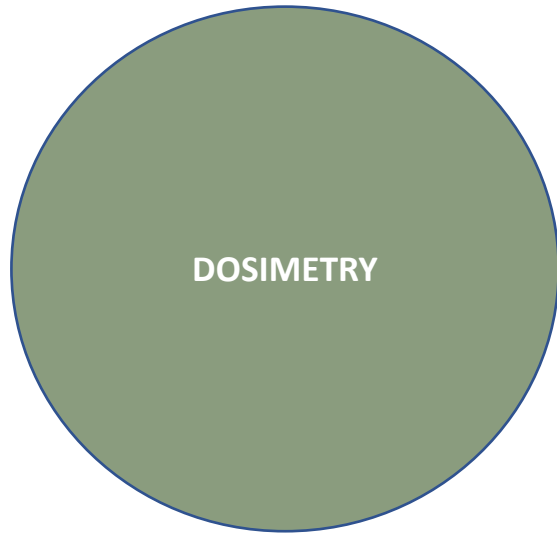


NEW ERA

:
Minimal Invasive Precision Medicine



INTERVENTIONAL RADIOOTHERAPY



INTENSITY MODULATED IRT

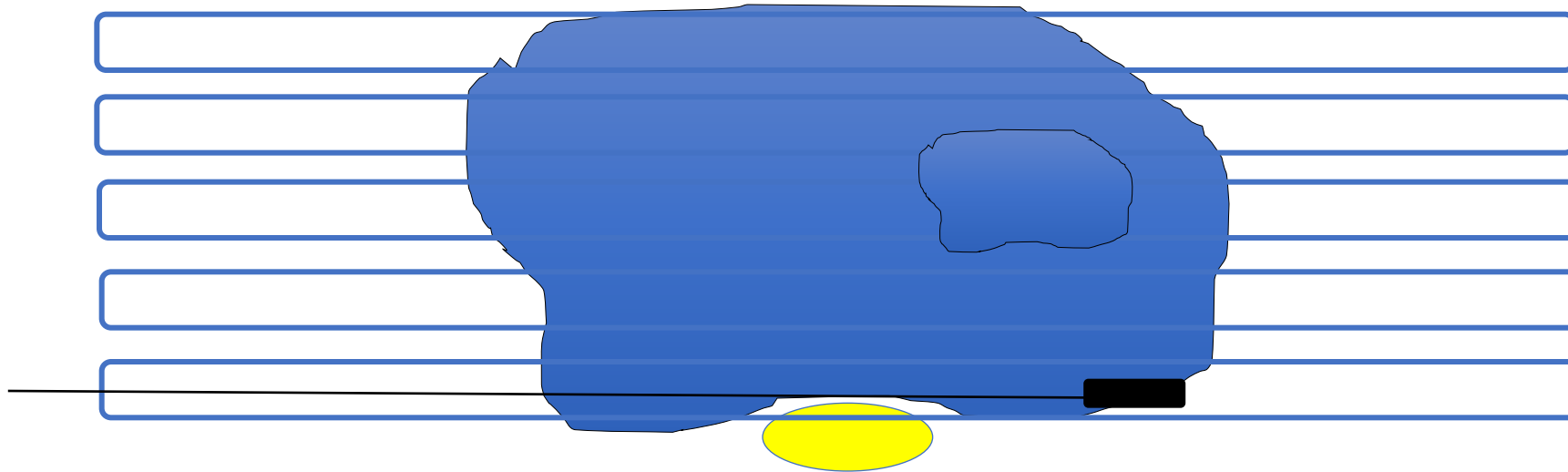
INTERVENTIONAL RADIOOTHERAPY



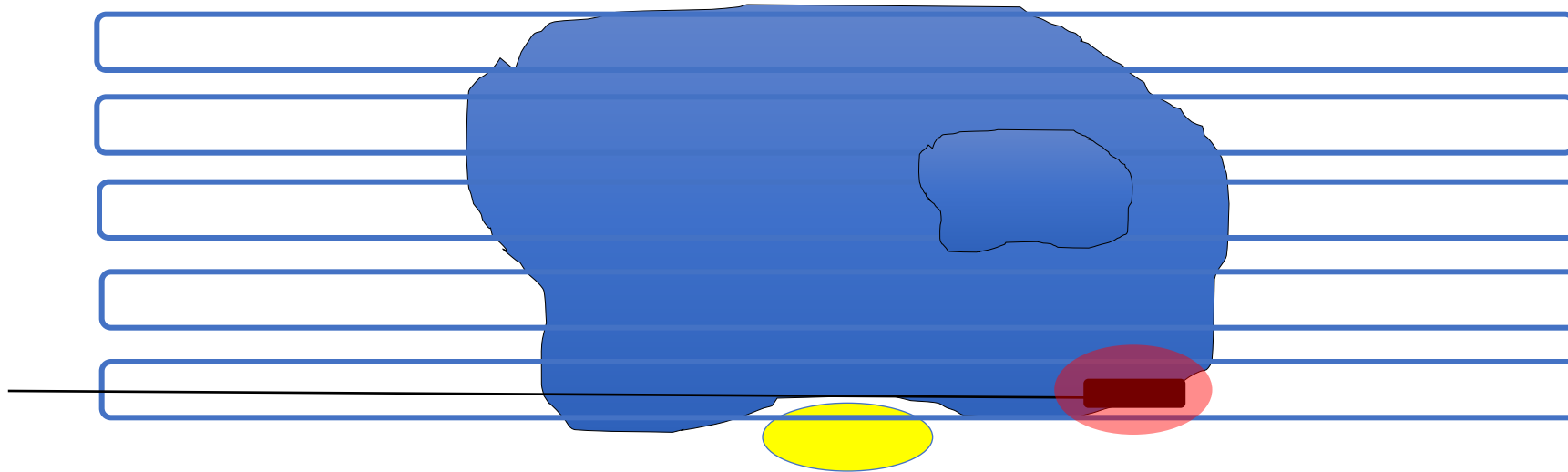
INTERVENTIONAL RADIOOTHERAPY

1D

2D



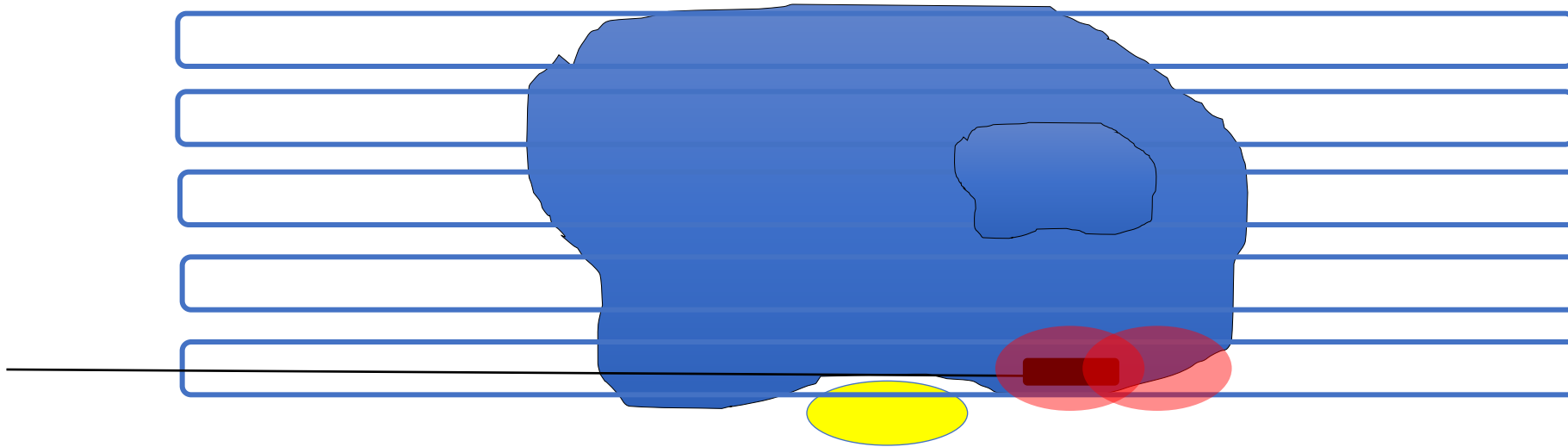
INTERVENTIONAL RADIOOTHERAPY



INTERVENTIONAL RADIOOTHERAPY

1D

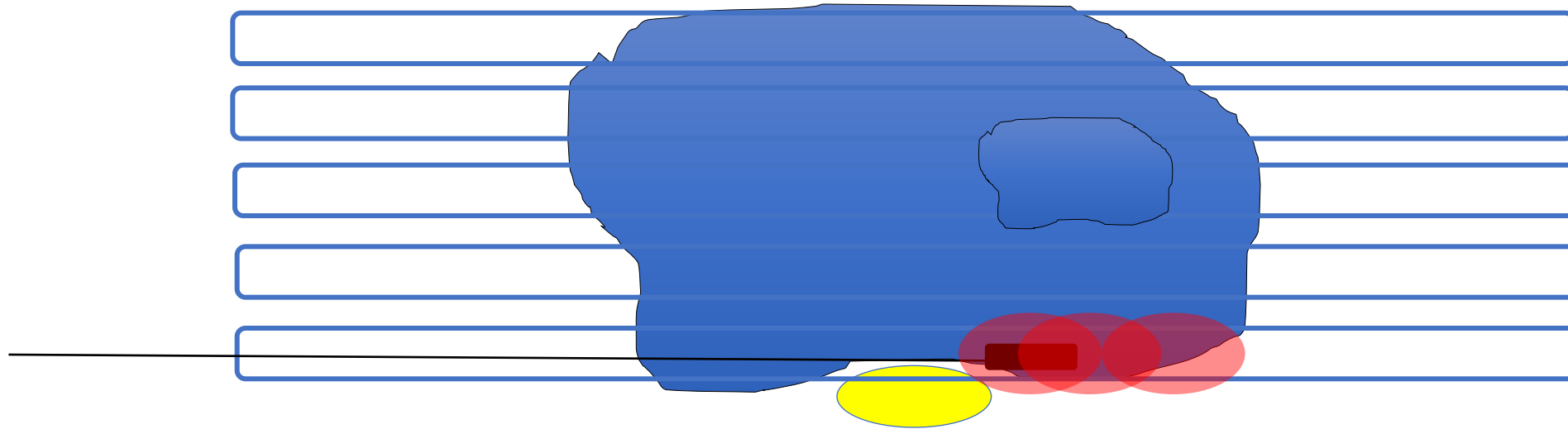
2D



INTERVENTIONAL RADIOLOGY

1D

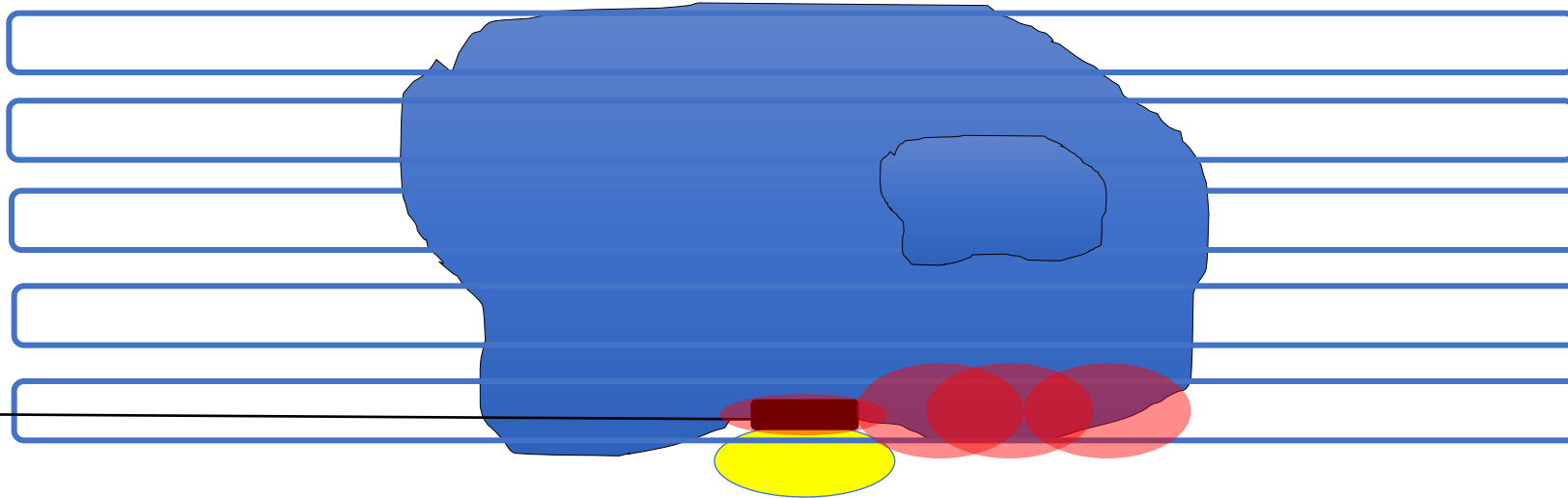
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INTERVENTIONAL RADIOOTHERAPY

1D

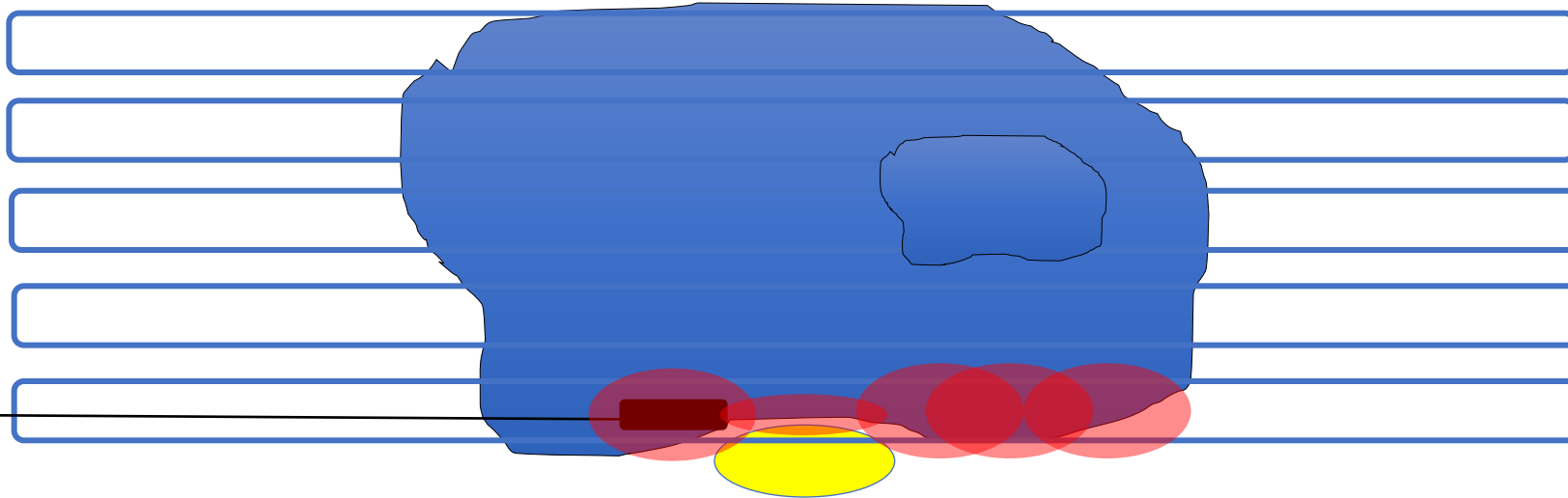
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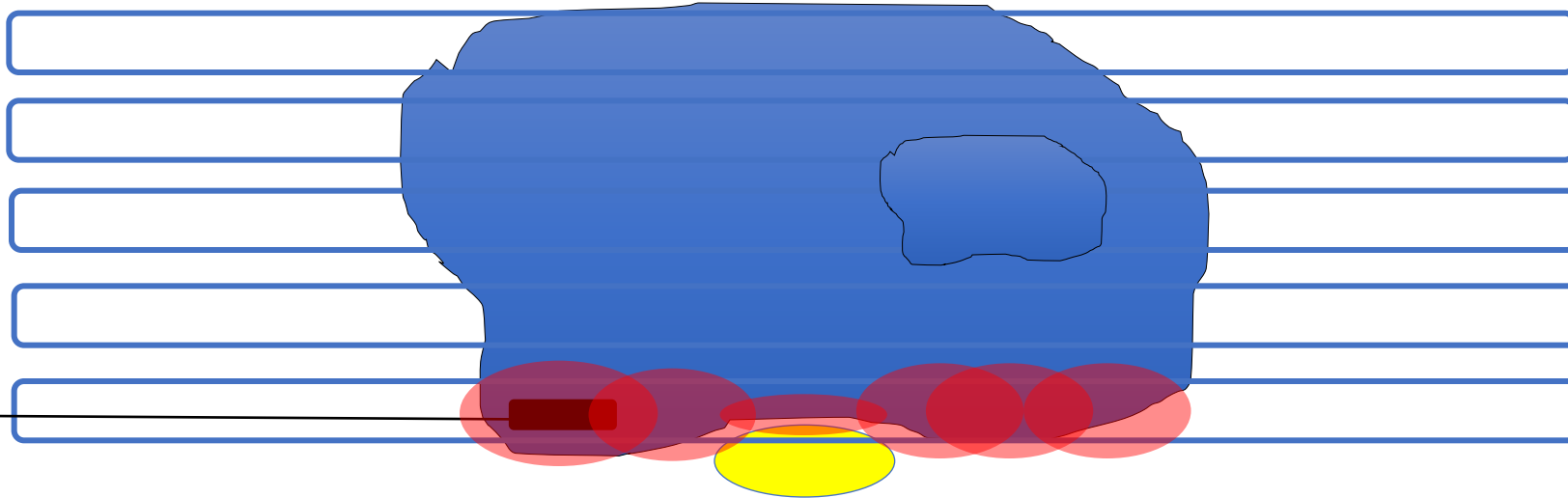
INTERVENTIONAL RADIOOTHERAPY

1D

2D



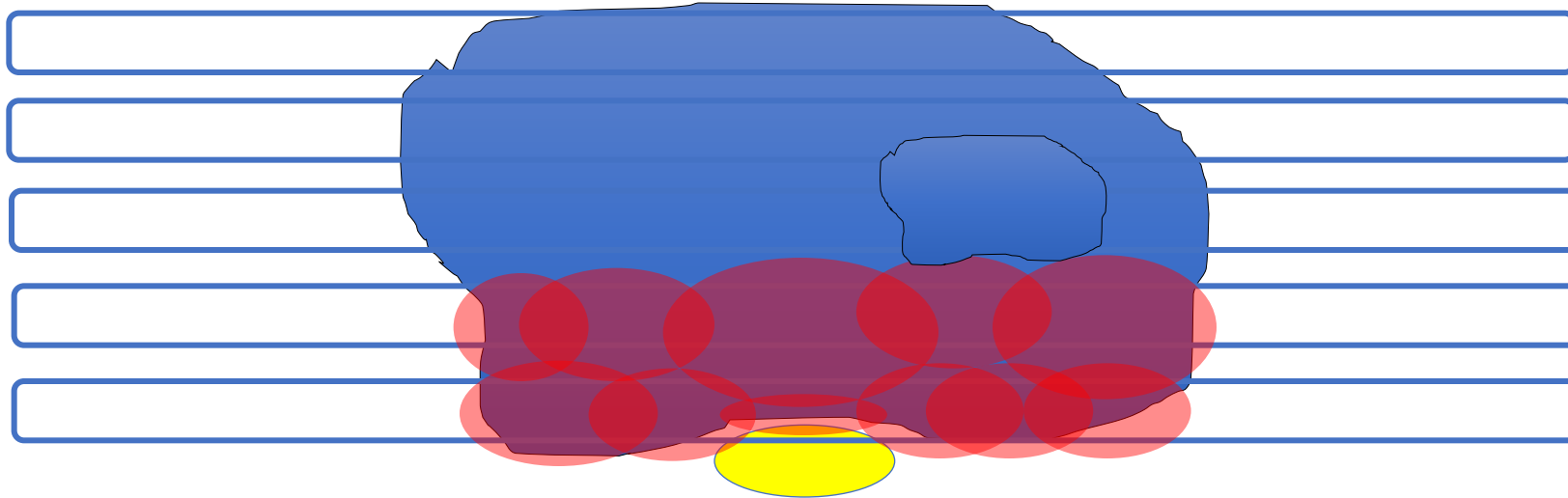
INTERVENTIONAL RADIOOTHERAPY



INTERVENTIONAL RADIOOTHERAPY

1D

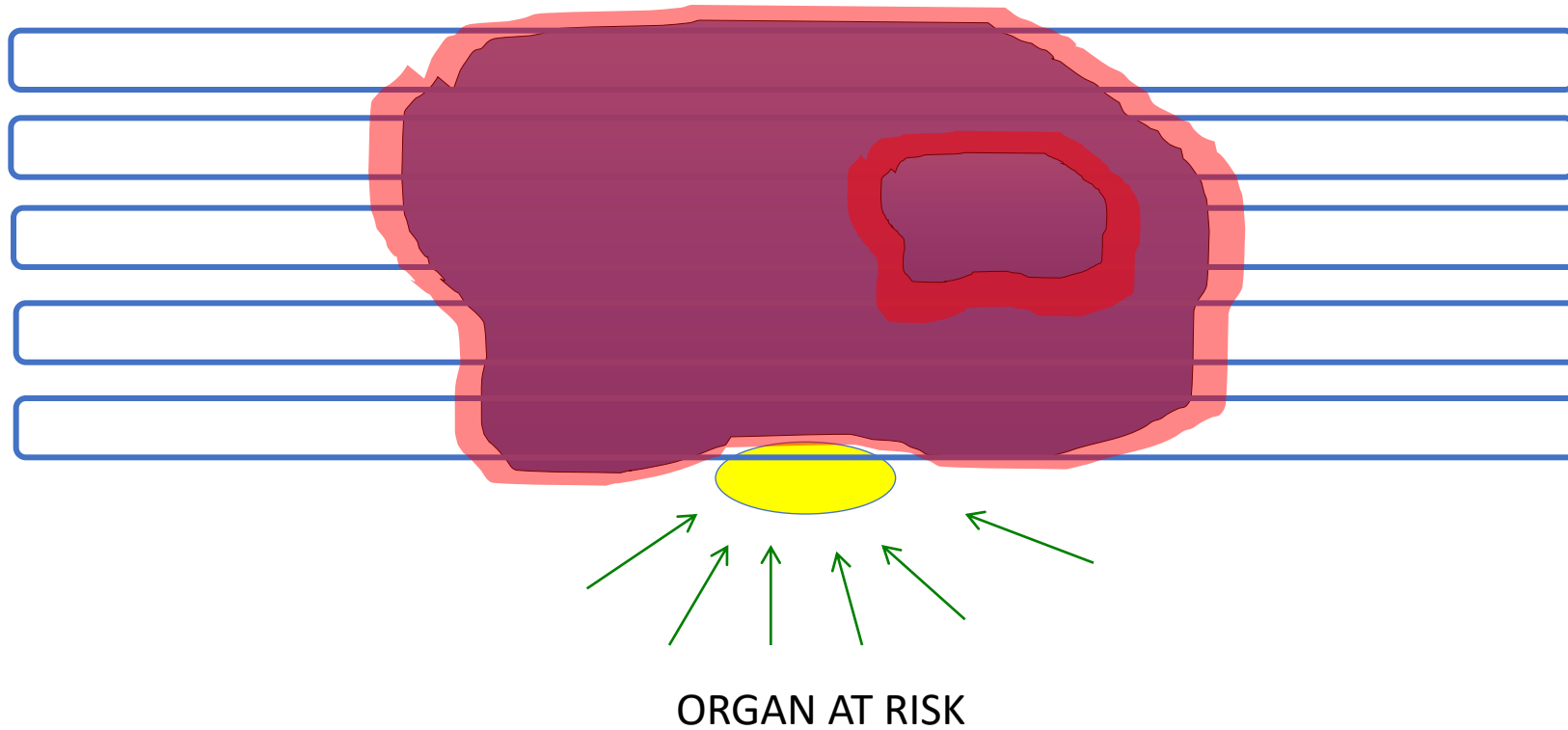
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INTERVENTIONAL RADIOOTHERAPY

1D

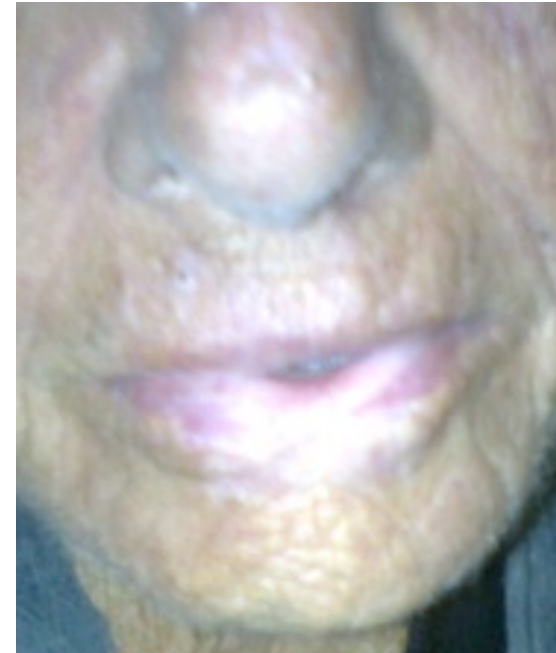
2D



INTERVENTIONAL RADIOOTHERAPY

1D

2D



INTERVENTIONAL RADIOOTHERAPY



Toxicity

Author	n	Dose (Gy)	LDR	HDR	PDR	5 years local control (%)	5 years OS (%)	Toxicity
Beauvois <i>et al.</i> [21]	237	65-68	¹⁹² Ir	–	–	85	75	9.5% necrosis
Gerbaulet <i>et al.</i> [22]	231	76	¹⁹² Ir	–	–	95	75	13.0% necrosis
Tombolini <i>et al.</i> [24]	57	62	–	HDR	–	90 (10 yrs)	n.d.	n.d.
Guinot <i>et al.</i> [26]	104	9 × 5.0 bid	–	HDR IMBT	–	95	85	0%
Lock <i>et al.</i> [173]	51	55	¹⁹⁸ Au	–	–	97.8	87.9	Good cosmesis 48/51
Serkies <i>et al.</i> [25]	32	60-70	–	–	PDR	98	95	2/32
Johansson <i>et al.</i> [20]	43	60	–	–	PDR	94.5 (10 yrs)	58.3	2% soft tissue necrosis 2% bone necrosis

Linear S

IM-IRT

IM-IRT

9,5-13%

0-2%

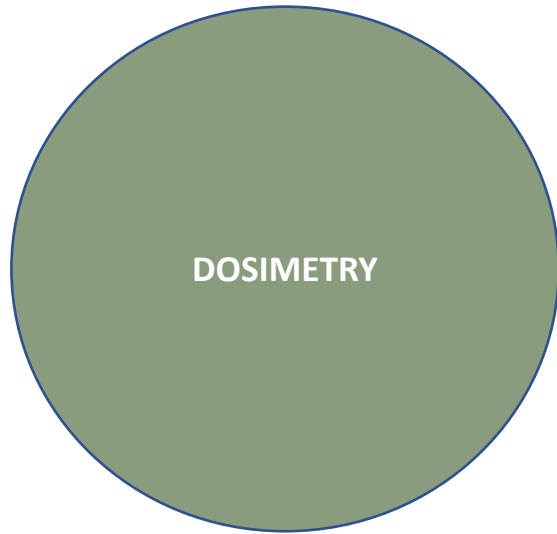


INTERVENTIONAL RADIOOTHERAPY

1D

2D

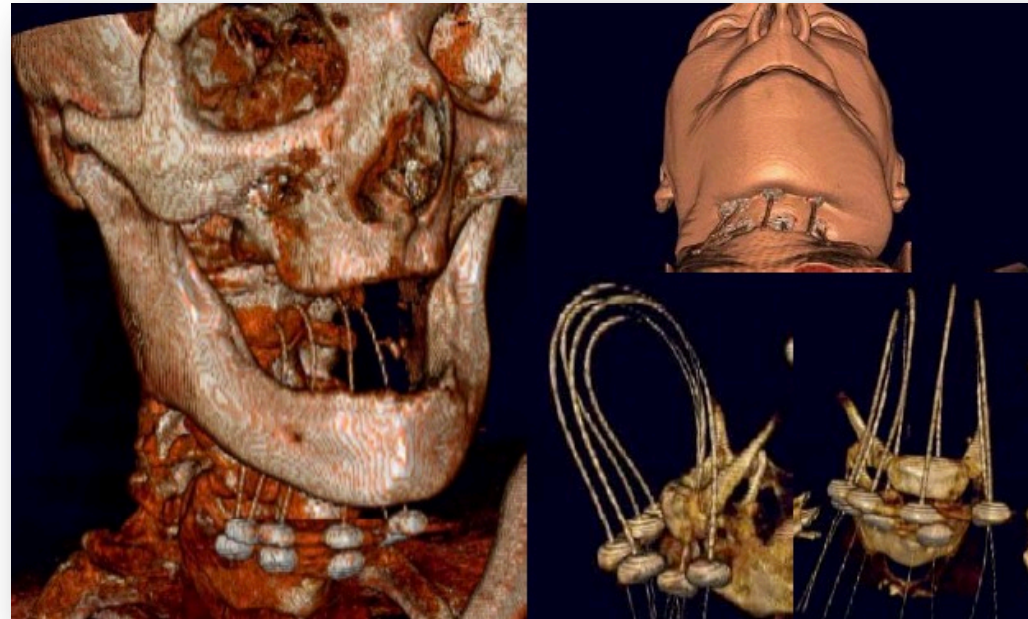
3D



DOSIMETRY

INTENSITY MODULATED IRT

**3D CATHETERS RECONSTRUCTION
AND 3D DOSIMETRY**

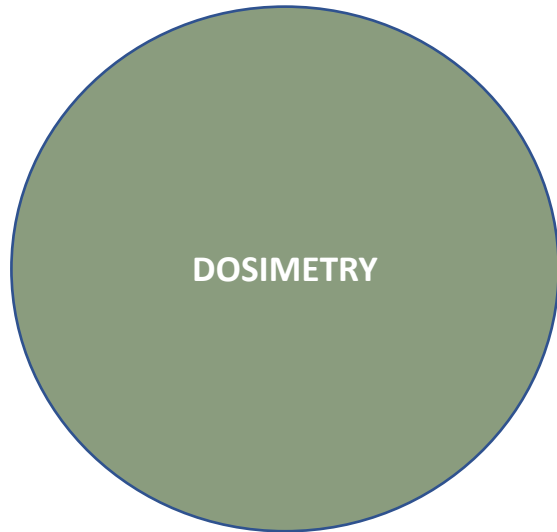


INTERVENTIONAL RADIOOTHERAPY

1D

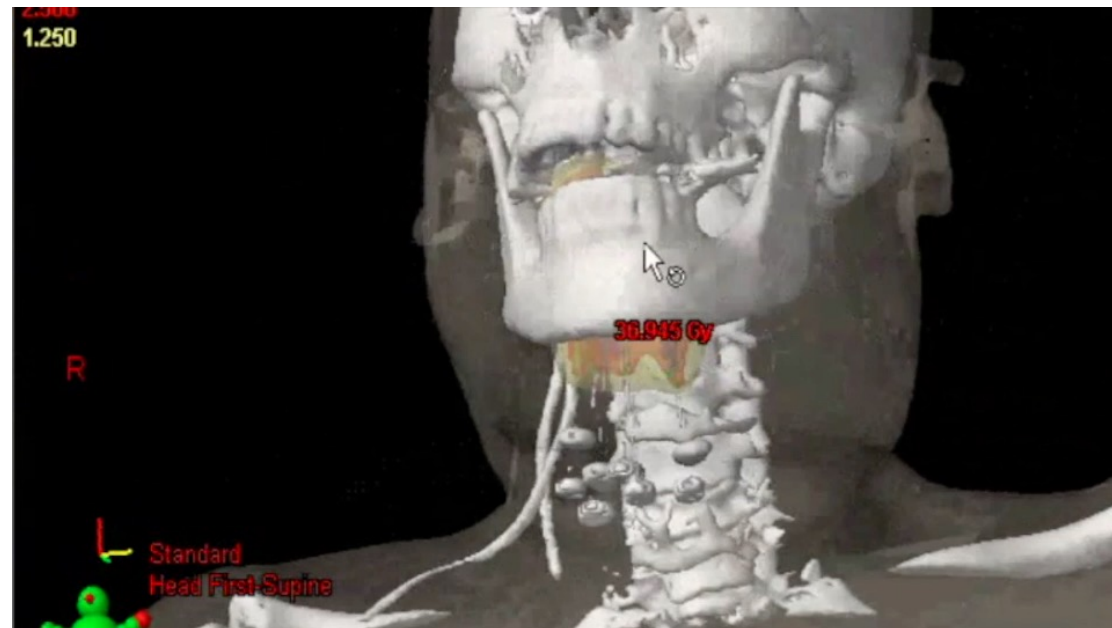
2D

3D



INTENSITY MODULATED IRT

3D CATHETERS RECONSTRUCTION
AND 3D DOSIMETRY

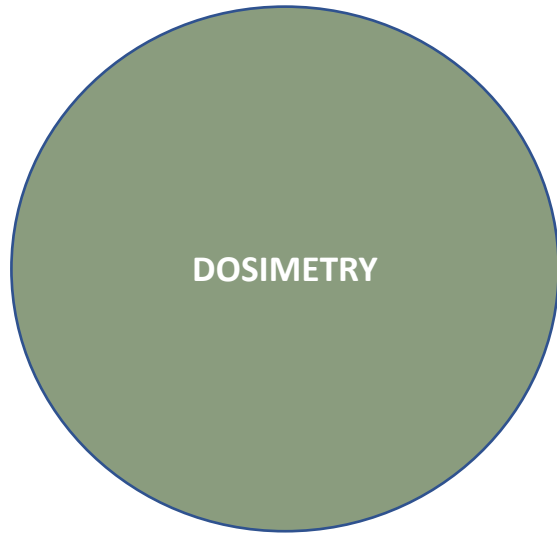


INTERVENTIONAL RADIOOTHERAPY

1D

2D

3D



INTENSITY MODULATED IRT

3D CATHETERS RECONSTRUCTION
AND 3D DOSIMETRY



INTERVENTIONAL RADIOOTHERAPY

1D

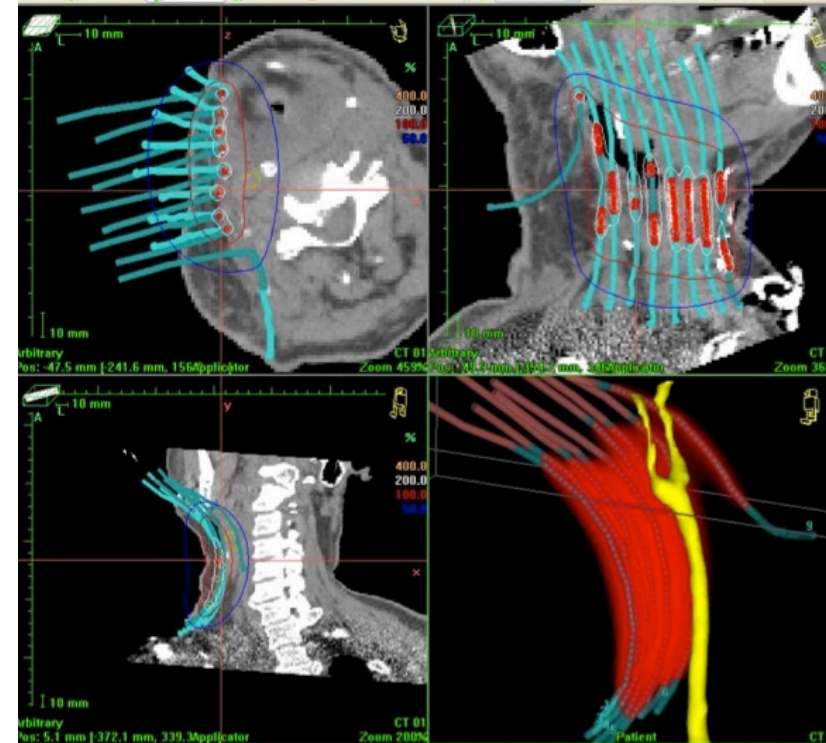
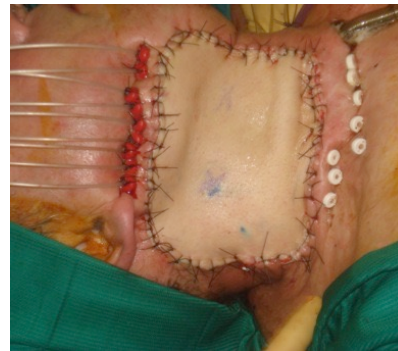
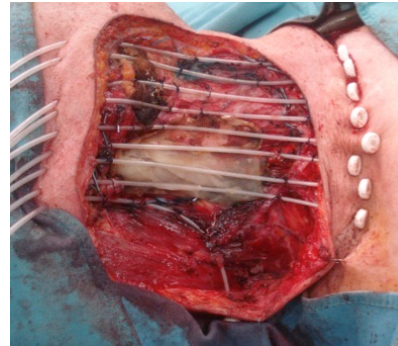
2D

3D

DOSIMETRY

INTENSITY MODULATED IRT

3D CATHETERS RECONSTRUCTION
AND 3D DOSIMETRY

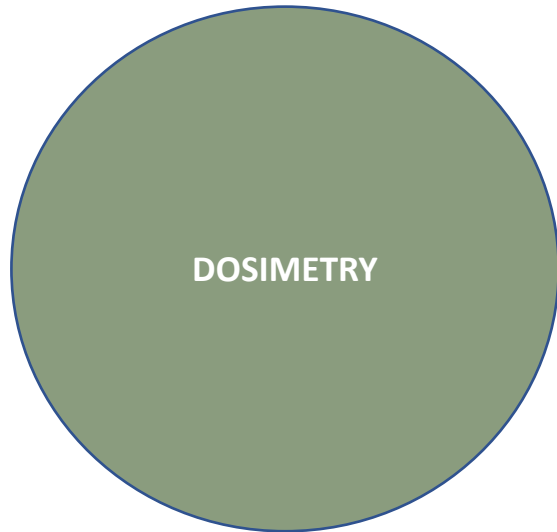


INTERVENTIONAL RADIOOTHERAPY

1D

2D

3D

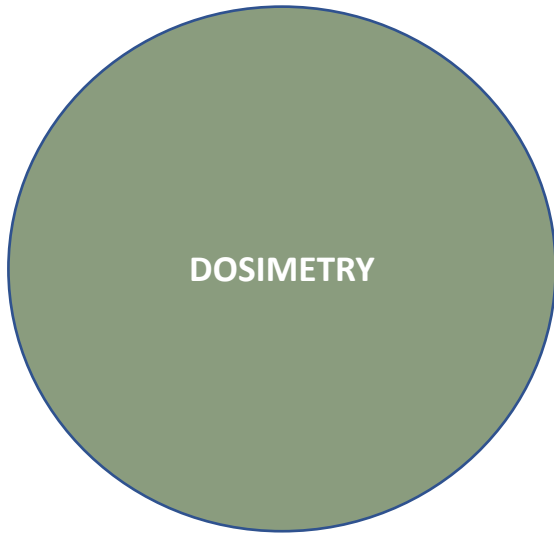


INTENSITY MODULATED IRT

3D CATHETERS RECONSTRUCTION
AND 3D DOSIMETRY



INTERVENTIONAL RADIOOTHERAPY

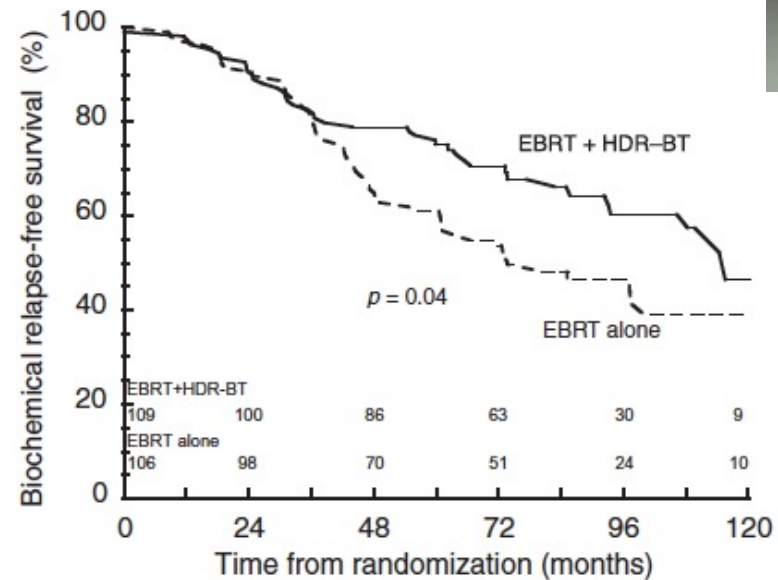
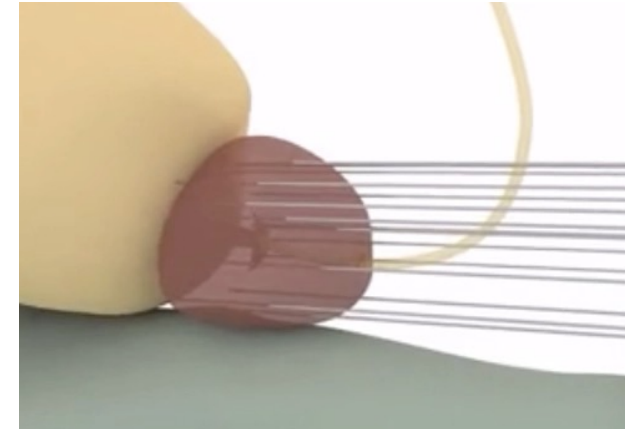


INTENSITY MODULATED IRT

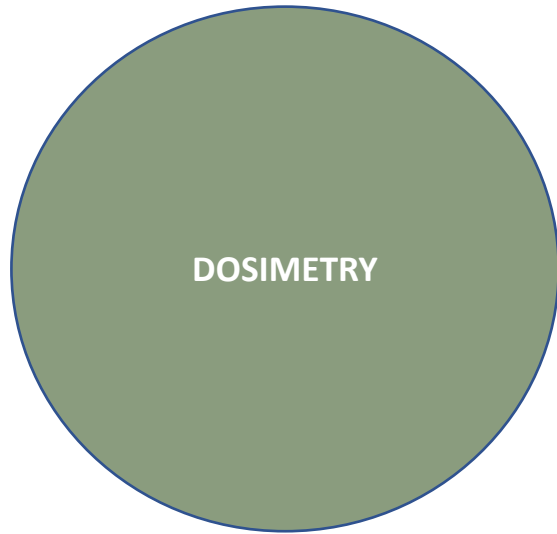
3D CATHETERS RECONSTRUCTION
AND 3D DOSIMETRY

HYPOFRACTIONATED RADIOOTHERAPY

HDR



INTERVENTIONAL RADIOOTHERAPY



INTENSITY MODULATED IRT



3D IMAGING

3D CATHETERS

RECONSTRUCTION AND DOSIMETRY

HYPOFRACTIONATED RADIOOTHERAPY

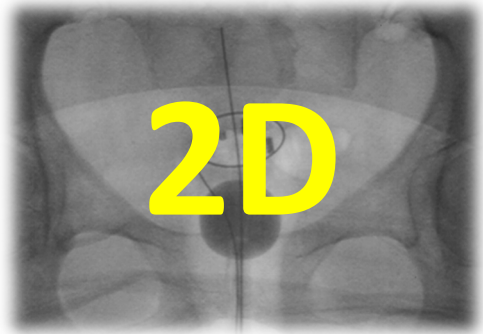
INTERVENTIONAL RADIOOTHERAPY

1D

2D

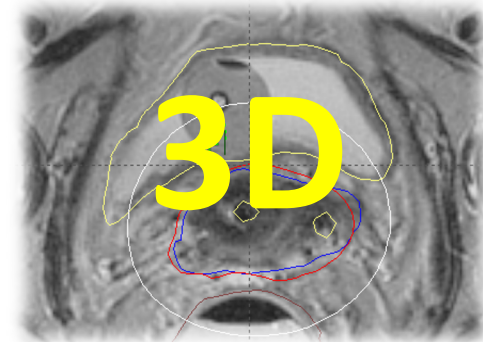
3D

CERVIX CANCER Local Control IIb-IIIb



- Pernot M, et al. *Bull Cancer* 1995; 82(7):568 – 81.
- Gerbaulet A, et al. *The GEC ESTRO Handbook of Brachytherapy*
- Perez CA, et al. *Cancer* 1984; 54: 235-46.
- Fletcher GH, et al. *Textbook of radiotherapy. Philadelphia:1980; 720-89.*
- Pötter R, et al. *Bull Cancer Radiother* 2000; 4: 159 – 172.
- Horiot JC, et al. *Int J Radiat Oncol Biol Phys* 1988; 14(4): 605-11.

40 - 75%



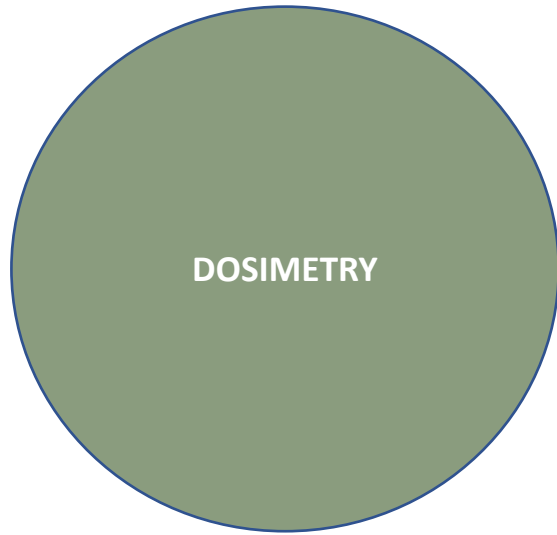
- Pötter R. *Radiother Oncol* 2007
- Haie-Meder C. *Radiother Oncol* 2007
- Chargari C. *IJROBP* 2009
- Dimopoulos JCA. *Radiother Oncol* 2009
- Dimopoulos IJROBP 2009
- Fidarova EF et al. *Radiother Oncol* 2010
- Georg P et al. *IJROBP* 2009

80 - 95%

Less toxicity



INTERVENTIONAL RADIOOTHERAPY



INTENSITY MODULATED IRT

3D CATHETERS
RECONSTRUCTION AND DOSIMETRY

HYPOFRACTIONATED RADIOOTHERAPY



3D IMAGING

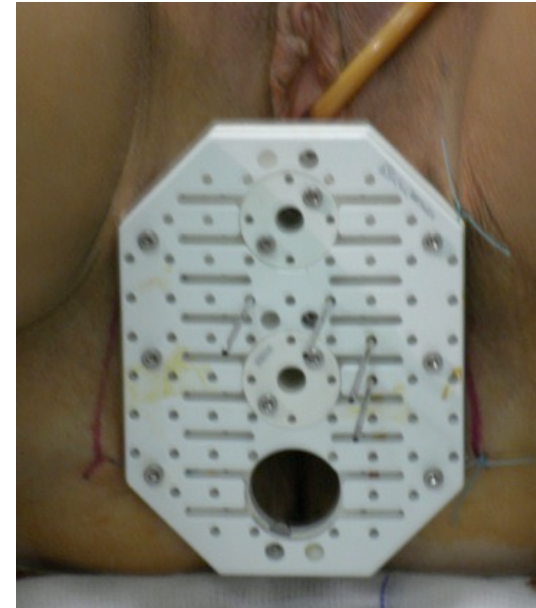
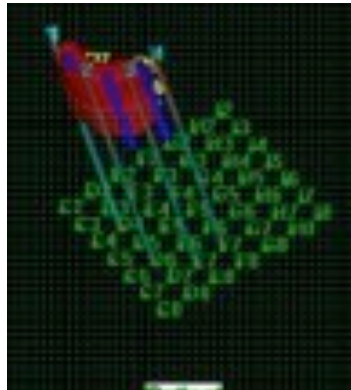
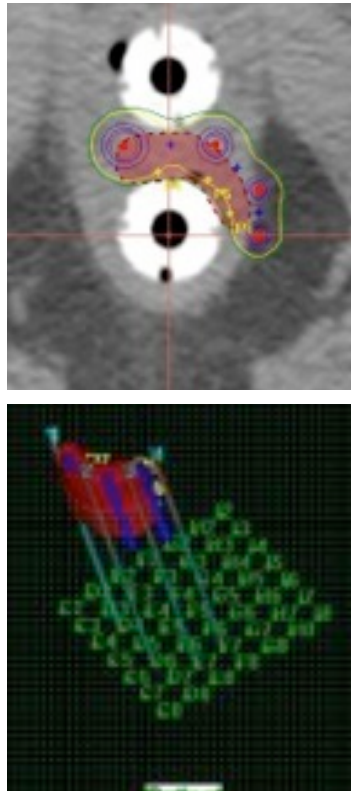
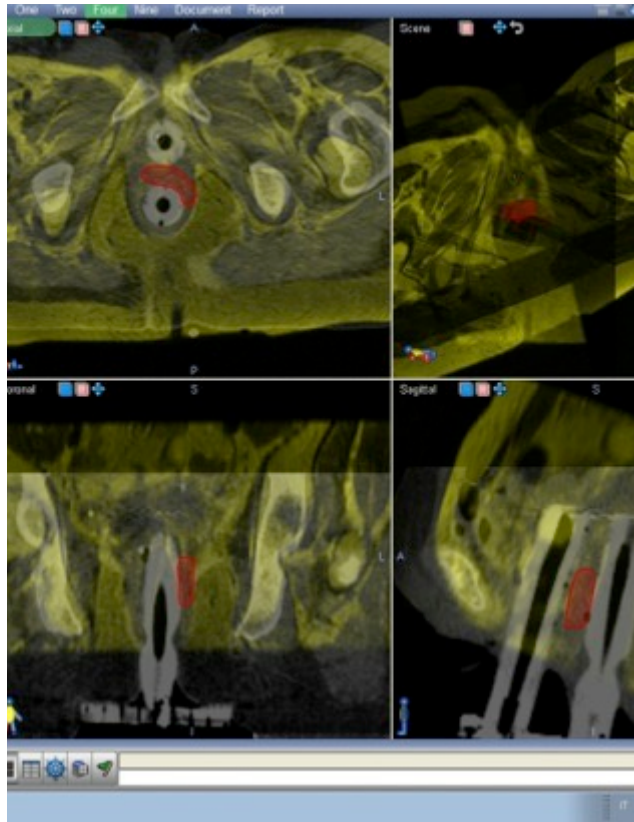
**ADVANCED
IMAGING**

INTERVENTIONAL RADIOOTHERAPY

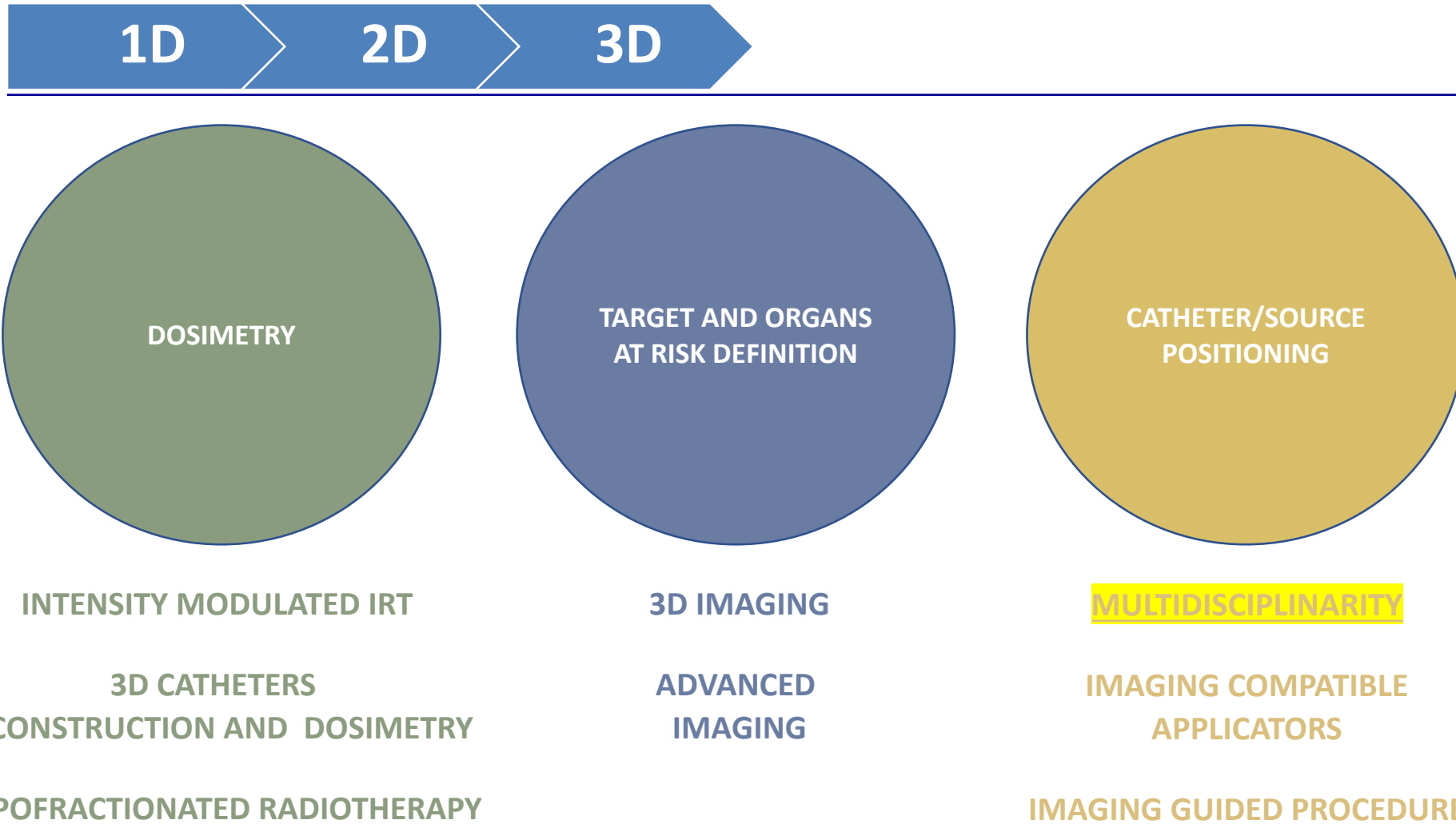
1D

2D

3D



INTERVENTIONAL RADIOOTHERAPY



1D

2D

3D

Editorial

Is an Interventional Oncology Center an advantage in the service of cancer patients or in the education? The Gemelli Hospital and INTERACTS experience

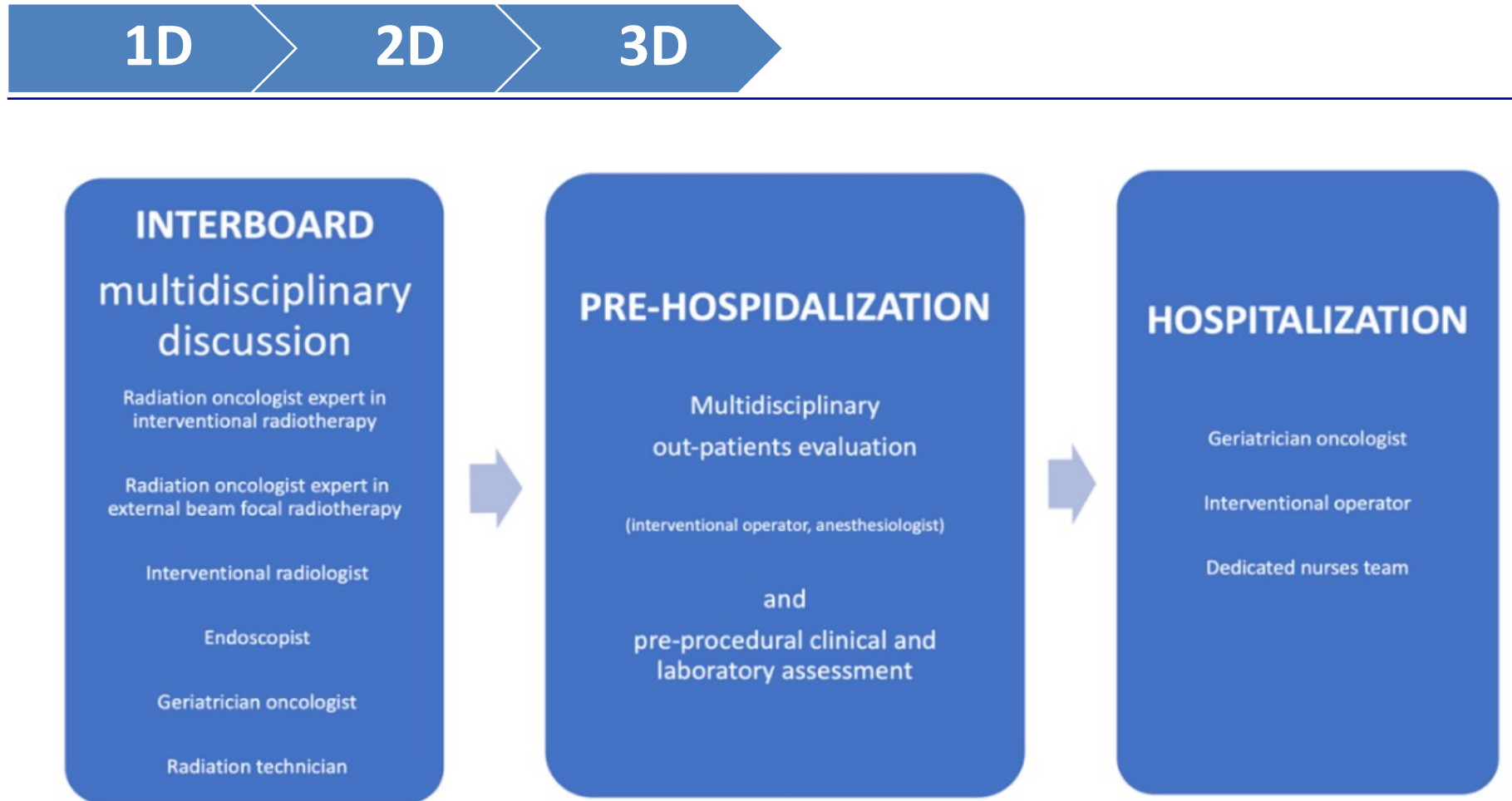
Prof. György Kovács, MD, PhD^{1,2}, Luca Tagliaferri, MD, PhD^{3,4}, Prof. Vincenzo Valentini, MD, PhD^{5,6}

¹Interdisciplinary Brachytherapy Unit, University of Lübeck/UKSH-CL, Germany, ²INTERACTS Scientific Program Director, ³Polo Scienze Oncologiche ed Ematologiche, Università Cattolica del Sacro Cuore, Fondazione Policlinico Universitario Agostino Gemelli, Roma, Italy, ⁴INTERACTS courses organizer, ⁵Polo Scienze Oncologiche ed Ematologiche, Istituto di Radiologia, Università Cattolica del Sacro Cuore, Fondazione Policlinico Universitario Agostino Gemelli, Roma, Italy, ⁶INTERACTS School Director



- *Kovács G, Tagliaferri L, Valentini V. Is an Interventional Oncology Center an advantage in the service of cancer patients or in the education? The Gemelli Hospital and INTERACTS experience. J Contemp Brachytherapy. 2017*

INTERVENTIONAL RADIOOTHERAPY



A dedicated and personalized pathway for interventional oncology patients

INTERVENTIONAL RADIOOTHERAPY



CHOICE OF THE BEST COMBINED PERSONALIZED APPROACH

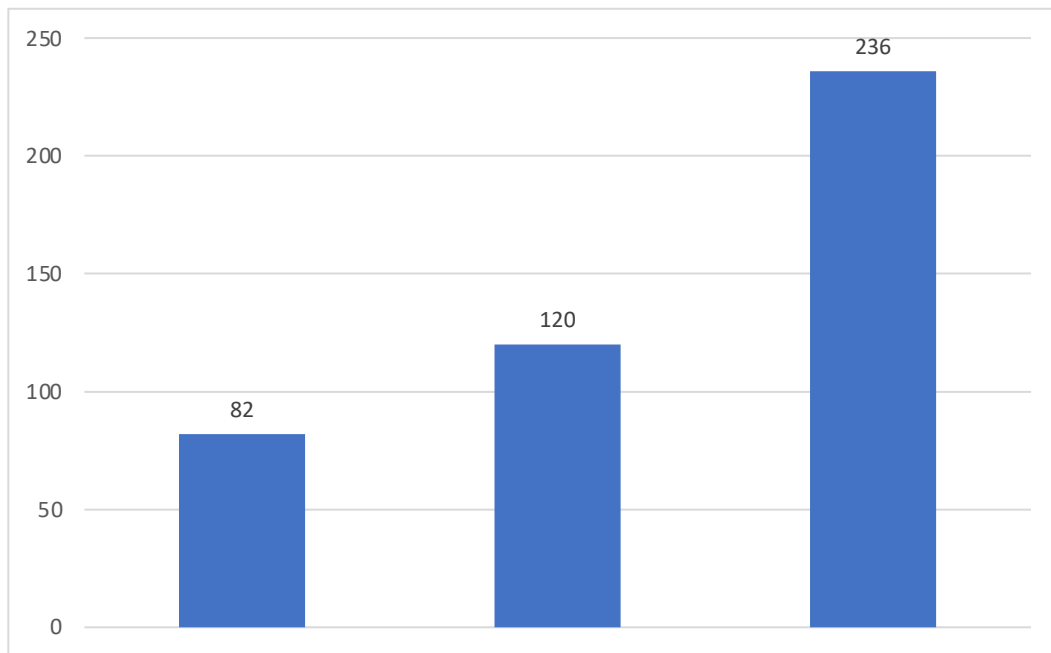
Improving local control
(SVV, DFS)

Reduction Toxicity
(organ preservation, QoL)

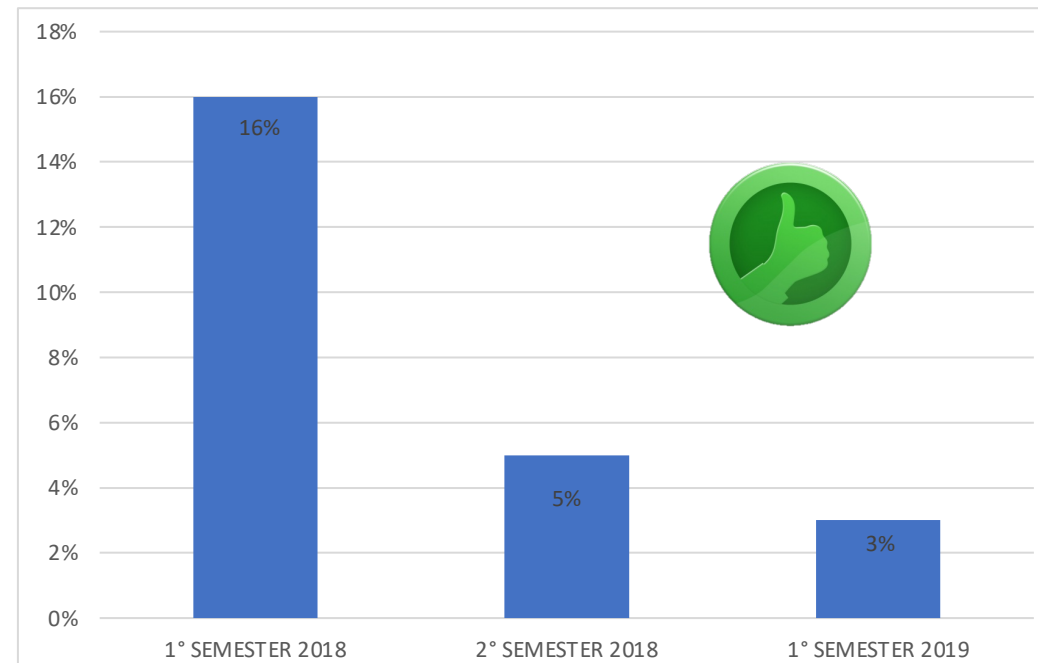
INTERVENTIONAL RADIOOTHERAPY



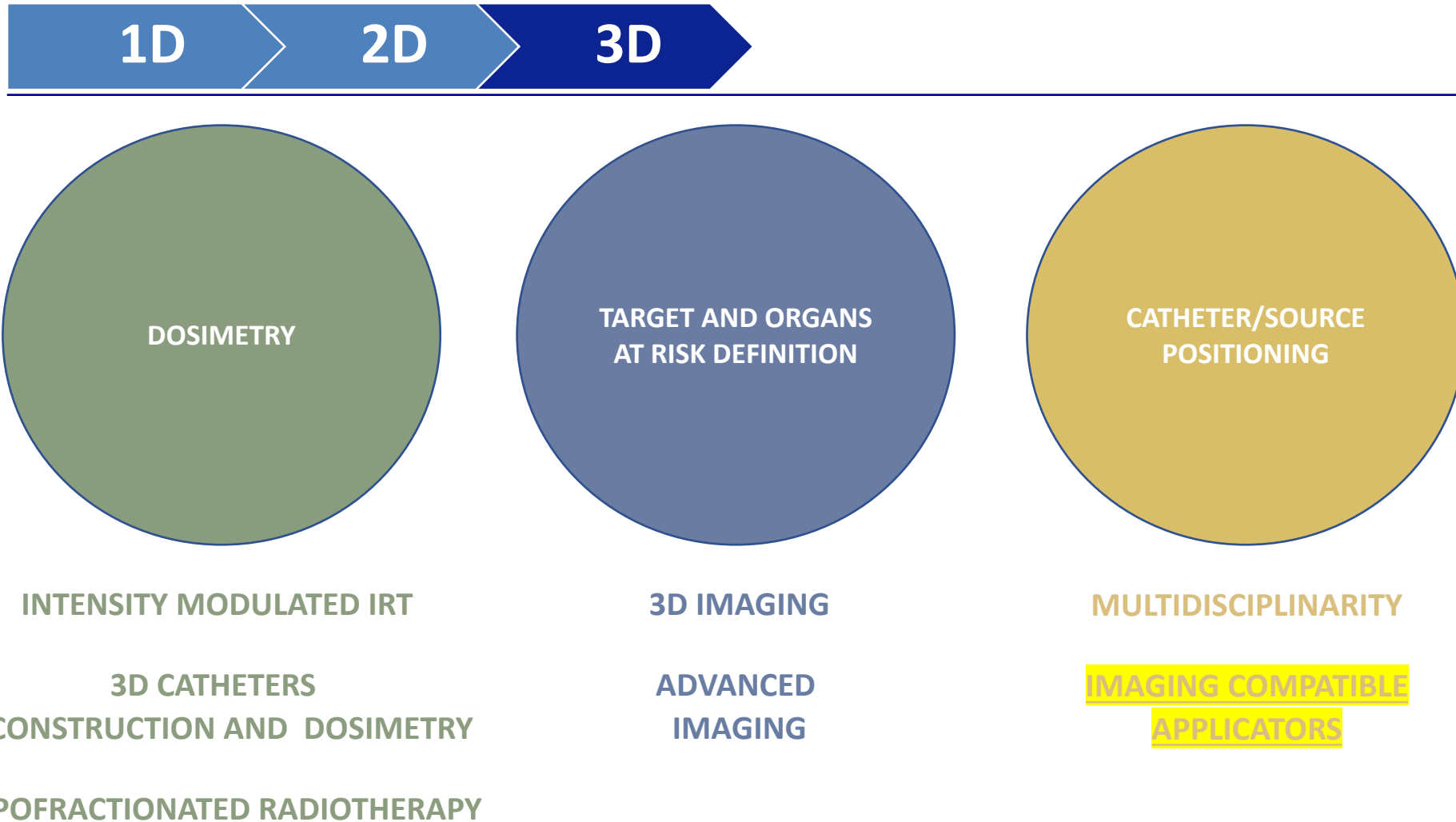
NUMBER OF PATIENTS



COMPLICATIONS



INTERVENTIONAL RADIOOTHERAPY

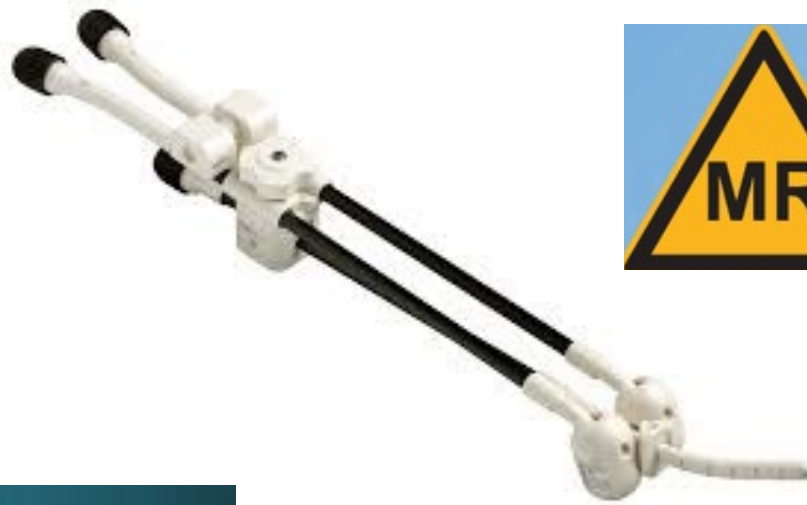
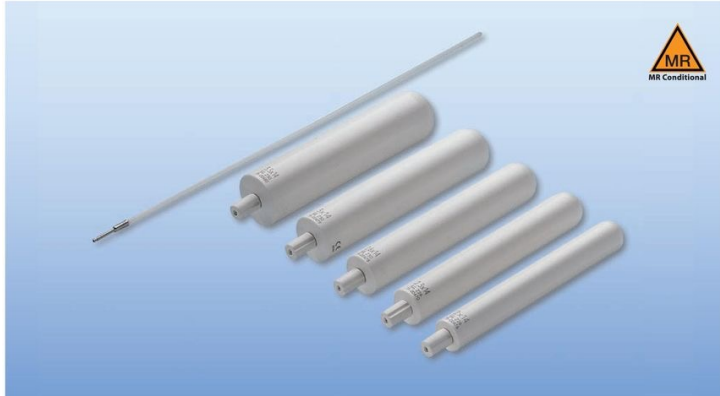


INTERVENTIONAL RADIOOTHERAPY

1D

2D

3D

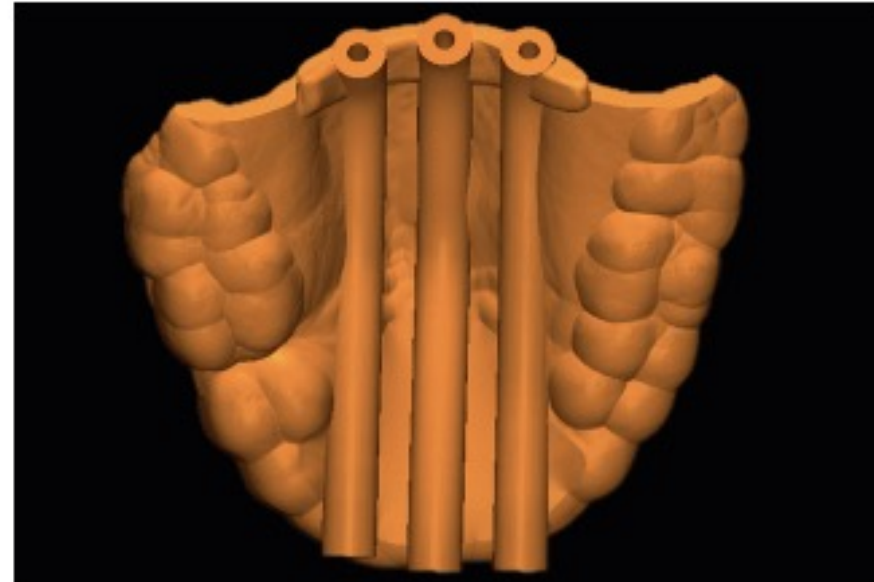
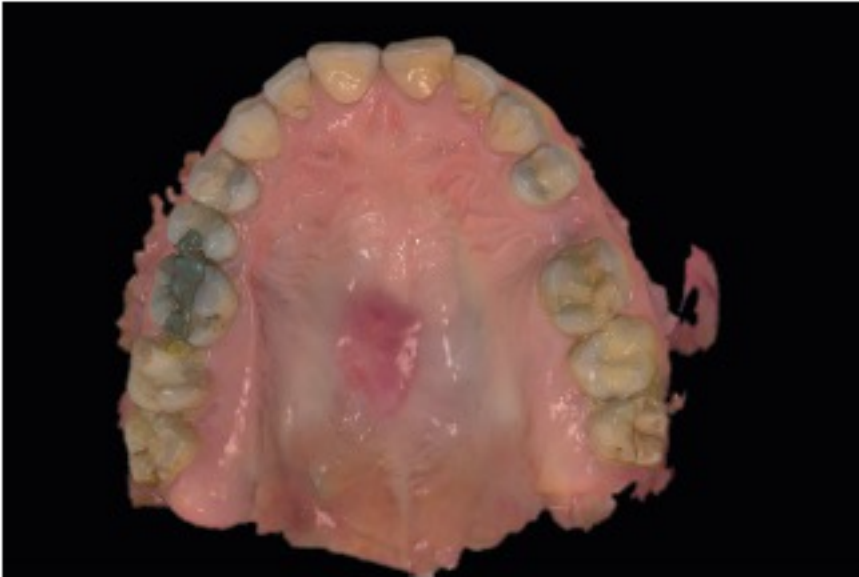


INTERVENTIONAL RADIOOTHERAPY

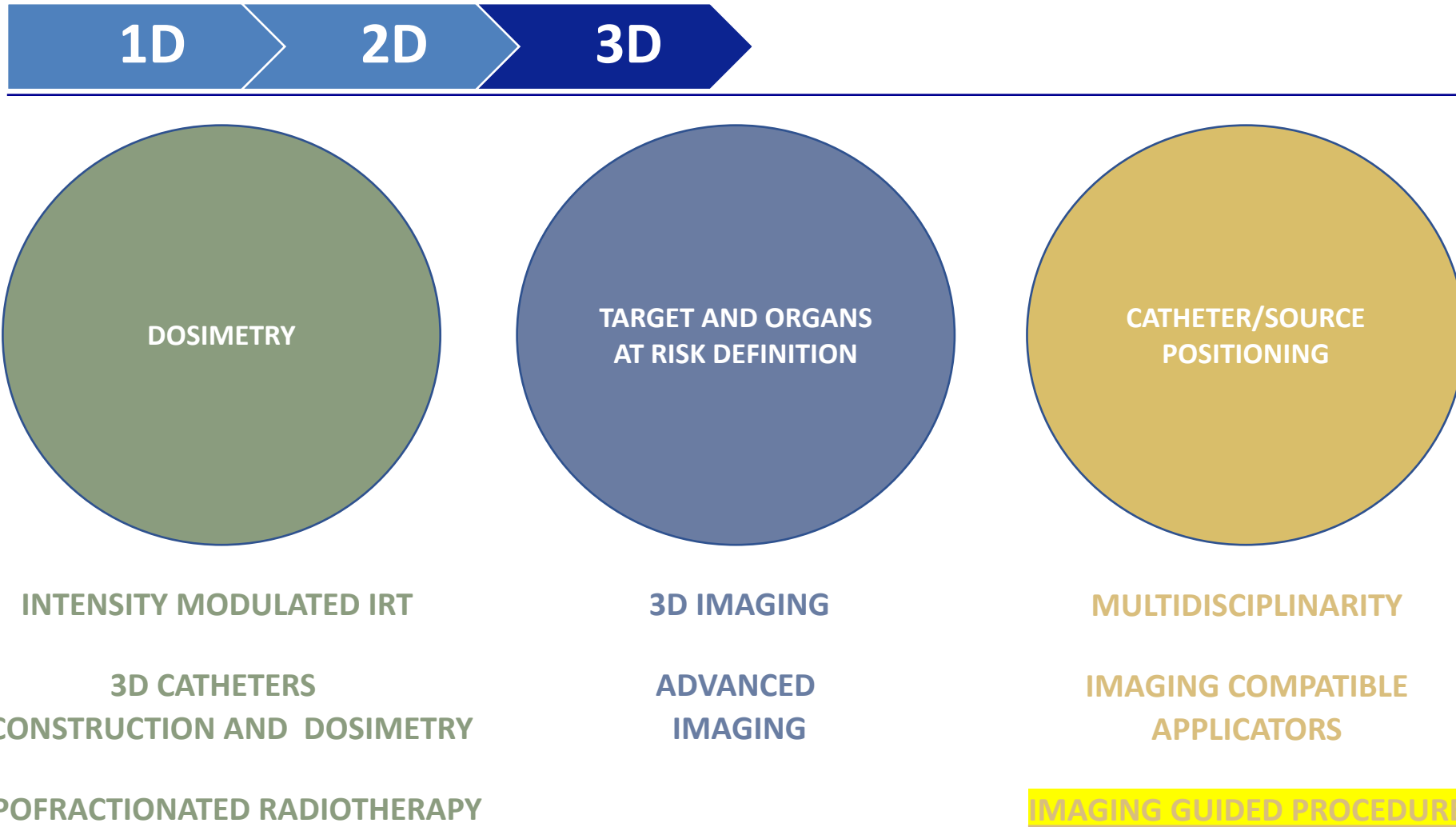
1D

2D

3D



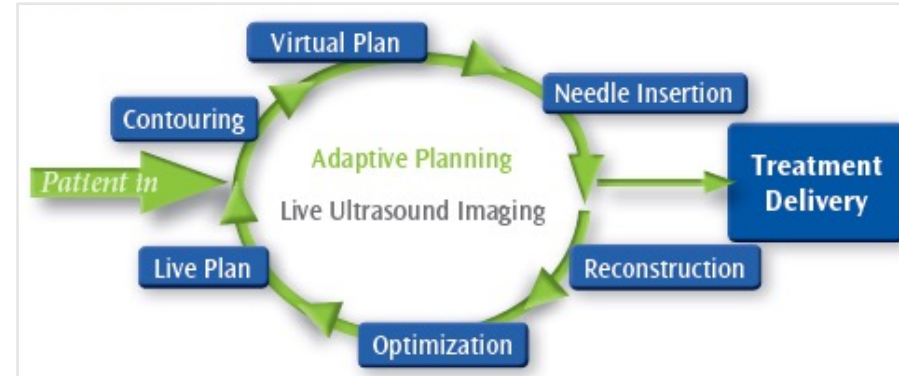
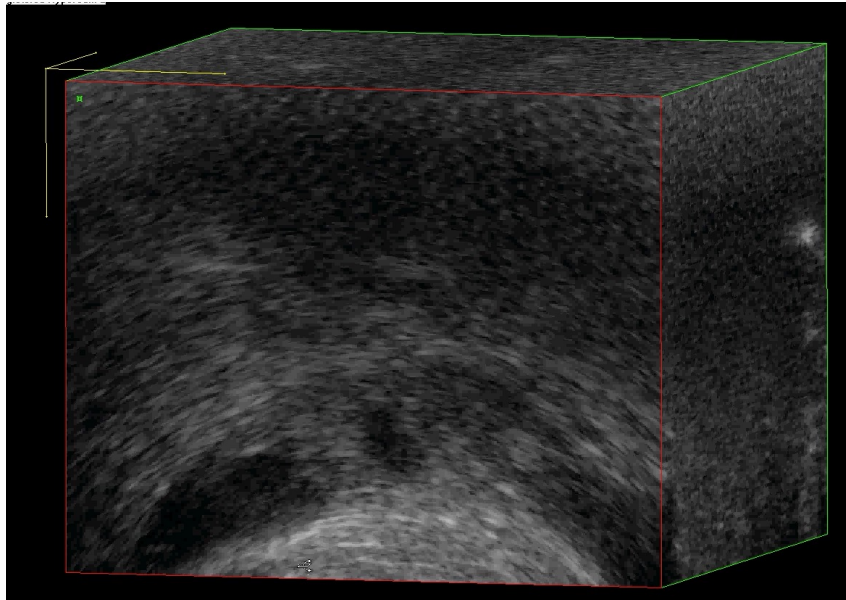
INTERVENTIONAL RADIOOTHERAPY



INTERVENTIONAL RADIOOTHERAPY



Image Guided Procedure in Prostate Cancer



INTERVENTIONAL RADIOOTHERAPY



US GUIDED IRT

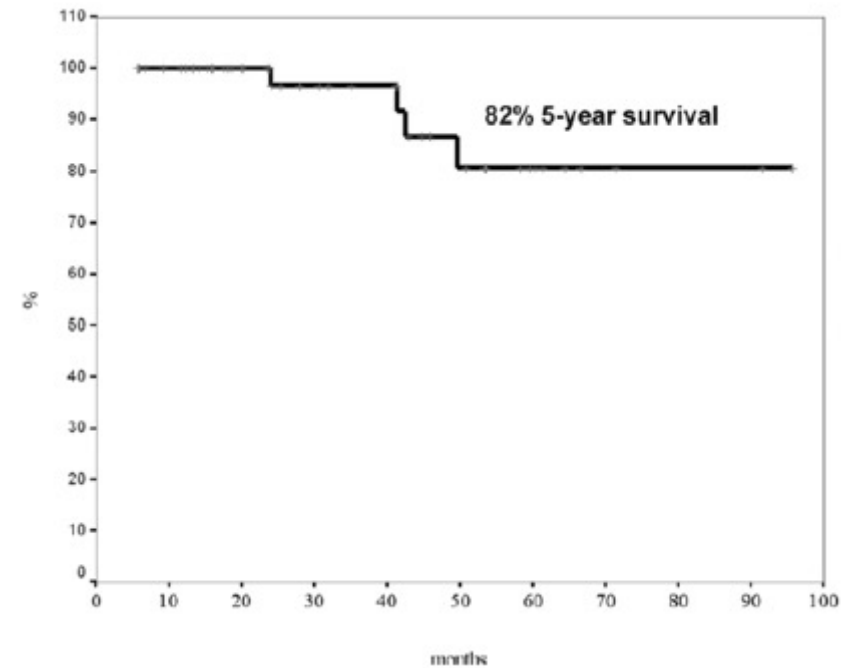
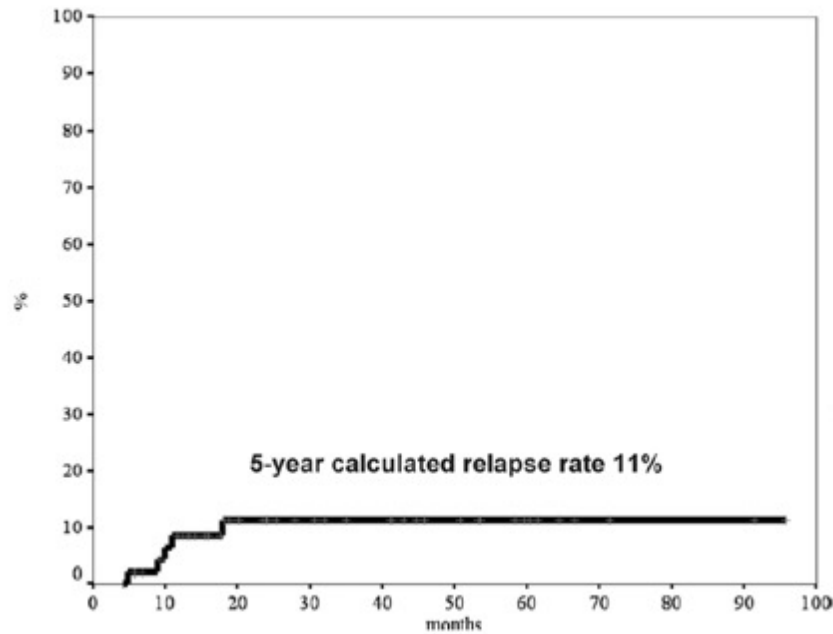
the needles are inserted into the residual tumor through the applicator

.... their position is checked by EAUS

the applicator cover is assembled; brachytherapy can be delivered

The diagram illustrates the process of US-guided IRT. It starts with the insertion of needles into a residual tumor through an applicator. The position of the needles is then checked by EAUS. The applicator cover is assembled, and brachytherapy can be delivered. The process is shown in a sequence of images: a photograph of the procedure, a 2D ultrasound image, a 3D ultrasound image, and a 4D ultrasound image. A large 3D ultrasound image is also shown on the right side of the diagram.

INTERVENTIONAL RADIOOTHERAPY



no anal stenosis – 6% anal incontinence
no necrosis with standard dose (4Gy + 4Gy)



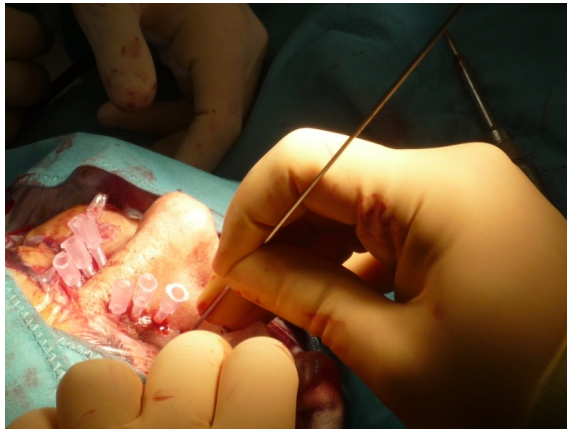
INTERVENTIONAL RADIOOTHERAPY

1D

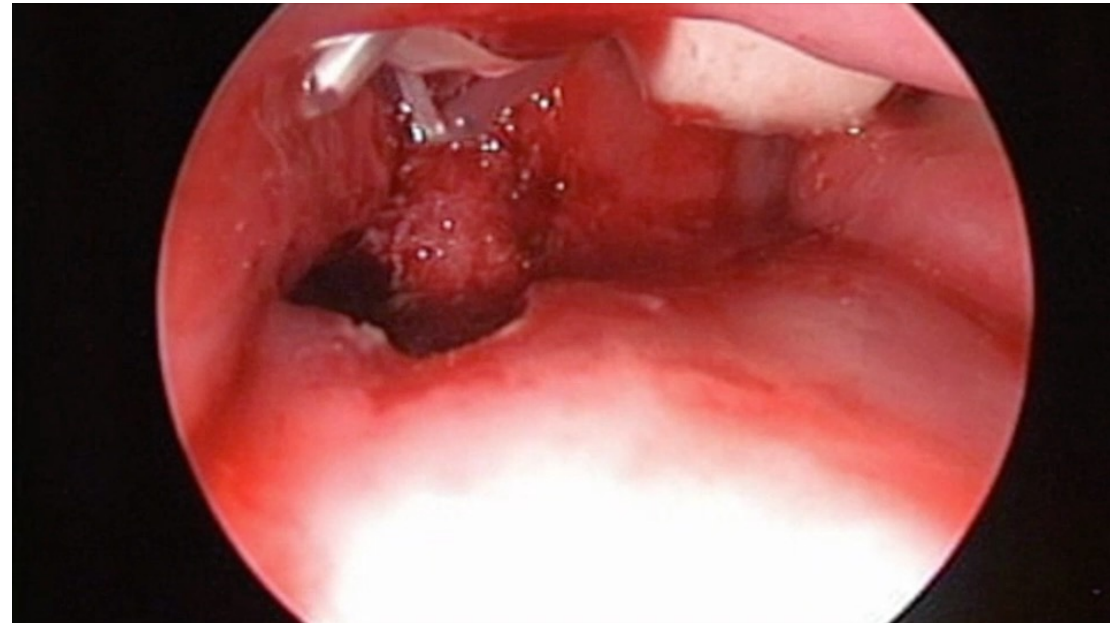
2D

3D

4D



Endoscopy Guided Procedure



INTERVENTIONAL RADIOOTHERAPY

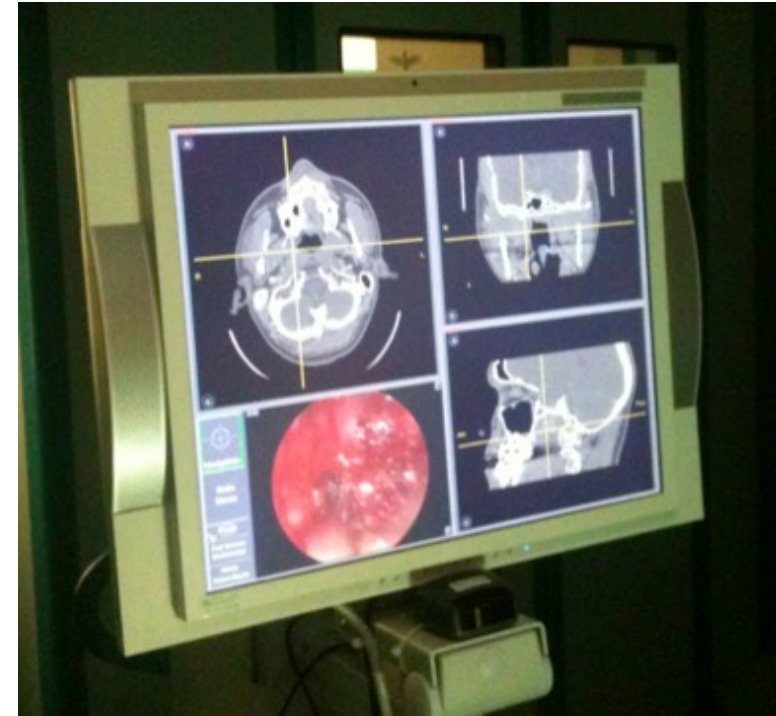
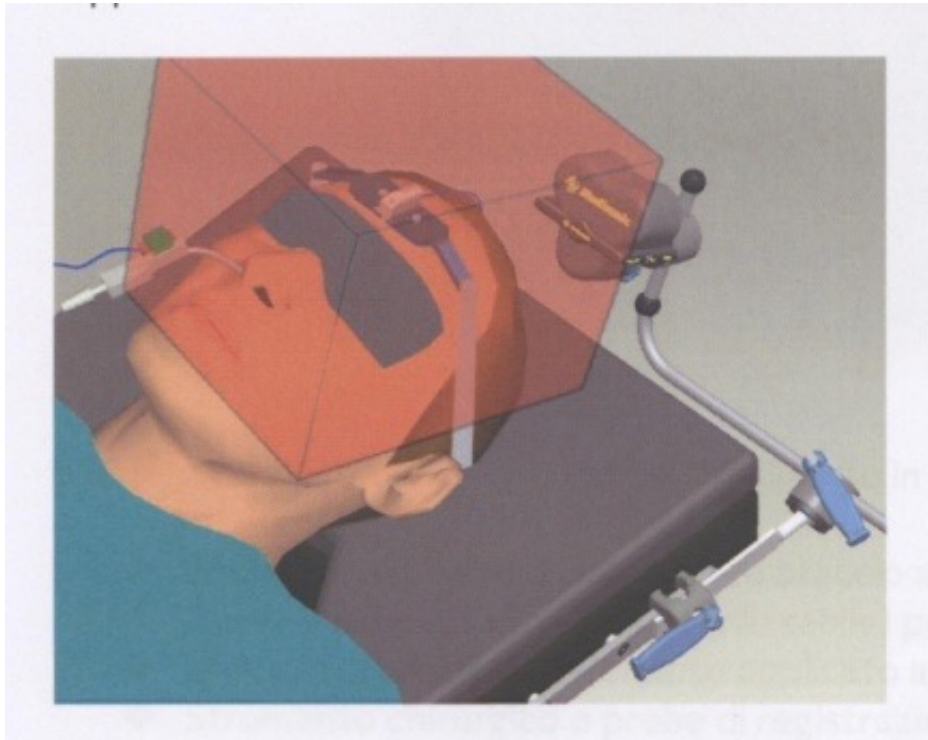
1D

2D

3D

4D

Neuro-navigator Guided Procedure



INTERVENTIONAL RADIOOTHERAPY

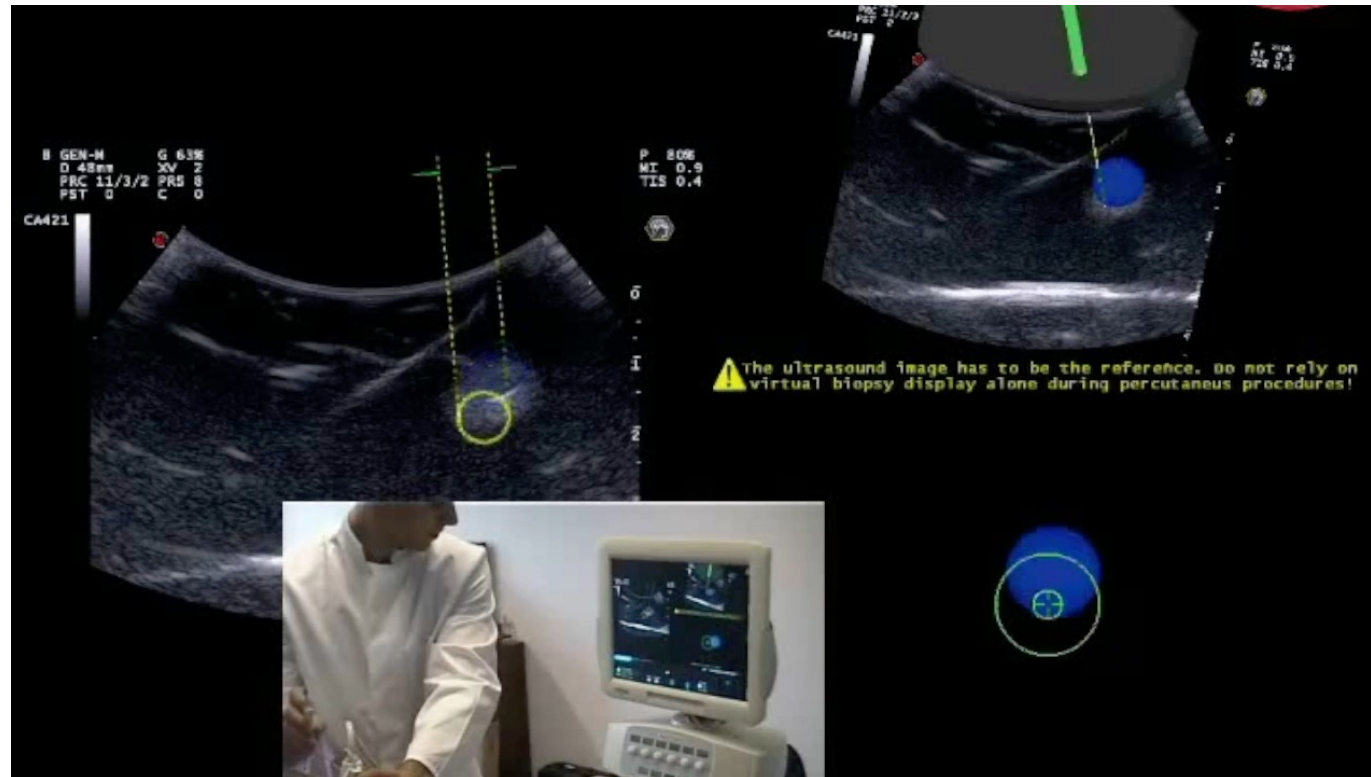
1D

2D

3D

4D

Navigator Guided Procedure



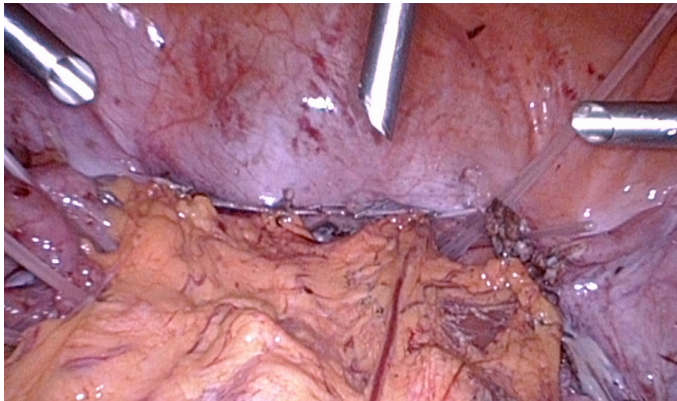
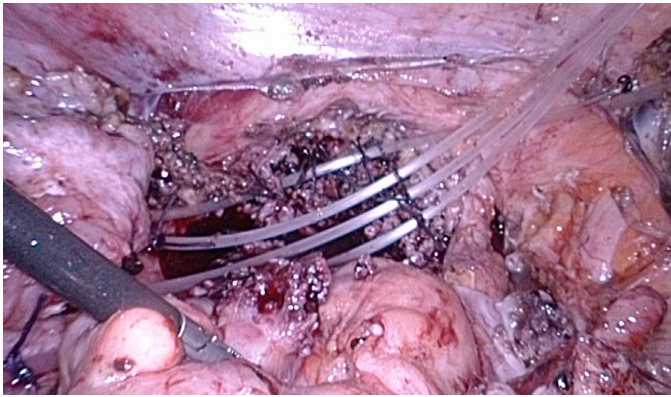
INTERVENTIONAL RADIOOTHERAPY

1D

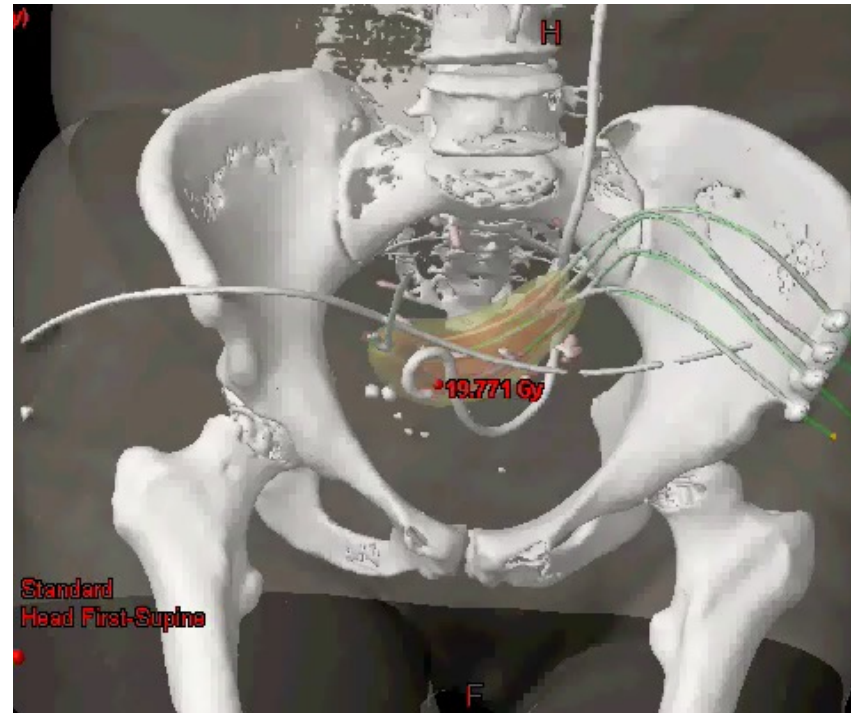
2D

3D

4D



Laparoscopy Guided Procedure



INTERVENTIONAL RADIOOTHERAPY

1D

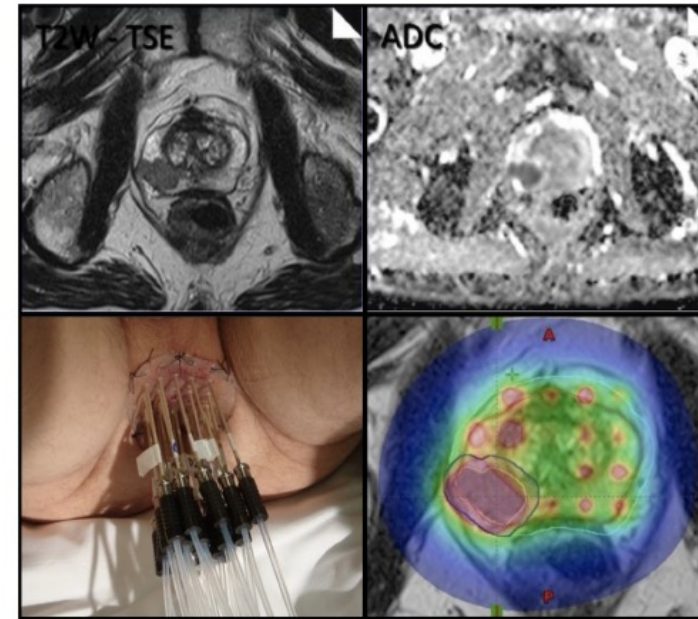
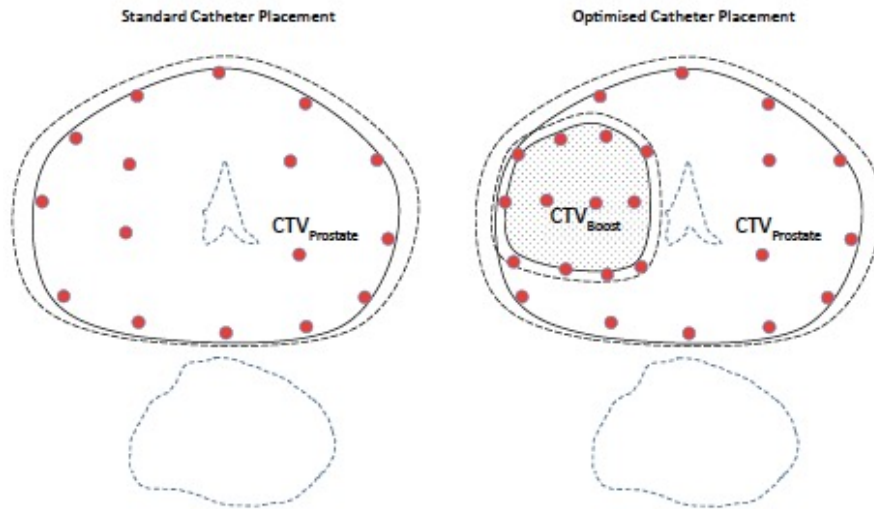
2D

3D

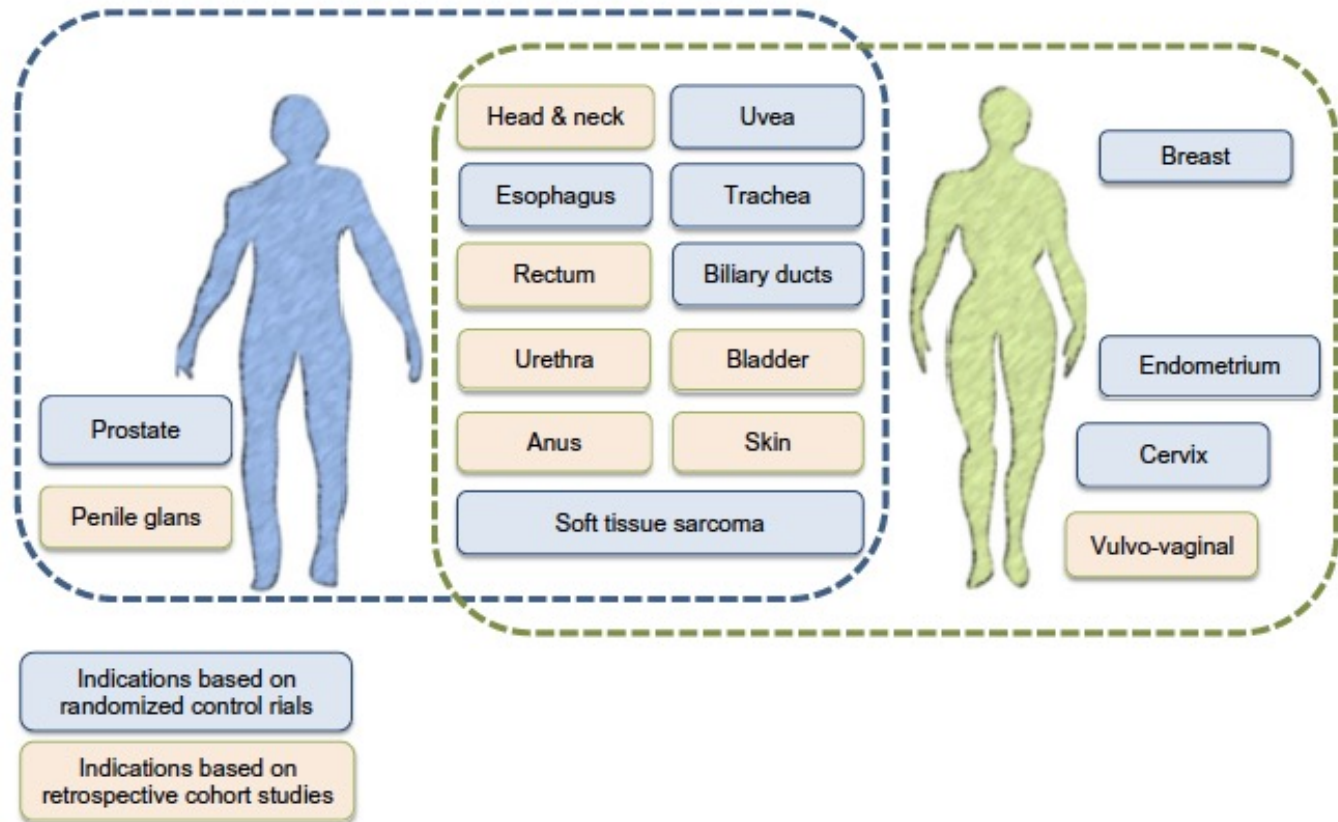
4D

5D

Biology Guided Procedure in Prostate Cancer



INTERVENTIONAL RADIOOTHERAPY



INTERVENTIONAL RADIOOTHERAPY



PATIENT'S DIMENSION

INTERVENTIONAL RADIOOTHERAPY



Value Based Health Care: The patient-centric approach

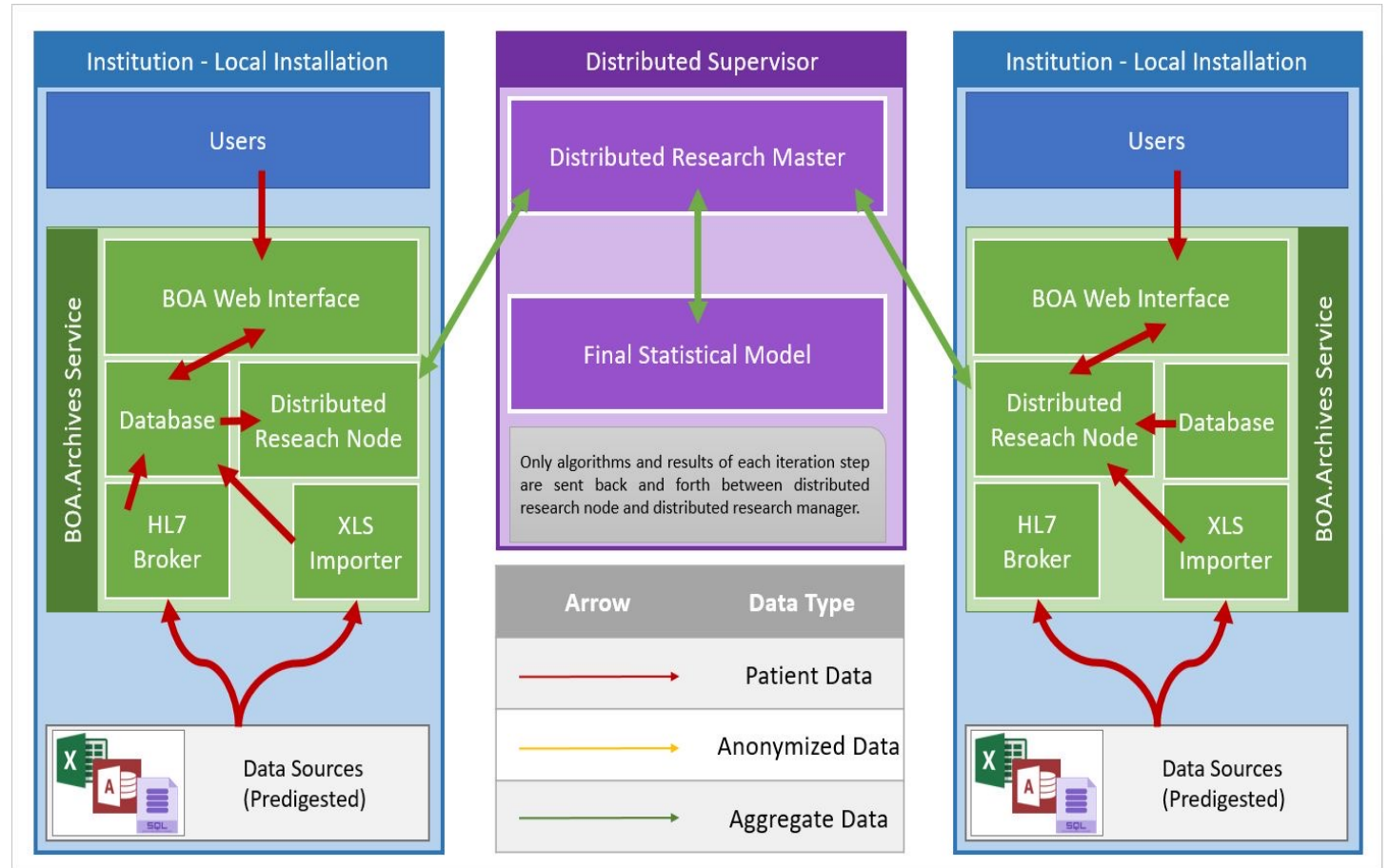


INTERVENTIONAL RADIO THERAPY



COBRA
 CONsortium for BRachytherapy data Analysis


LION
 Large-database for Interventio**n**al Oncology Network



1D

2D

3D

4D

5D

6D

APACHE

Advanced patient monitoring and A.I. supported outcomes assessment in cervical cancer using Internet of things technologies

A mobile application

to monitor

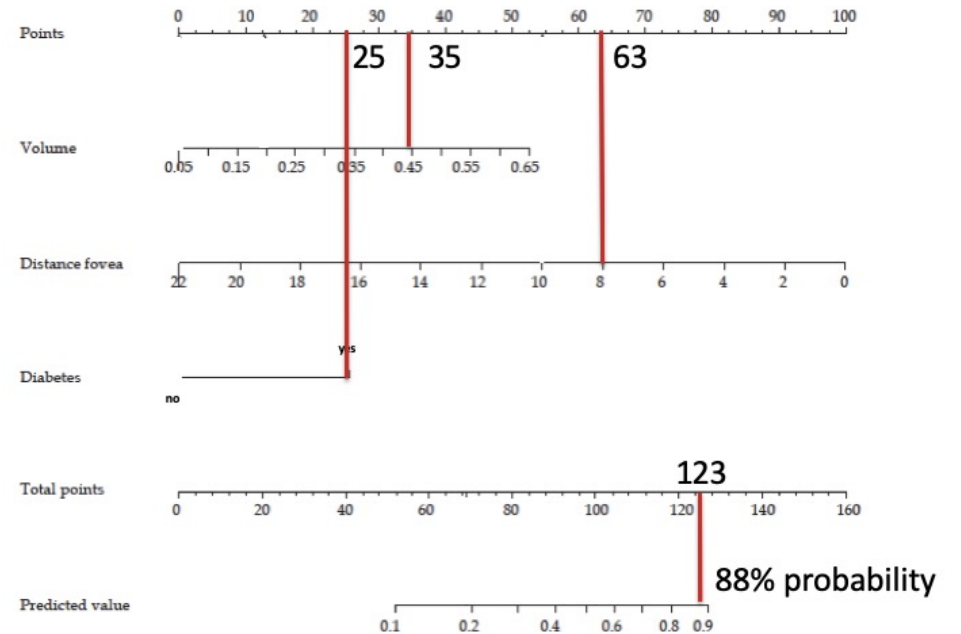
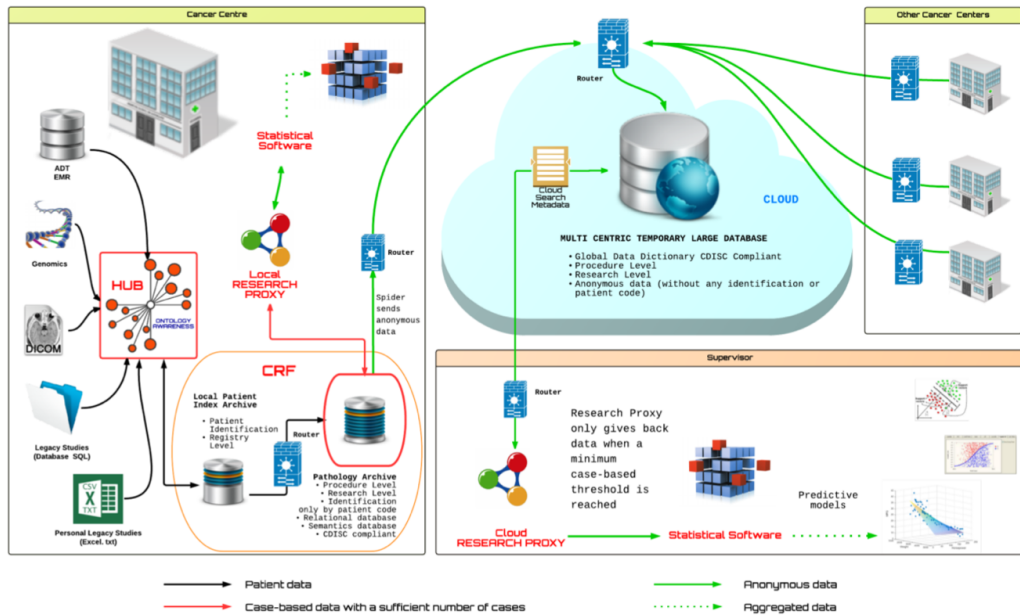
symptoms and outcomes for

cervical cancer **patients**

during and after treatment



INTERVENTIONAL RADIOOTHERAPY



INTERVENTIONAL RADIOOTHERAPY

1D

2D

3D

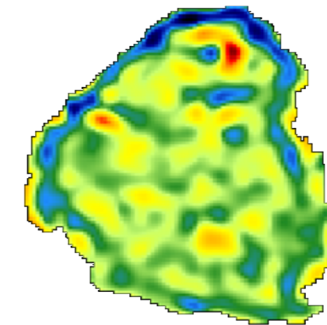
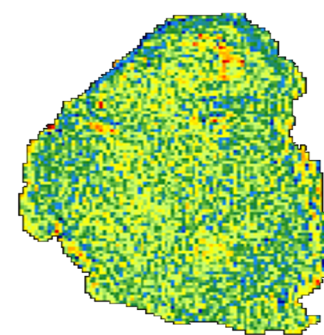
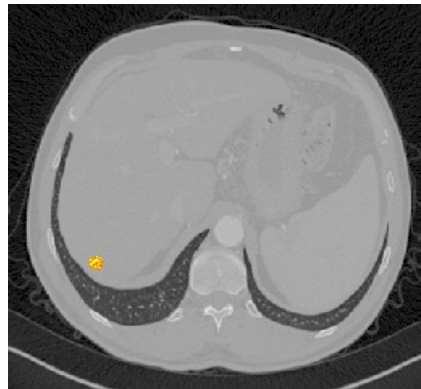
4D

5D

6D

POLAR

Project for interventional **O**ncology **L**arge-database in live**R**

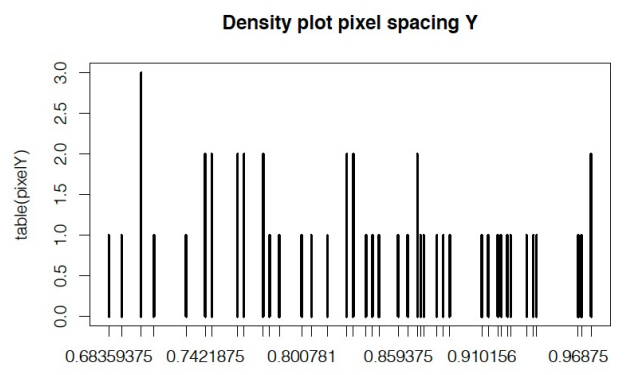
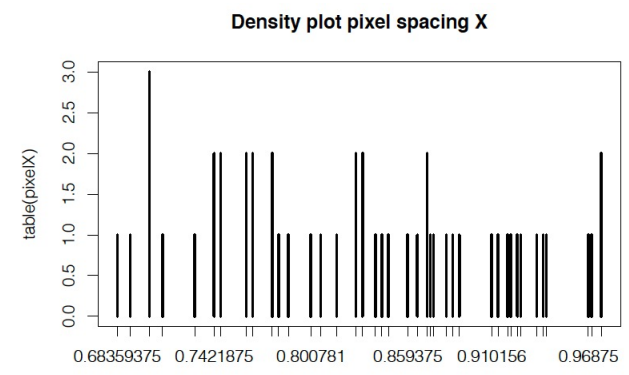


RADIOMICS: extraction of quantitative features

INTERVENTIONAL RADIOOTHERAPY



10
Procedures



PREDICTIVE MODEL
(decision supporting tool)

Good Responders

Bad Responders

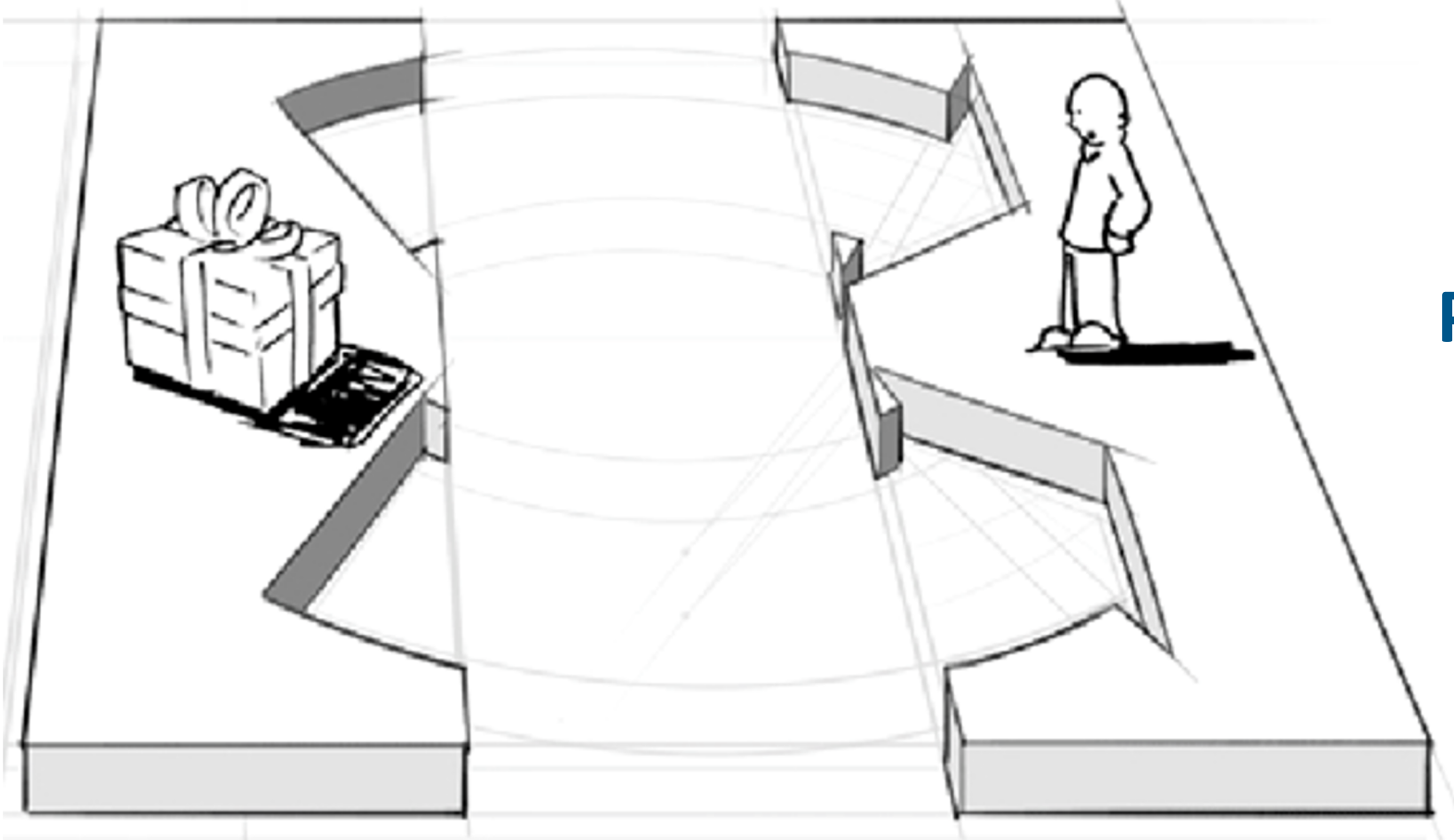
Radiotherapy
Electrochemotherapy
Others therapies

double shot

VALUE BASED HEALTH CARE: A GIFT FOR OUR PATIENTS



**HEALTH
and
RELIEF**

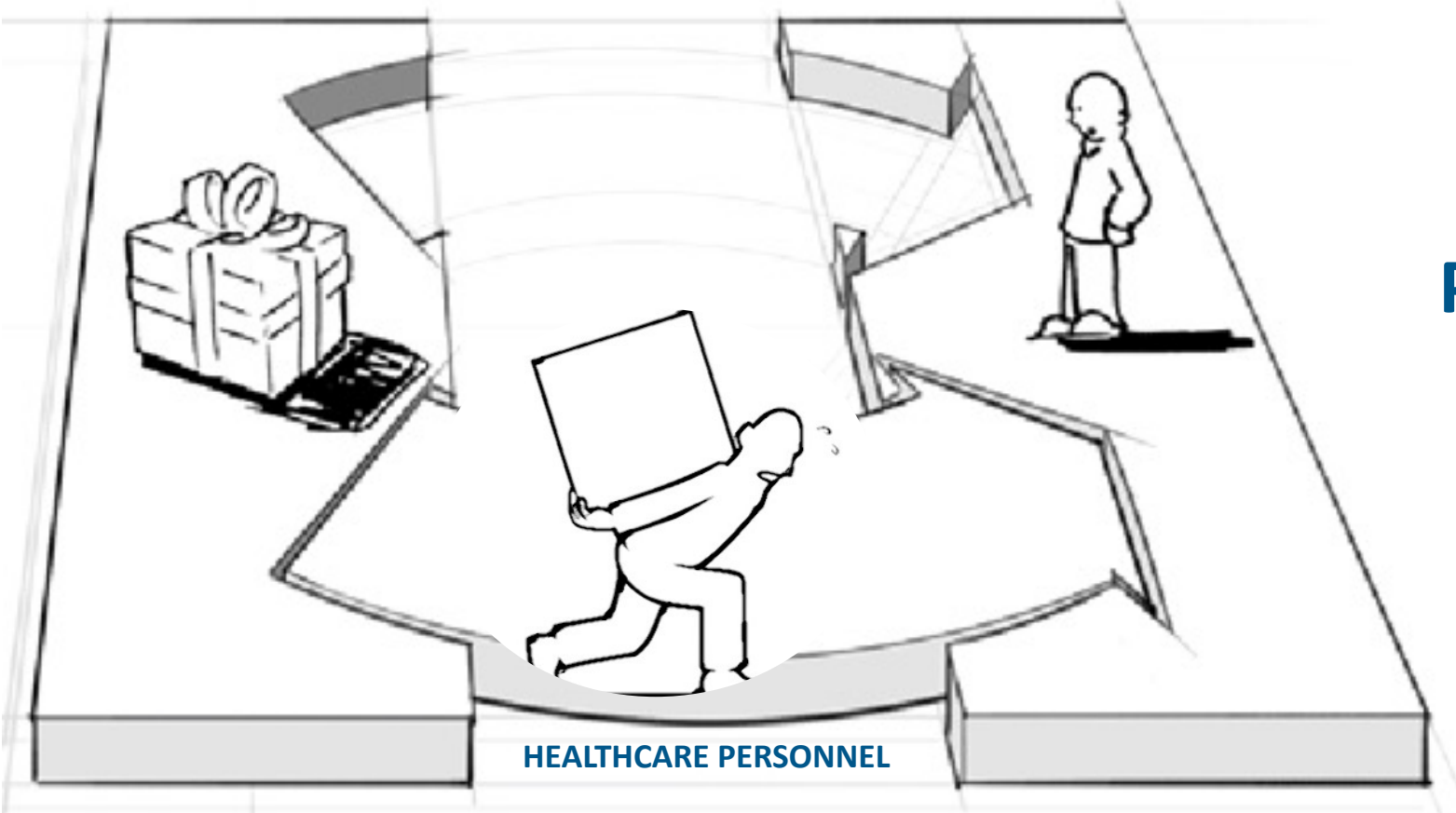


PATIENT

VALUE BASED HEALTH CARE: A GIFT FOR OUR PATIENTS



**HEALTH
and
RELIEF**

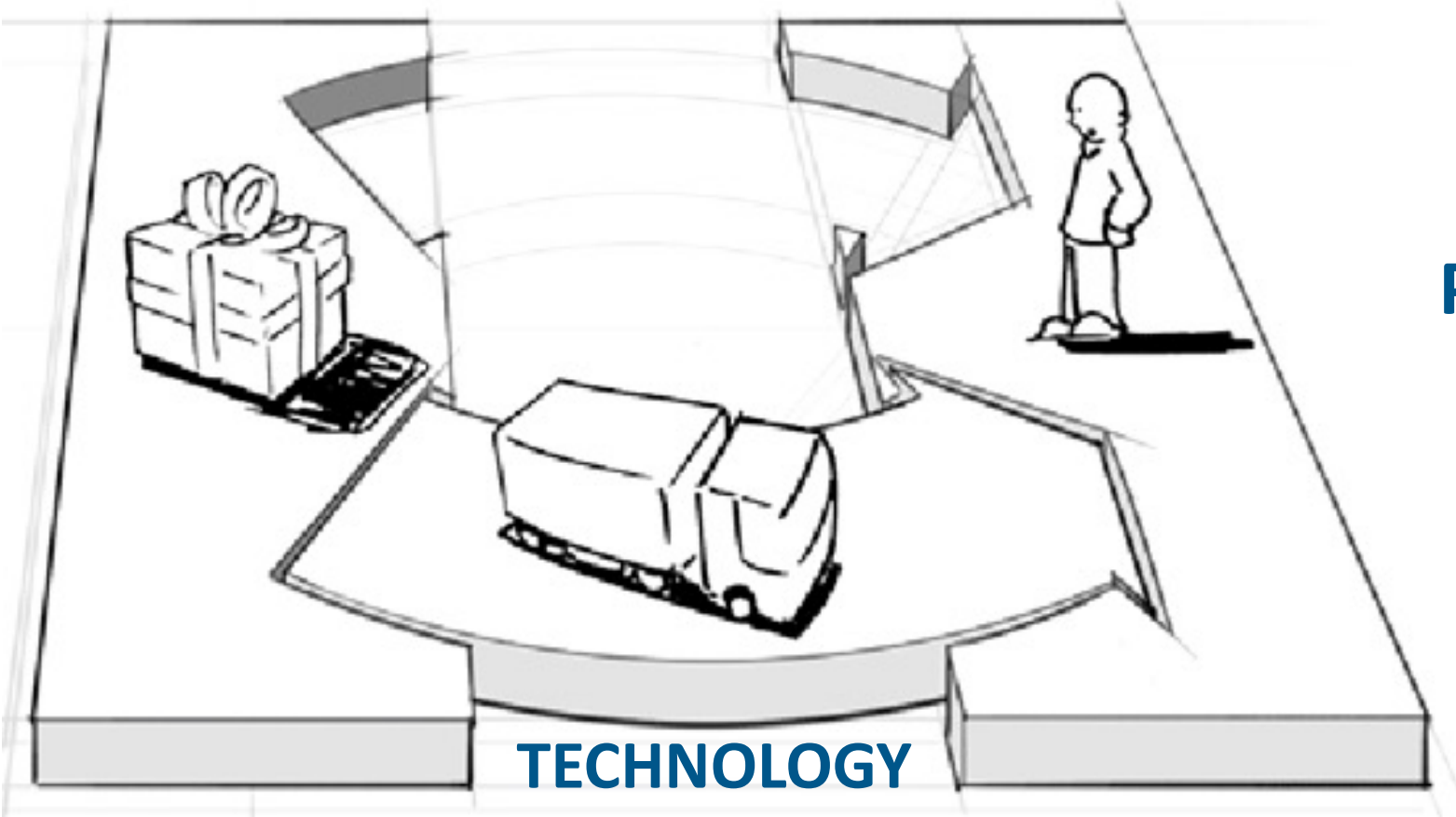


PATIENT

VALUE BASED HEALTH CARE: A GIFT FOR OUR PATIENTS



**HEALTH
and
RELIEF**

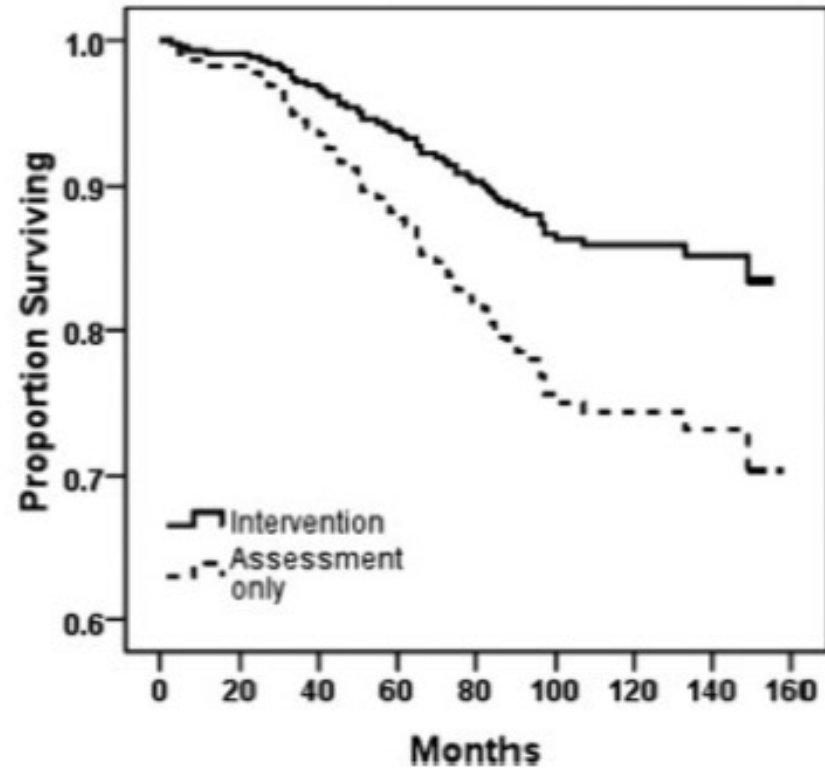


PATIENT

VALUE BASED HEALTH CARE - THE PATIENT-CENTRIC APPROACH



(c) Overall survival



PSYCHOLOGIC INTERVENTION IMPROVES SURVIVAL

INTERVENTIONAL RADIO THERAPY



Clinical Investigations

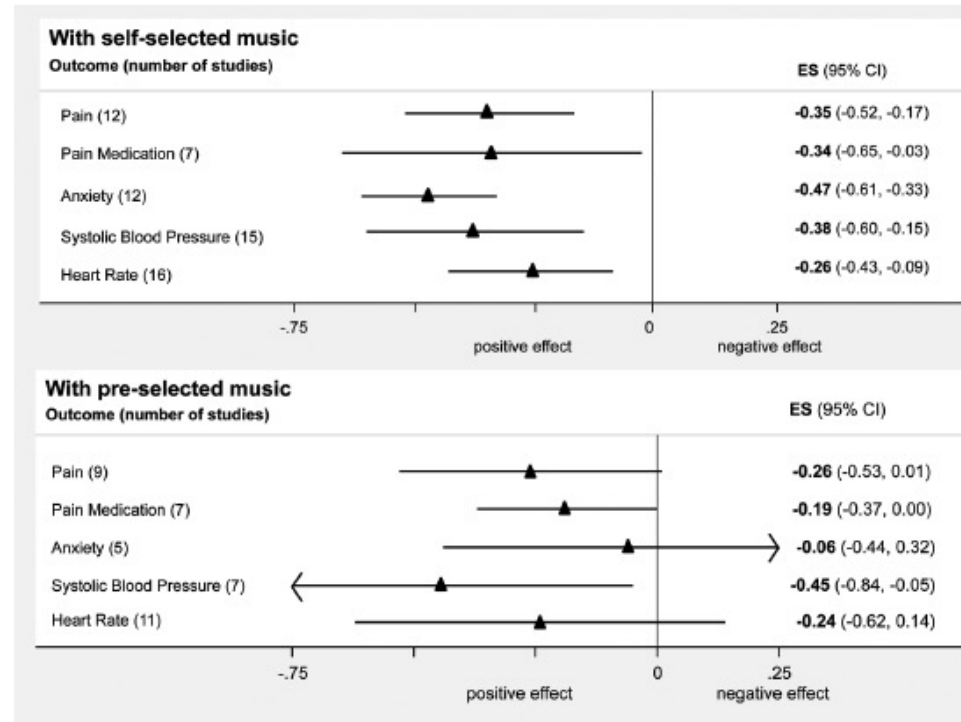
Original paper

HAPPY – Humanity Assurance Protocol in interventional radiotheraPY (brachytherapy) – an AIRO Interventional Radiotherapy Study Group project

Valentina Lancellotta, MD¹, Vitaliana De Sanctis, MD², Patrizia Cornacchione, MSc¹, Fernando Barbera, MD³, Vincenzo Fusco, MD⁴, Cristiana Vidali, MD⁵, Sara Scalise, MSc¹, Giulia Panza, MD⁶, Angela Tenore, MSc¹, Giuseppe Ferdinando Colloca, MD¹, Renzo Corvò, MD⁷, Maria Antonietta Gambacorta, MD⁶, Stefano Maria Magrini, MD⁸, Luca Tagliaferri, MD¹

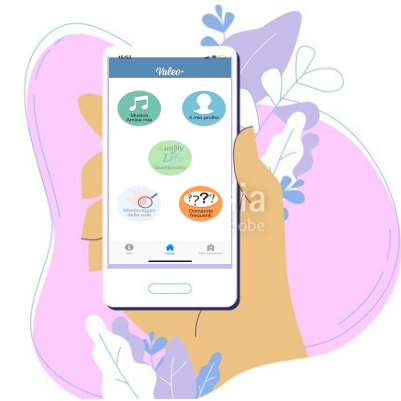
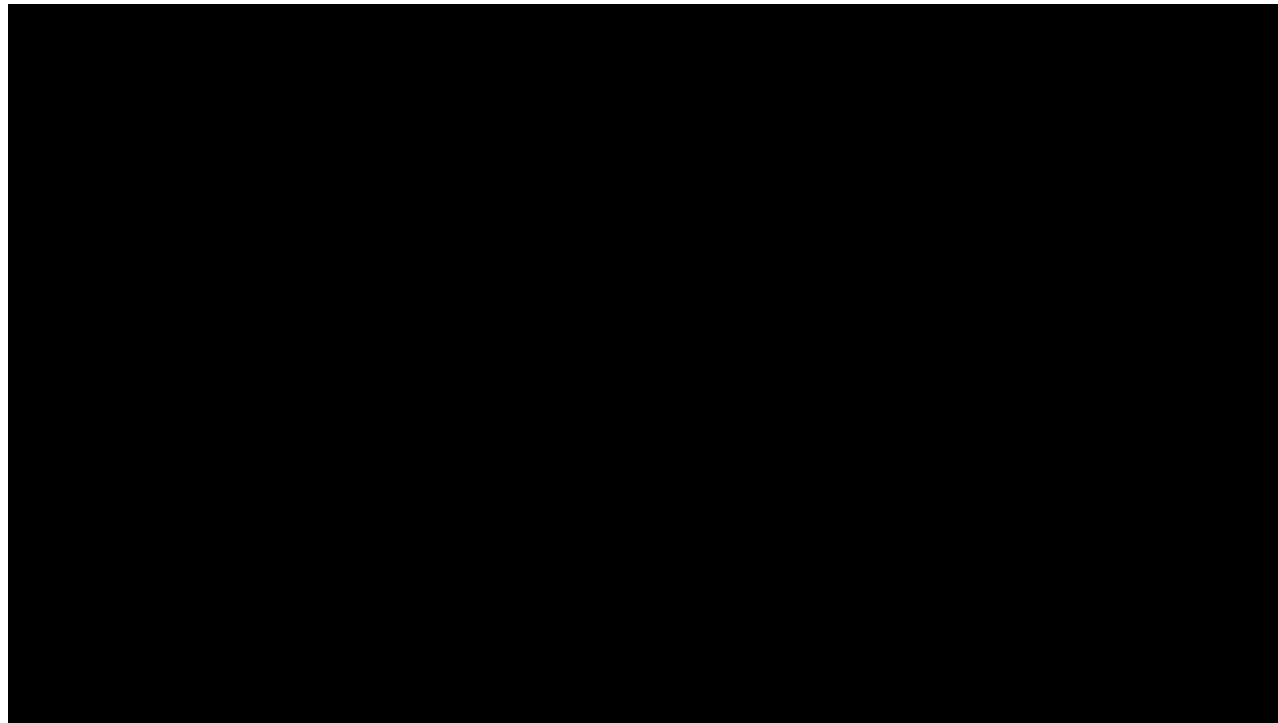
	Patient's needs/issues general clusters	HAPPY interventions/recommendations
1	Lack of information and the fear of “unknown”	Procedure information booklet, possibly with FAQs, and sharing patient story, to be delivered many days before the therapy Improving the patient’s participation in therapeutic choices also using decision support tools and discussing predictive models
2	Comfortable and relaxing environment	Possibility of hearing music chosen by the patient and/or watching relaxing videos
3	Ability to reduce anxiety	Psychological support in the interventional room and/or prescription of anxiolytics if necessary
4	Fear of the word “Bunker”	Use alternative words like “Interventional Room” or “Treatment Room”
5	Use of the word “Brachytherapy” often not known and heard for the first time by the patient	Use a more conventional term such as “interventional radiotherapy”
6	Embarrassment over external genital depilation (if necessary) in the interventional room	Suggestion to perform external genital depilation at home
7	Discomfort due to the long maintenance of the bladder catheter	The bladder catheter will be placed in the interventional room just before the procedure
8	Sense of loneliness in the room	If possible, an operator holds the patient’s hand during the applicator positioning and plans optimization making human proximity perceived

VALUE BASED HEALTH CARE - THE PATIENT-CENTRIC APPROACH



PERSONALIZED ENVIROMENT

INTERVENTIONAL RADIO THERAPY



MISSION

MultISenSory Integrated system for patient cOmpliaNce improvement

INTERVENTIONAL RADIO THERAPY

1D

2D

3D

4D

5D

6D



HEALTH: THE GIFT FOR OUR PATIENTS

1D

2D

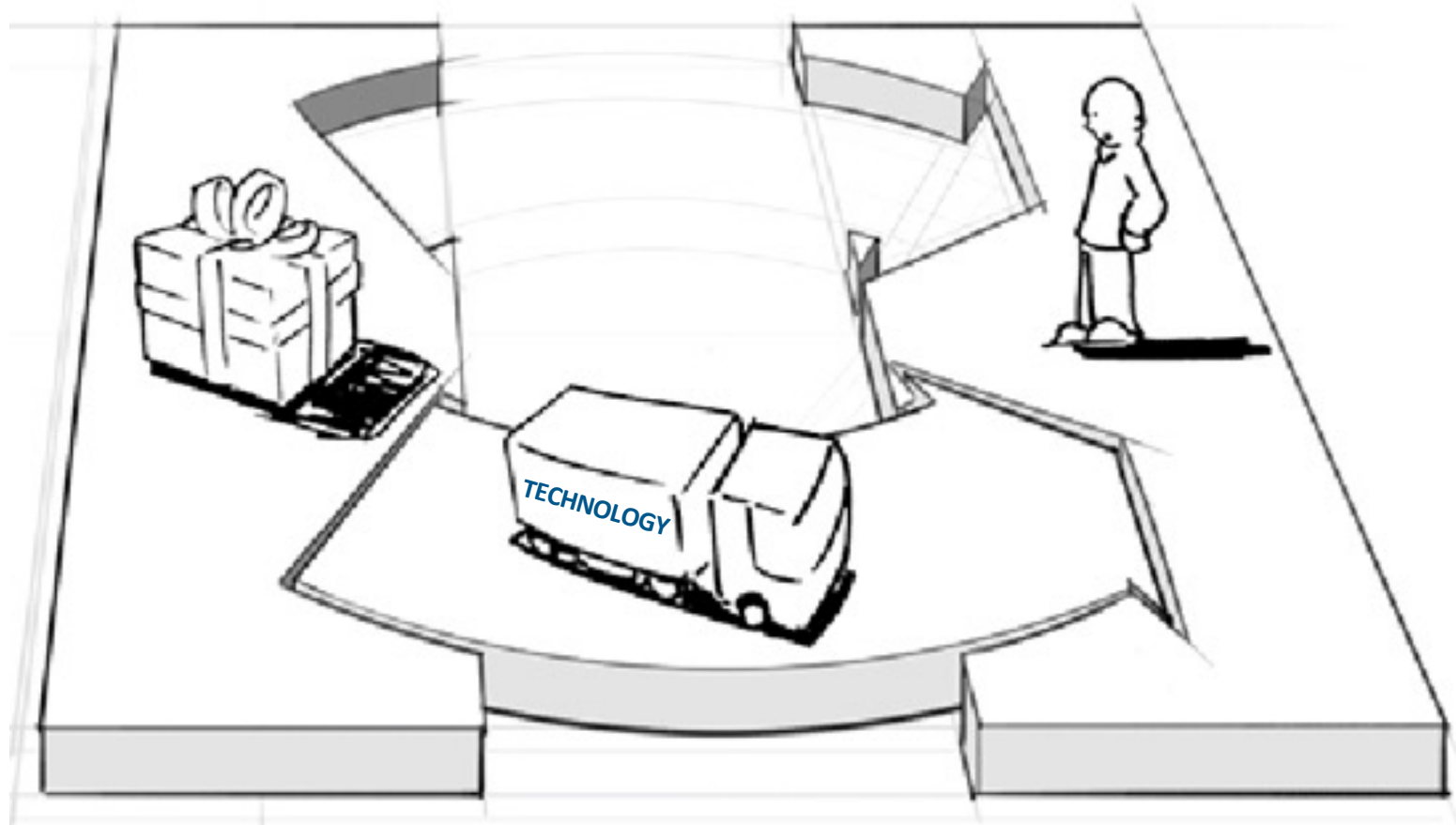
3D

4D

5D

6D

**HEALTH
and
RELIEF**



PATIENT

GLOBAL PATIENT CENTRIC APPROACH

1D

2D

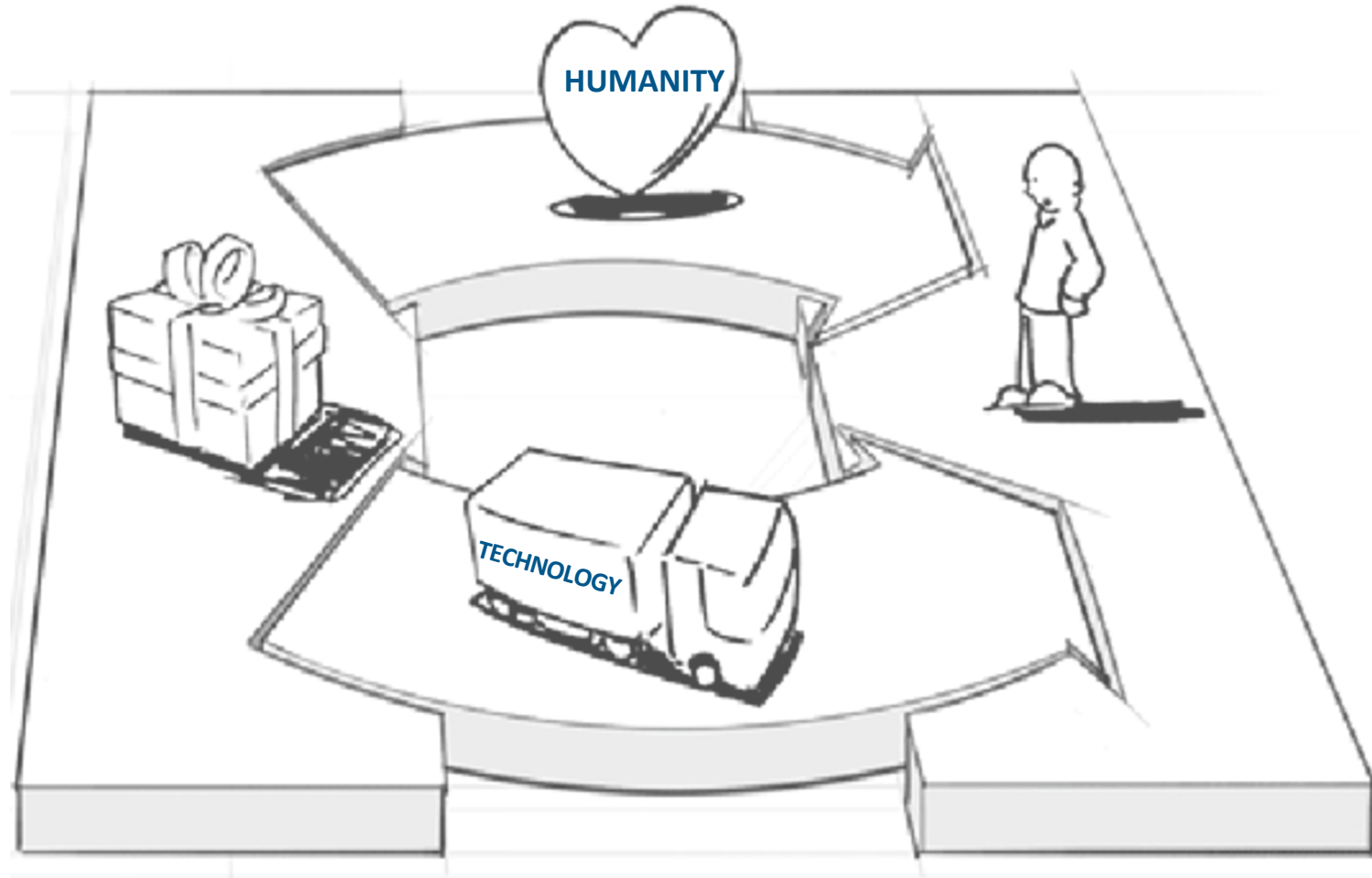
3D

4D

5D

6D

**HEALTH
and
RELIEF**



PATIENT

PATIENT CENTRIC APPROACH



Thank you for your attention

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<https://www.linkedin.com/in/luca-tagliaferri-a80878112/>



<https://www.youtube.com/user/gemelliart>



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