

# MODERN IMAGING AND AI APPLICATIONS IN INTERVENTIONAL RADIOTHERAPY

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9th October 2023

Gemelli



Fondazione Policlinico Universitario Agostino Gemelli IRCCS  
Università Cattolica del Sacro Cuore

ART

Advanced Radiation  
Therapy



Interventional Oncology Center  
Centro di Oncologia Interventistica



Organization Accredited  
by Joint Commission International

Interventional and External beam

**INTERACTS**

Radiotherapy Active Teaching School

# MODERN ONCOLOGY APPROACH

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**DISEASE CONTROL**

**QUALITY OF LIFE**

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**ART**

Advanced Radiation  
Therapy

# MODERN ONCOLOGY APPROACH



# INTERVENTIONAL RADIOTHERAPY



DISEASE CONTROL

QUALITY OF LIFE

Gemelli



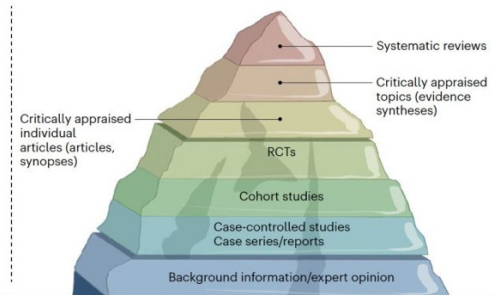
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ART

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Therapy

# DECISION MAKING PROCESS

**GROUP  
RECOMMENDATION  
(clustering)**



**GUIDELINES  
(treatment standardization)**

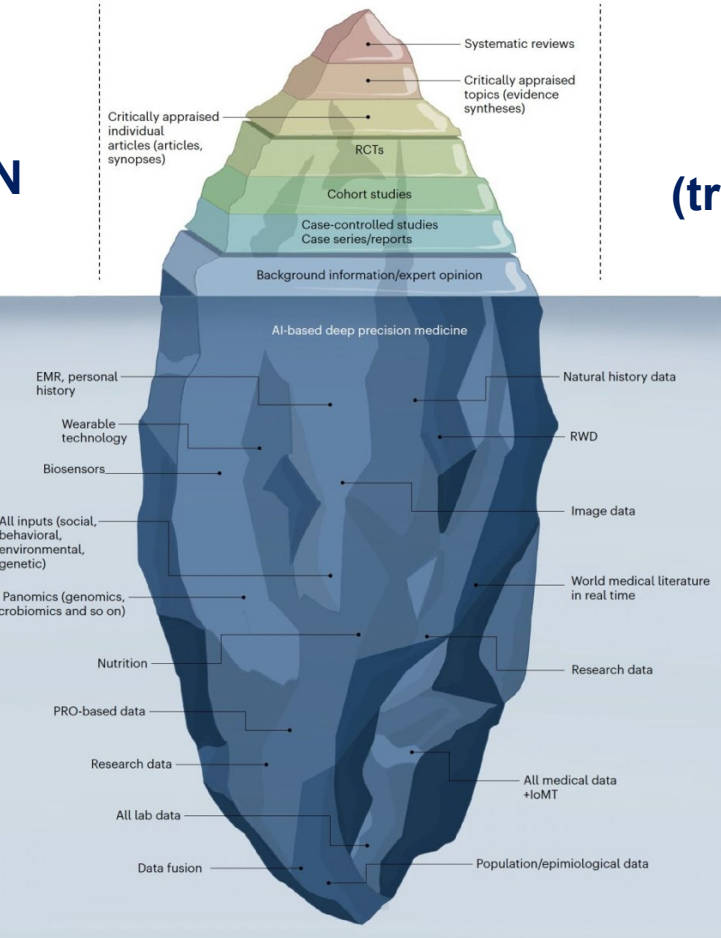
*TREATMENT MODALITY  
APPLICATOR SELECTION  
VOLUME CONTOURING  
TREATMENT PLAN  
TOTAL DOSE  
SCHEDULE  
CONSTRAINTS*



# DECISION MAKING PROCESS

**GROUP  
RECOMMENDATION  
(clustering)**

**GUIDELINES  
(treatment standardization)**



**PATIENT'S  
RELATED  
FACTORS**

**DISEASE  
RELATED  
FACTORS**

Expectations, family, behaviour, living, environment, Lifestyle...

Staging, Grading, Radiomics, Genomics, Proteomics...

# MODERN ONCOLOGY APPROACH



# INTERVENTIONAL RADIOTHERAPY



PERSONALIZED

DISEASE CONTROL

QUALITY OF LIFE

Gemelli



ART

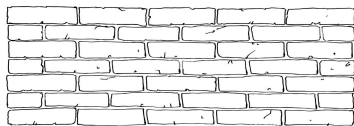
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Advanced Radiation  
Therapy

# MODERN ONCOLOGY APPROACH



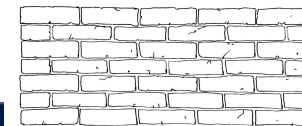
## BRACHYTHERAPY (INTERVENTIONAL RADIO THERAPY)



**TIME**



**PERSONALIZED**

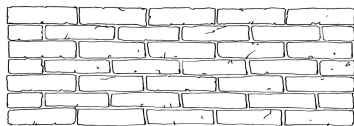
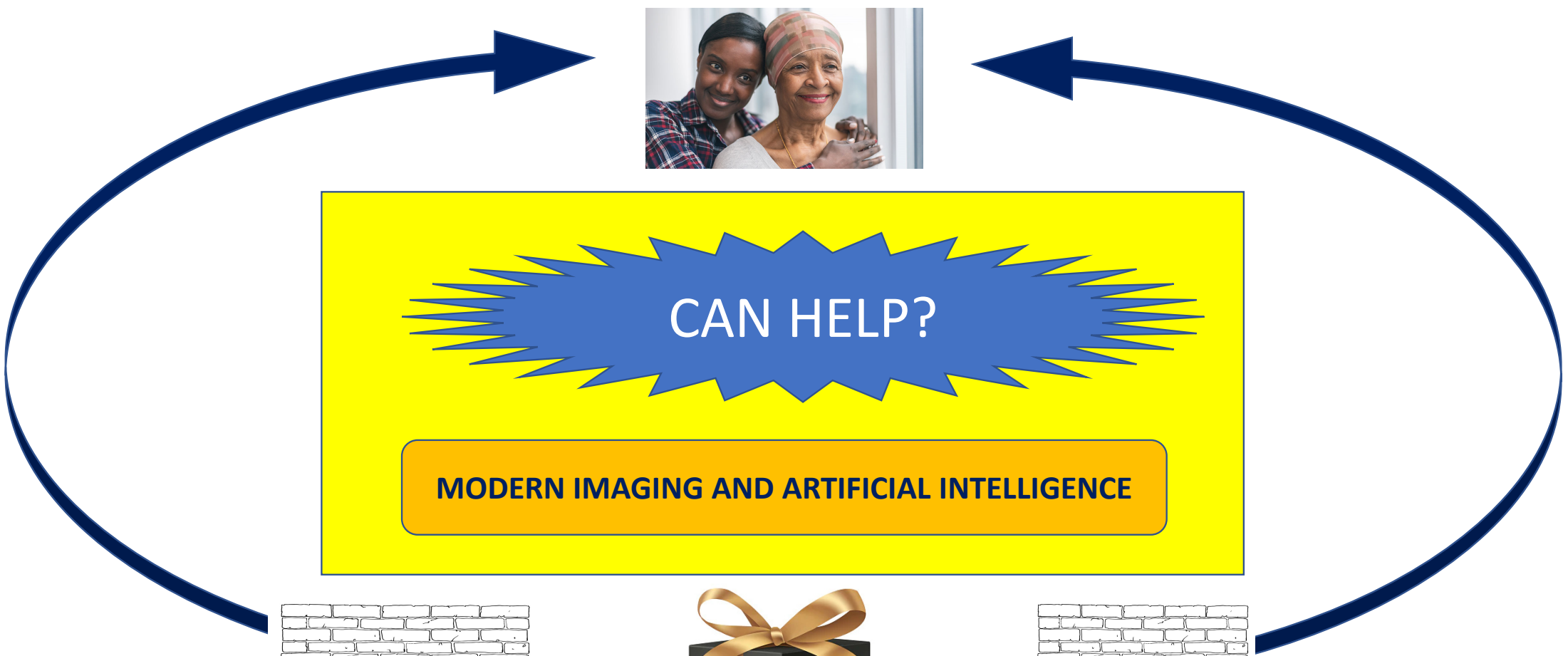


**MANY FACTORS**

**DISEASE CONTROL**

**QUALITY OF LIFE**

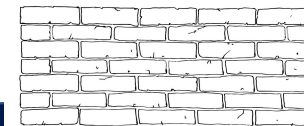
# MODERN ONCOLOGY APPROACH



**TIME**



**PERSONALIZED**



**MANY FACTORS**

**DISEASE CONTROL**

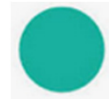
**QUALITY OF LIFE**

# MODERN IMAGING AND AI APPLICATION

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**Providing clinical decision support**



**Mining –omics, analysing data**



**Facilitating repetitive tasks, optimising time**



**Modelling behaviors, in heterogeneous contexts**

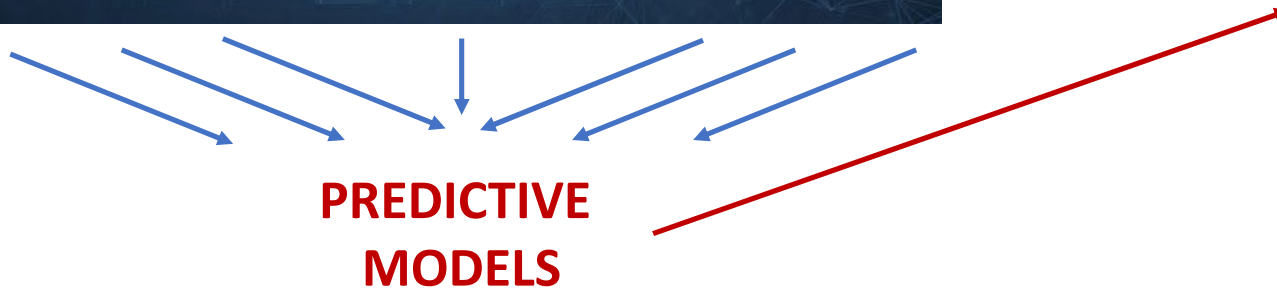
# MODERN IMAGING AND AI APPLICATION



## Providing clinical decision support

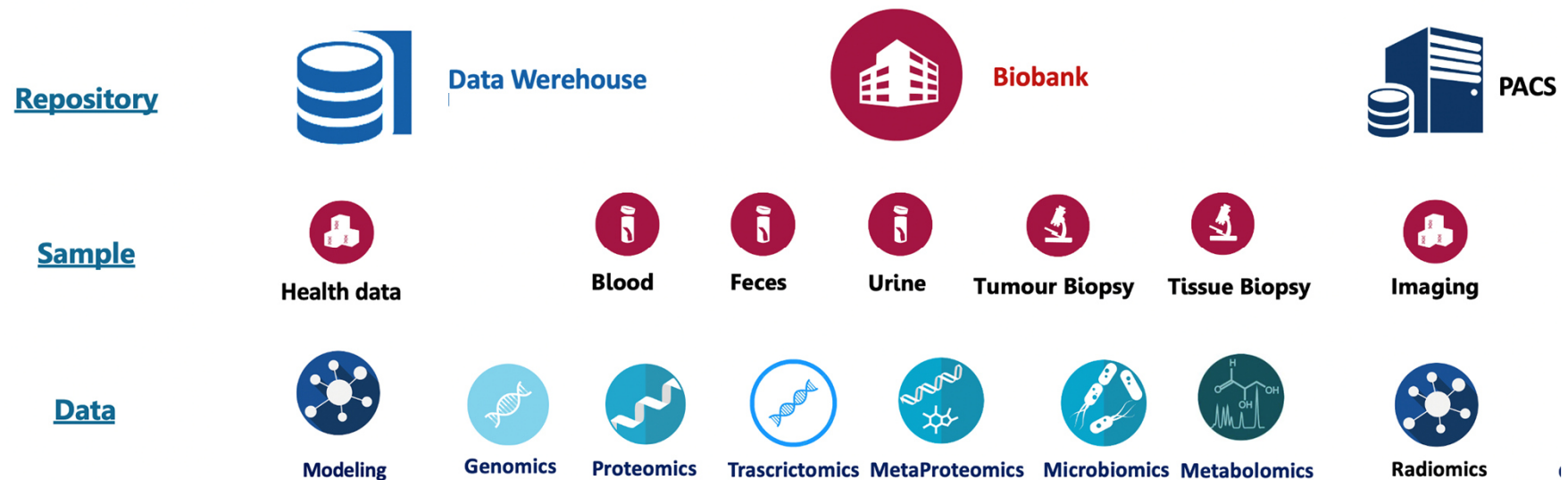


**DECISION  
SUPPORTING  
SYSTEM**



# MODERN IMAGING AND AI APPLICATION

## Mining –omics, analysing data





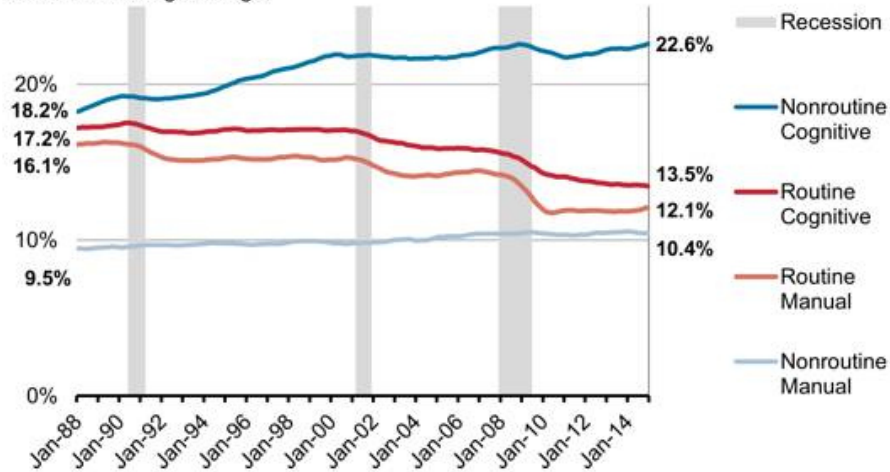
# MODERN IMAGING AND AI APPLICATION



## Facilitating repetitive tasks, optimising time

### Decline of Routine

Percentage of the population in jobs that have been identified as routine and nonroutine, 12-month moving average



Source: Henry Siu and Nir Jaimovich for Third Way | WSJ.com

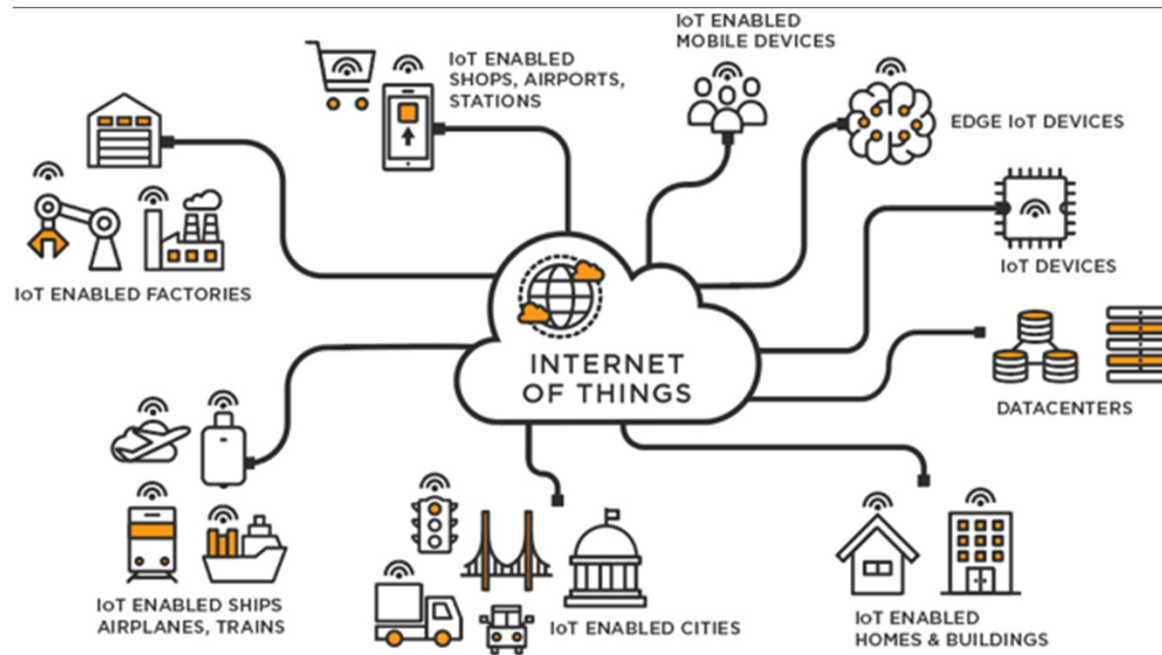


# AUTOMATION



# MODERN IMAGING AND AI APPLICATION

## Modelling of behaviors in heterogeneous contexts



# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIOOTHERAPY WORKFLOW



First patient  
consultation

Implant

Delineation

Planning

Treatment  
session  
delivery

End of  
treatment

Providing clinical  
decision support

Mining –omics,  
analysing data

Facilitating  
repetitive tasks,  
optimising time

Modelling  
behaviors,  
in heterogeneous  
contexts

## MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIOOTHERAPY WORKFLOW

# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIOOTHERAPY WORKFLOW

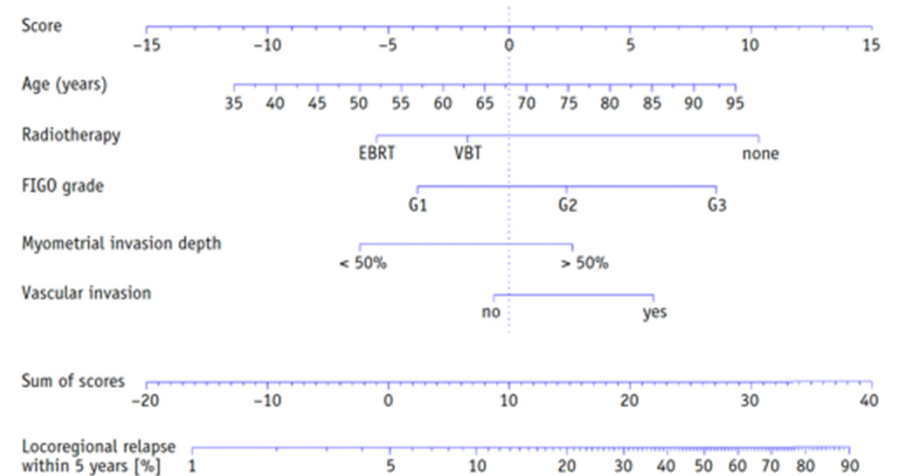
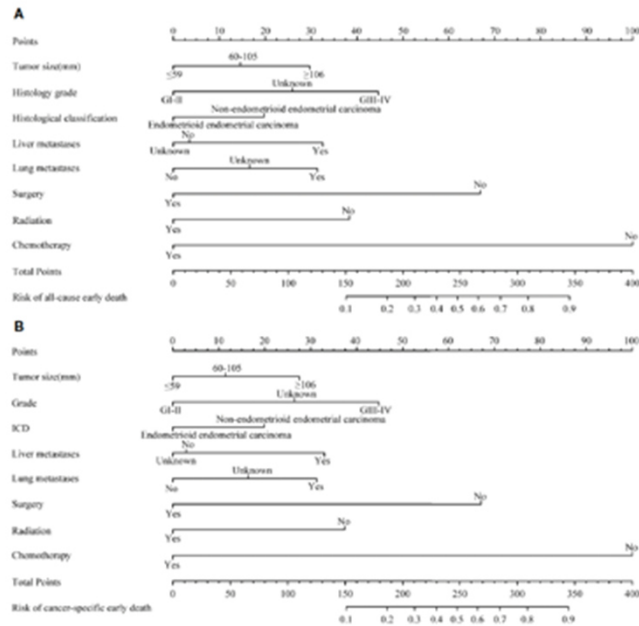


Providing clinical decision support

Mining -omics, analysing data

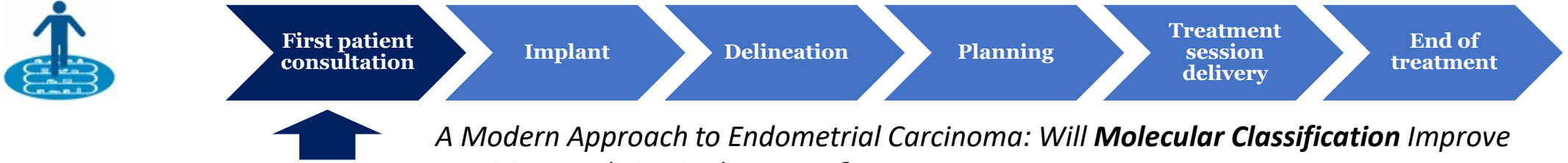
Facilitating repetitive tasks, optimising time

Modelling behaviors, in heterogeneous contexts



PORTEC-1 and PORTEC-2

# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIOOTHERAPY WORKFLOW



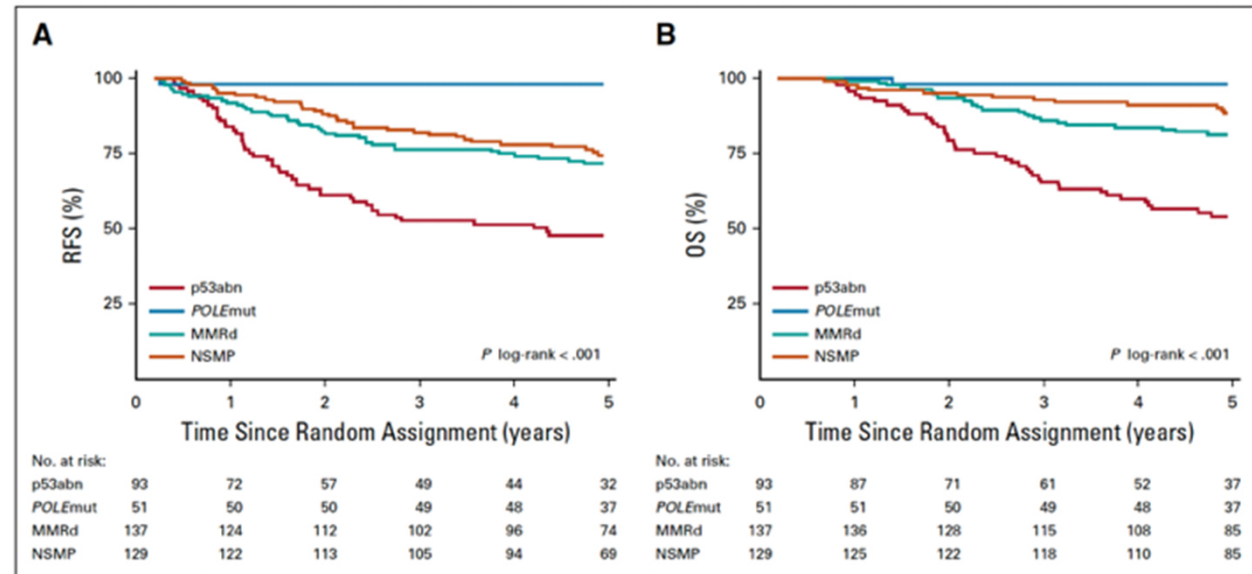
Providing clinical decision support

Mining -omics, analysing data

Facilitating repetitive tasks, optimising time

Modelling behaviors, in heterogeneous contexts

*A Modern Approach to Endometrial Carcinoma: Will **Molecular Classification** Improve Precision Medicine in the Future?*



**FIG 2.** Kaplan-Meier survival curves for 5-year (A) recurrence-free survival (RFS) for patients with p53abn endometrial cancer (EC; 48.0%), POLEmut EC (98.0%), MMRd (71.7%), or NSMP EC (74.4%), and (B) overall survival (OS) in patients with p53abn EC (54.0%), POLEmut EC (98.0%), MMRd (81.3%), or NSMP EC (88.5%). MMRd, MMR-deficient; NSMP, no specific molecular profile; p53abn, p53-abnormal; POLEmut, POLE-ultramutated.

# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIOTHERAPY WORKFLOW

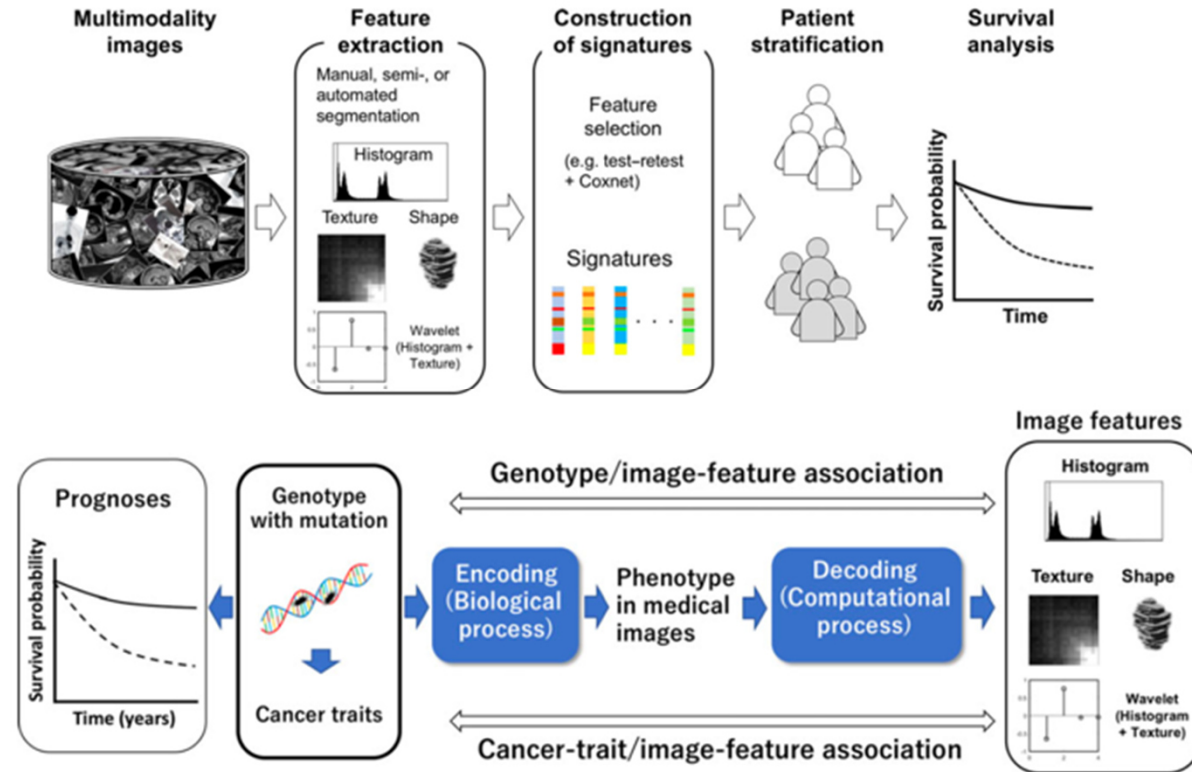


Providing clinical decision support

Mining -omics, analysing data

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# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



Providing clinical decision support

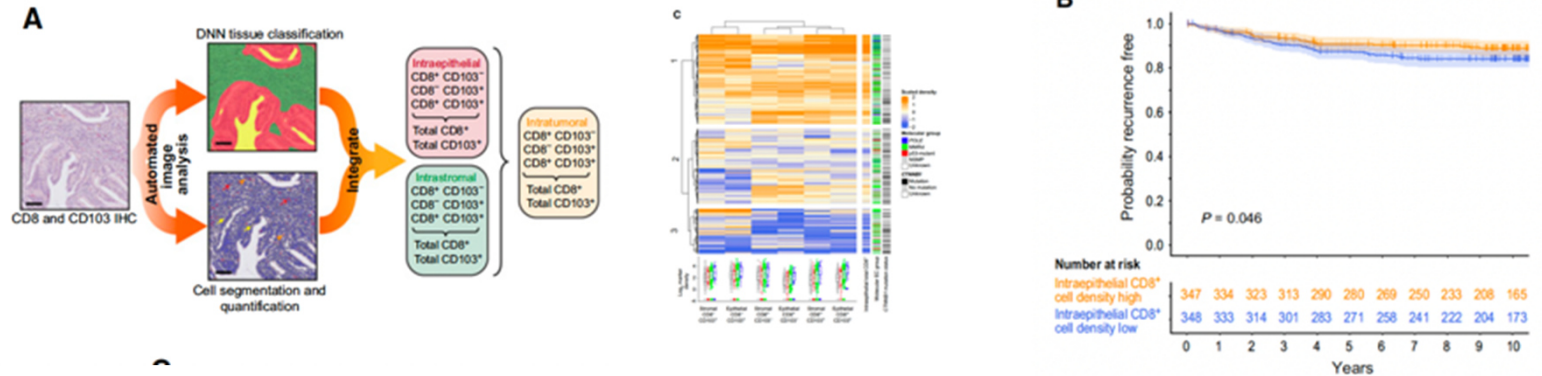
Mining –omics, analysing data

Facilitating repetitive tasks, optimising time

Modelling behaviors, in heterogeneous contexts

## Prognostic Integrated Image-Based Immune and Molecular Profiling in Early-Stage Endometrial Cancer

Nanda Horeweg<sup>1</sup>, Marco de Bruyn<sup>2</sup>, Remi A. Nout<sup>1</sup>, Ellen Stelloo<sup>3</sup>, Katarzyna Kedzierska<sup>4</sup>, Alicia León-Castillo<sup>3</sup>, Annechien Plat<sup>2</sup>, Kirsten D. Mertz<sup>5</sup>, Michelle Osse<sup>3</sup>, Ina M. Jürgenliemk-Schulz<sup>6</sup>, Ludy C.H.W. Lutgens<sup>7</sup>, Jan J. Jobsen<sup>8</sup>, Elzbieta M. van der Steen-Banasik<sup>9</sup>, Vincent T. Smit<sup>3</sup>, Carien L. Creutzberg<sup>1</sup>, Tjalling Bosse<sup>3</sup>, Hans W. Nijman<sup>2</sup>, Viktor H. Koelzer<sup>10,11</sup>, and David N. Church<sup>3,12,13</sup>





# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIOLOGY WORKFLOW

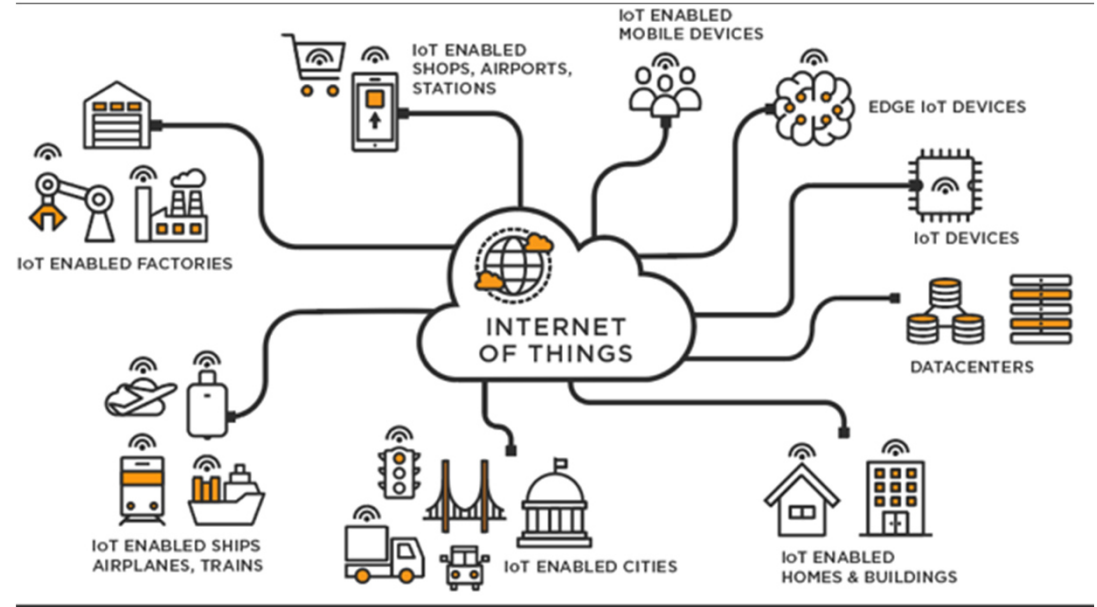
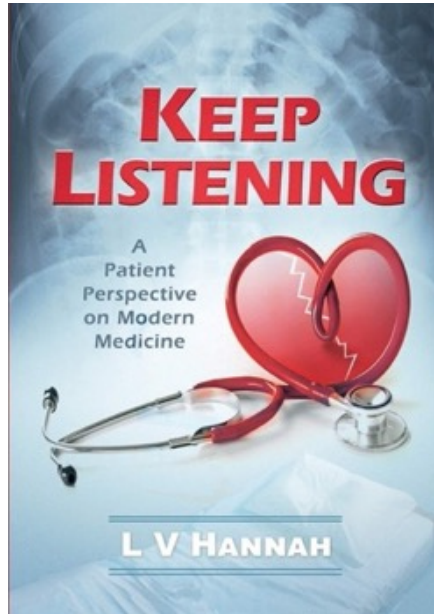


Providing clinical decision support

Mining –omics, analysing data

Facilitating repetitive tasks, optimising time

Modelling behaviors, in heterogeneous contexts



# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIO THERAPY WORKFLOW



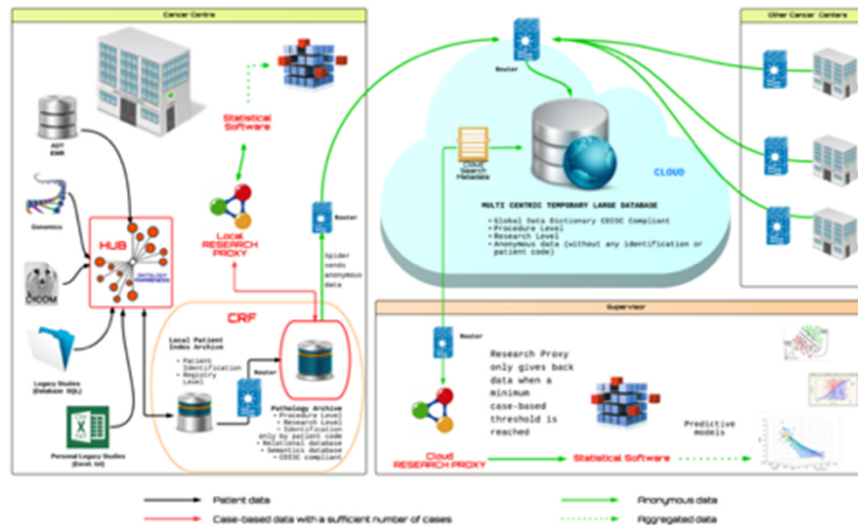
Providing clinical decision support

Mining –omics, analysing data

Facilitating repetitive tasks, optimising time

Modelling behaviors, in heterogeneous contexts

## COBRA CONsortium for BRachytherapy data Analysis



- Tagliaferri L, Kovács G, Autorino R, Budrukkar A, Guinot JL, Hildebrand G, Johansson B, Monge RM, Meyer JE, Niehoff P, Rovirosa A, Takácsi-Nagy Z, Dinapoli N, Lanzotti V, Damiani A, Soror T, Valentini V. ENT COBRA (Consortium for Brachytherapy Data Analysis): interdisciplinary standardized data collection system for head and neck patients treated with interventional radiotherapy (brachytherapy). *J Contemp Brachytherapy*. 2016
- Luca Tagliaferri, Monica Maria Pagliara, Carlotta Masciocchi, Andrea Scupola, Luigi Azario, Gabriela Grimaldi, Rosa Autorino, Maria Antonietta Gambacorta, Antonio Laricchiuta, Luca Boldrini, Prof. Vincenzo Valentini, Maria Antonietta Blasi. Nomogram for predicting radiation maculopathy in patients treated with Ruthenium-106 plaque brachytherapy for uveal melanoma *J Contemp Brachytherapy* 2017



# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIOLOGY WORKFLOW



Providing clinical decision support

Mining –omics, analysing data

Facilitating repetitive tasks, optimising time

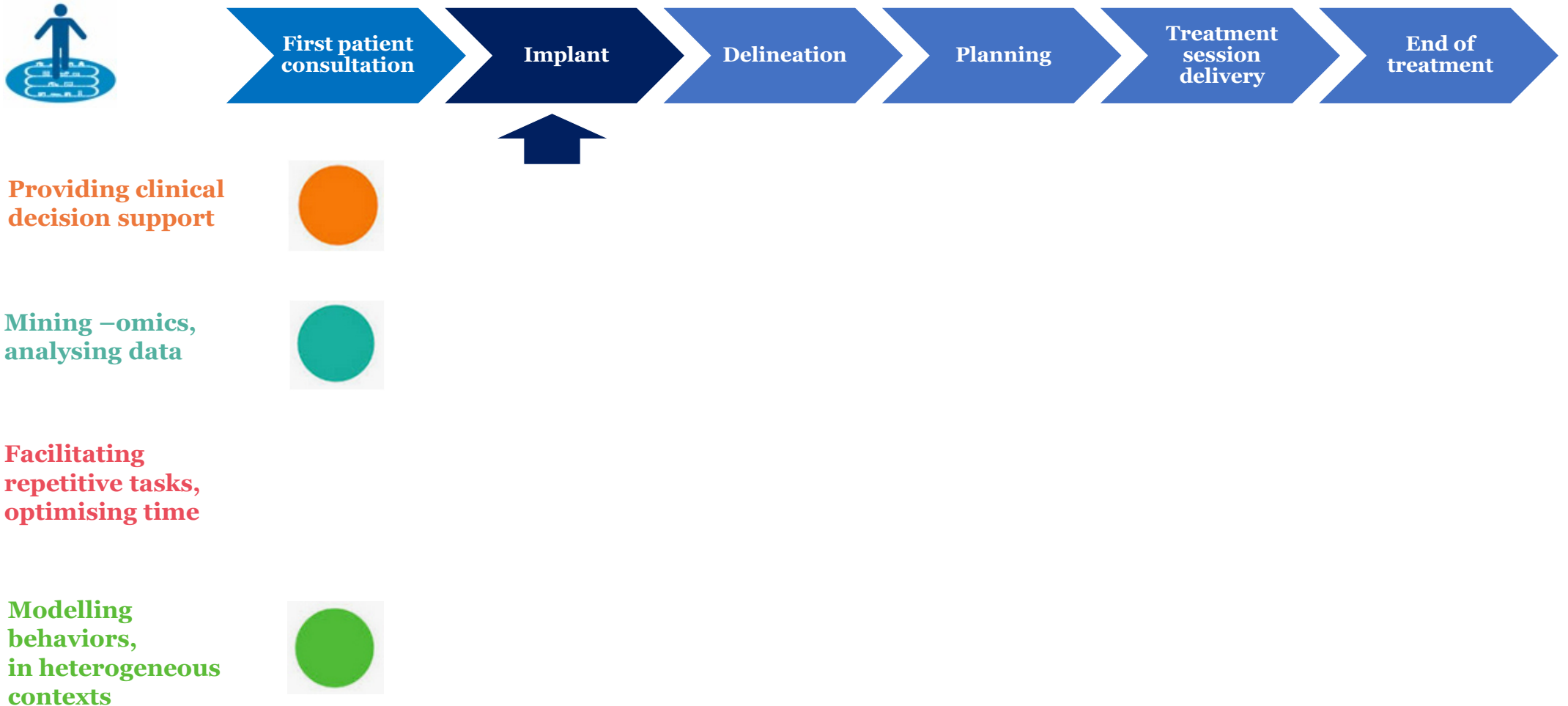
Modelling behaviors, in heterogeneous contexts



## IN SILICO MEDICINE

*modelling, simulation, and visualization of biological and medical processes in computers with the goal of simulating real biological processes in a virtual environment*

# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIOOTHERAPY WORKFLOW



# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIOOTHERAPY WORKFLOW



Providing clinical decision support

Mining –omics, analysing data

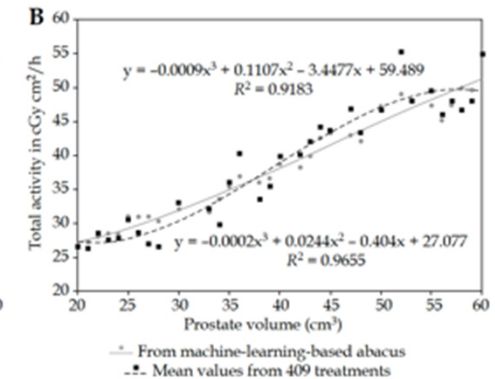
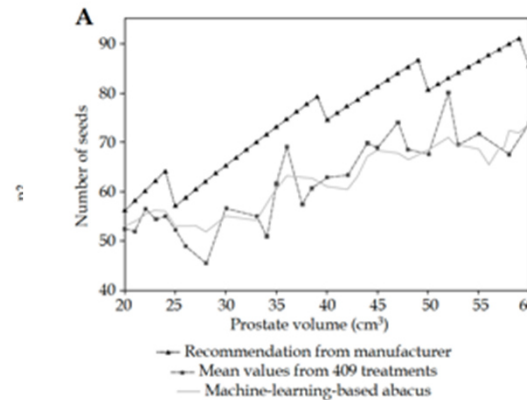
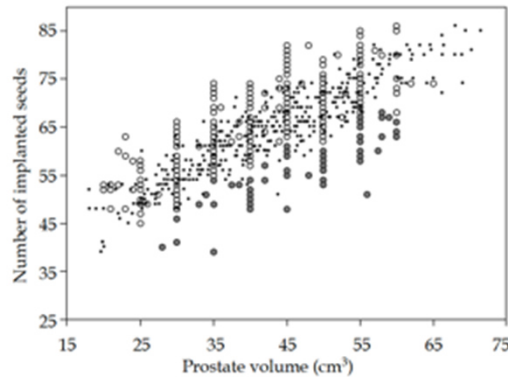
Facilitating repetitive tasks, optimising time

Modelling behaviors, in heterogeneous contexts

## A machine-learning approach based on 409 treatments to predict optimal number of iodine-125 seeds in low-dose-rate prostate brachytherapy

Nicolas Bousson, PhD<sup>1,2</sup>, Ulrike Schick, MD, PhD<sup>1,2</sup>, Gurvan Dissaux, MD<sup>1,2</sup>, Luc Ollivier, MD<sup>2</sup>, Gaëlle Goasduff, MSc<sup>2</sup>, Olivier Pradier, MD, PhD<sup>1,2</sup>, Antoine Valeri, MD, PhD<sup>1,3,4</sup>, Dimitris Visvikis, PhD<sup>1</sup>

<sup>1</sup>LaTIM, INSERM, UMR 1101, Univ Brest, Brest, France, <sup>2</sup>Radiation Oncology Department, CHU, Brest, France, <sup>3</sup>Urology Department, CHU, Brest, France, <sup>4</sup>CeRePP, Paris, France



# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIOTHERAPY WORKFLOW

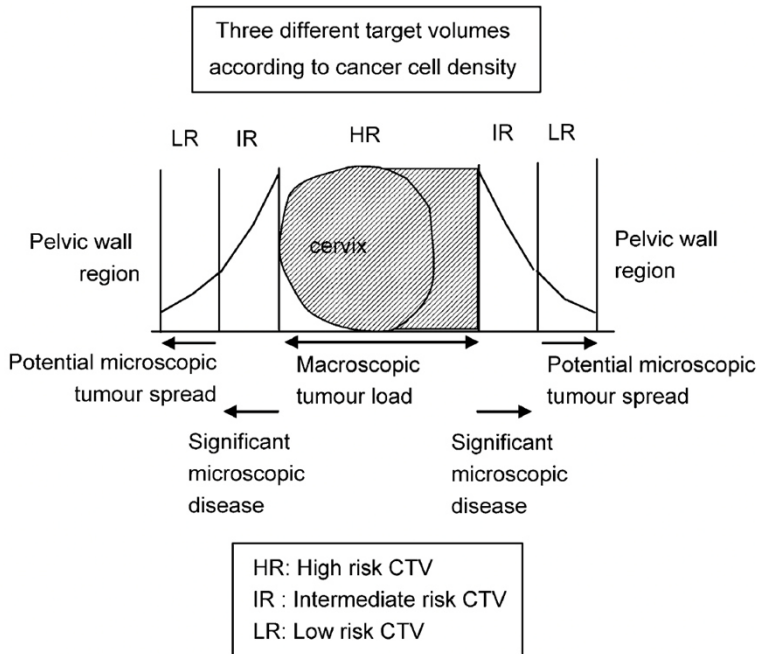


**Providing clinical decision support**

**Mining –omics, analysing data**

**Facilitating repetitive tasks, optimising time**

**Modelling behaviors, in heterogeneous contexts**



## TARGET VOLUME

### HR-CTV

- Cervix in toto
- Residual disease (GTV)
  - extra-cervical residual disease at the time of Interventional Radiotherapy

### IR-CTV

- area of disease at diagnosis

# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIO THERAPY WORKFLOW



Providing clinical decision support

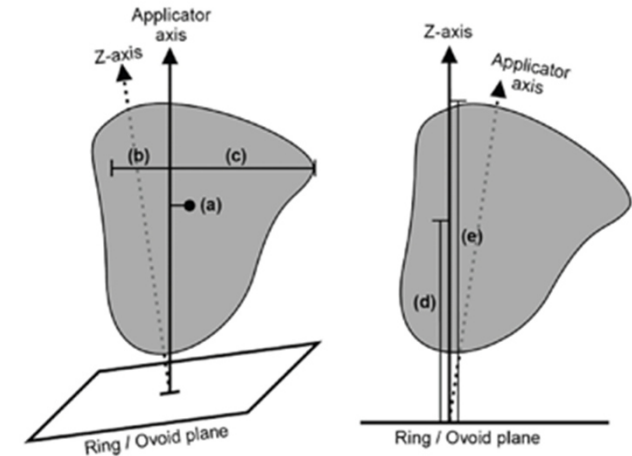
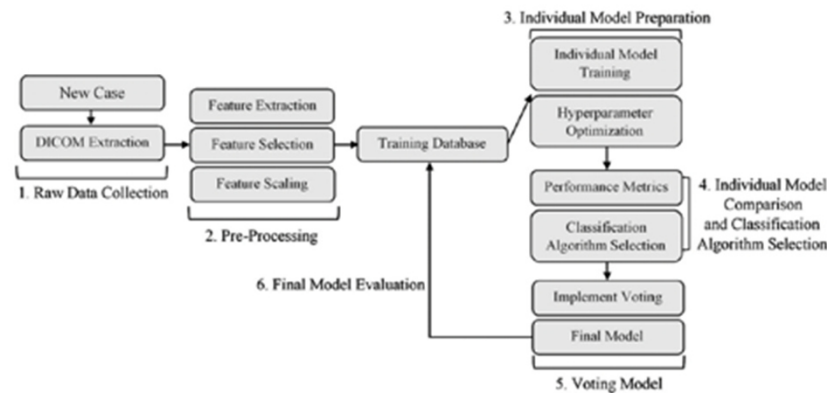
Mining –omics, analysing data

Facilitating repetitive tasks, optimising time

Modelling behaviors, in heterogeneous contexts

## Development of a Machine Learning Model for Optimal Applicator Selection in High-Dose-Rate Cervical Brachytherapy

Kailyn Stenhouse<sup>1,2\*</sup>, Michael Roumeliotis<sup>1,2,3</sup>, Philip Ciunkiewicz<sup>4</sup>, Robyn Banerjee<sup>3,5</sup>, Svetlana Yanushkevich<sup>6</sup> and Philip McGeachy<sup>1,2,3</sup>



# MODERN IMAGING AND AI APPLICATION IN INTERVENTIONAL RADIOOTHERAPY WORKFLOW

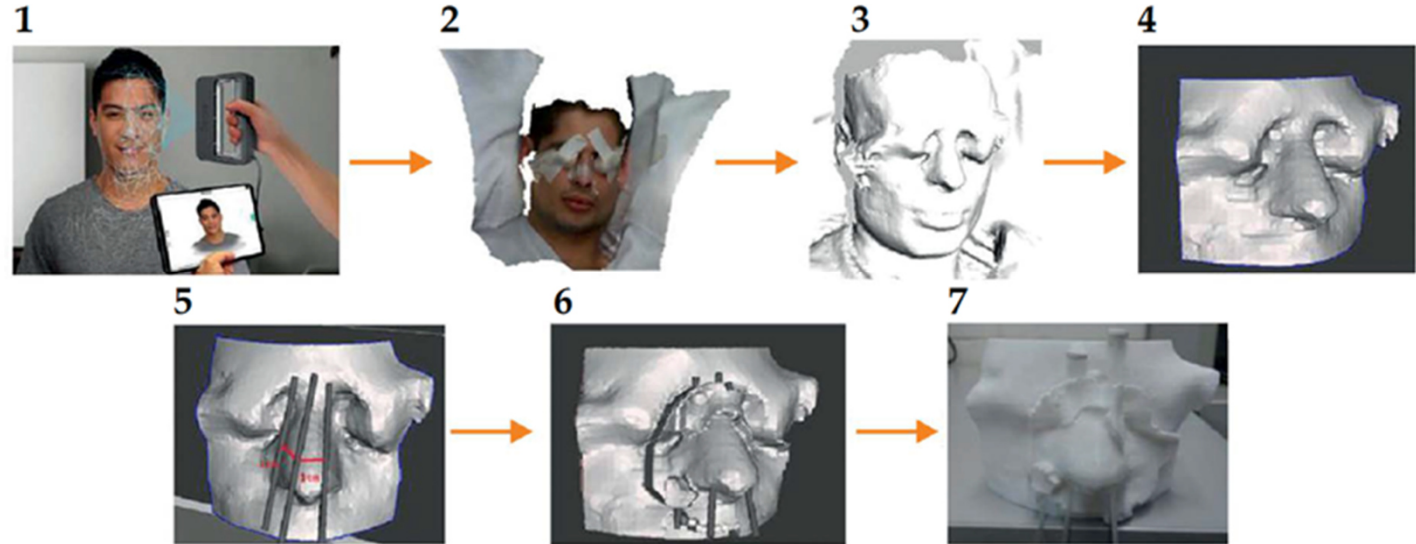


Providing clinical decision support

Mining –omics, analysing data

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Individualized 3D scanning and printing for non-melanoma skin cancer brachytherapy



# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



Providing clinical decision support

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Modelling behaviors, in heterogeneous contexts

Phases	Conventional process				Novel process based on 3D printing				
	Time (hours)	Waiting time (hours)	Human cost (euros)	Material cost (euros)	Time (hours)	Waiting time (hours)	Human cost (euros)	Material cost (euros)	
1. Definition of target	0.5 (RO)		19		1. Definition of target	0.5 (RO)	19		
2. Creation of the patient's alginate negative	1 (RT)		15	5	2. Patient 3D scan	0.25 (RT)	5		
3. Creation of the gypsum from the patient's negative	0.5 (RT)	24	7.5	3	3. 3D image preparation	0.5	7.5		
4. Definition of the area to treat in the gypsum	0.5 (RO)		19						
5. Creation of the counter mould with wax	0.5 (RT)		7.5	5					
6. Placement of catheter tubes	0.5 (RT)		7.5						
7. Addition of extra wax layers to make the final mould	0.5 (RT)		7.5	5	4. 3D printing of the mould with guide tubes		7	8*	
8. CT of the gypsum and the mould	0.5 (RT)	24	7.5	150					
9. CT of the mould on the patient	0.5 (RT)	24	7.5	150	5. CT of the mould on the patient	0.5 (RT)	24	7.5	150
10. Treatment planning	2 (RT)		30		6. Treatment planning	2 (RT)	30		
11. Planning approval	1 (P) 1 (RO)		76		7. Planning approval	1 (P) 1 (RO)	76		
12. Treatment verification	0.5 (RT)		7.5		8. Treatment verification	0.5 (RT)	7.5		
<b>Total</b>	<b>9.5</b>	<b>72</b>	<b>211.5</b>	<b>318</b>	<b>Total</b>	<b>6.25</b>	<b>31</b>	<b>152.5</b>	<b>158</b>

# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



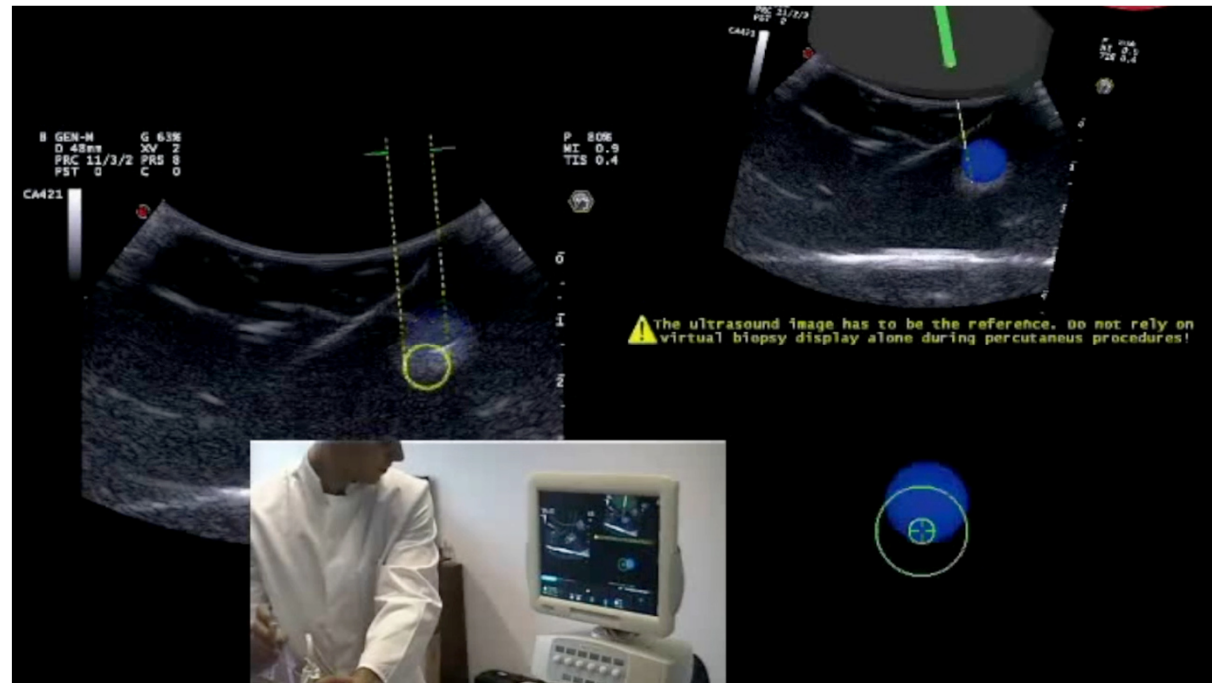
Providing clinical decision support

Mining –omics, analysing data

Facilitating repetitive tasks, optimising time

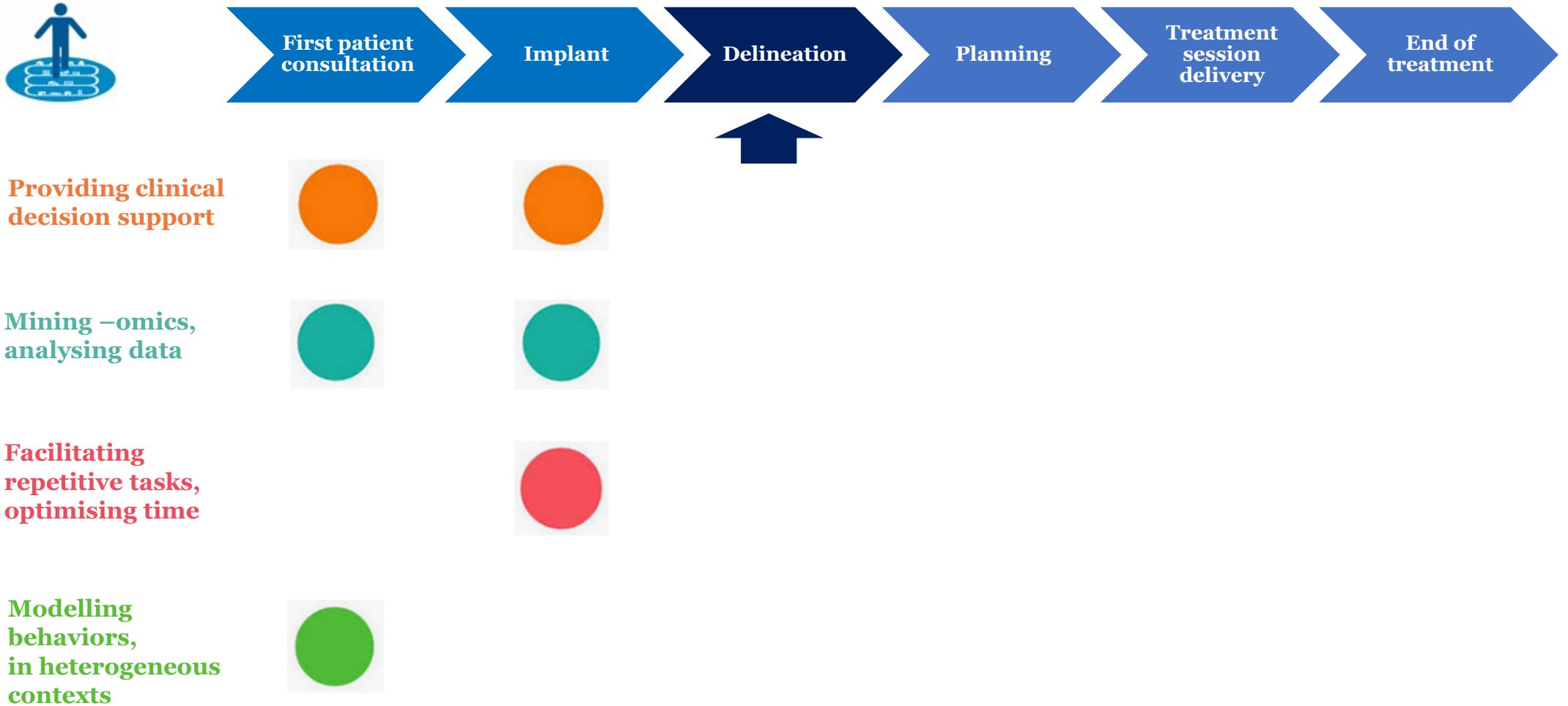
Modelling behaviors, in heterogeneous contexts

## Navigator AI based implant





# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



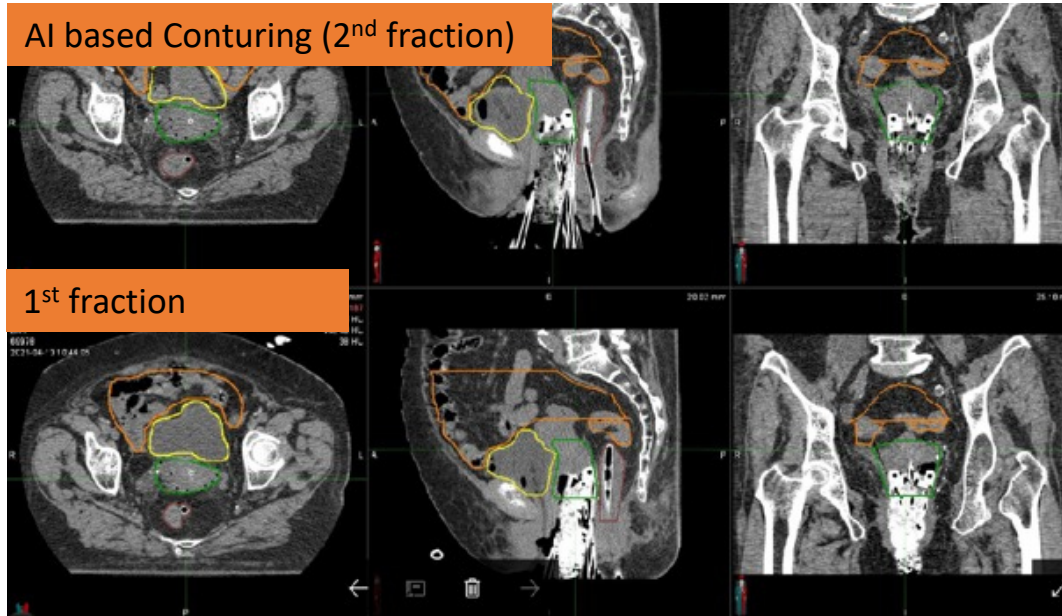
Providing clinical decision support

Mining –omics, analysing data

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Modelling behaviors, in heterogeneous contexts

## DEEP-LEARNING AUTO-SEGMENTATION METHODS IN CERVIX CANCER



the best results were obtained for bladder segmentation.

Automatic segmentation also achieved a good result for HR-CTV and IR-CTV

The most inferior segmentation accuracies were observed on the segmentations of rectum and small bowel

# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



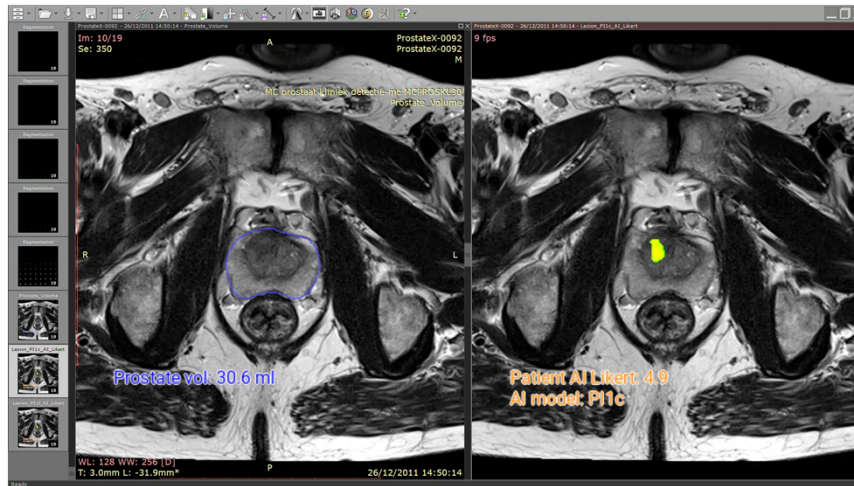
Providing clinical decision support

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Multi-stage AI analysis system to support prostate cancer diagnostic imaging

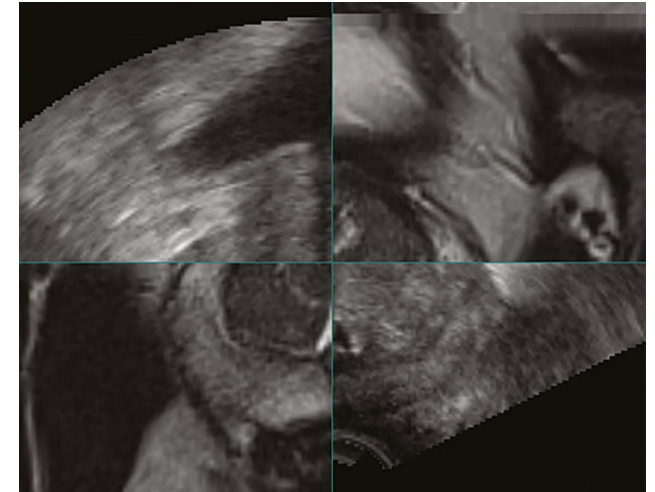


Courtesy of Professor Evis Sala

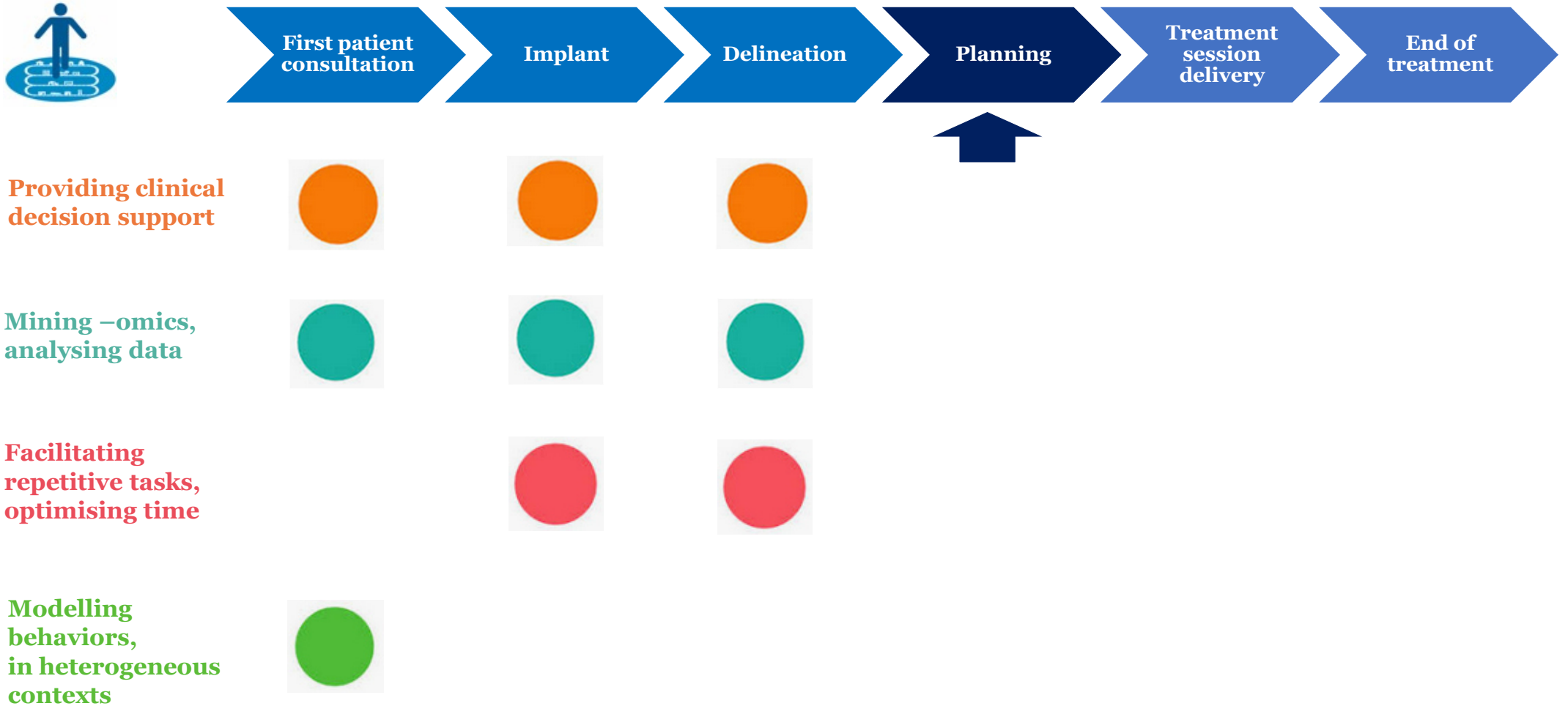
## PROGRESS

PROstate cancer artificial intelligence  
Guided interVentional radiotherapy  
proSpective Study

*Proof of trial at Policlinico Universitario Gemelli IRCCS  
Interventional Oncology Center*



# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



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Providing clinical decision support

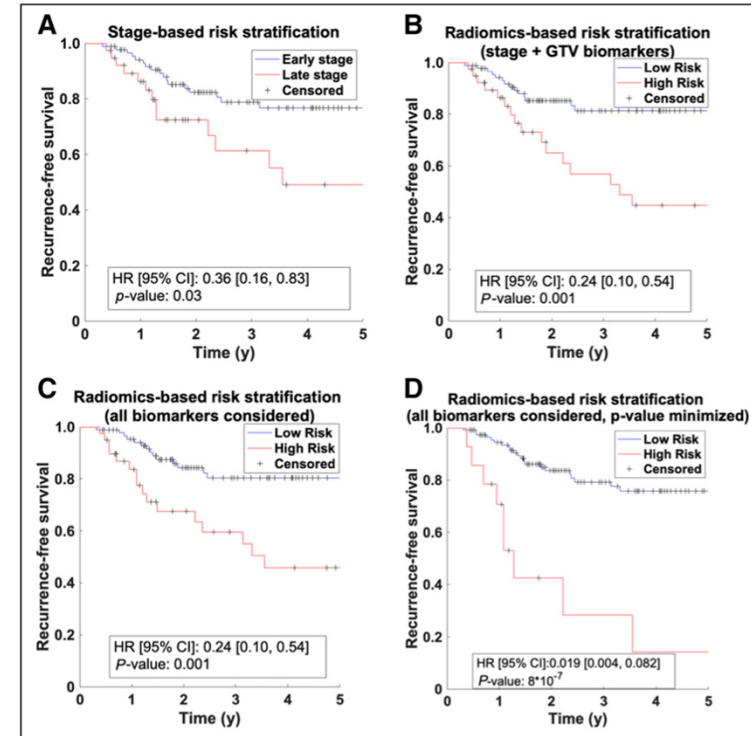
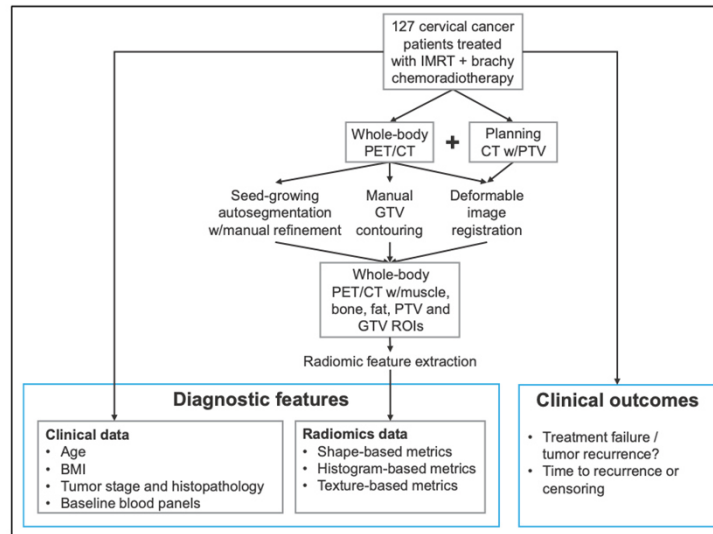
Mining -omics, analysing data

Facilitating repetitive tasks, optimising time

Modelling behaviors, in heterogeneous contexts

## Improved Prognosis of Treatment Failure in Cervical Cancer with Nontumor PET/CT Radiomics

Tahir I. Yusufaly<sup>1</sup>, Jingjing Zou<sup>2</sup>, Tyler J. Nelson<sup>3</sup>, Casey W. Williamson<sup>4</sup>, Aaron Simon<sup>1</sup>, Meenakshi Singhal<sup>3</sup>, Hannah Liu<sup>3</sup>, Hank Wong<sup>3</sup>, Cheryl C. Saenz<sup>2</sup>, Jyoti Mayadev<sup>3,4</sup>, Michael T. McHale<sup>2</sup>, Catheryn M. Yashar<sup>4</sup>, Ramez Eskander<sup>5</sup>, Andrew Sharabi<sup>3,4</sup>, Carl K. Hoh<sup>6</sup>, Sebastian Obrzut<sup>6</sup>, and Loren K. Mell<sup>3,4</sup>





# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



Providing clinical decision support

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Article

## Radiomics Analysis of 3D Dose Distributions to Predict Toxicity of Radiotherapy for Cervical Cancer

François Lucia <sup>1,2,\*</sup>, Vincent Bourbonne <sup>1,2,3</sup>, Dimitris Visvikis <sup>2</sup>, Omar Miranda <sup>1,3</sup>, Dorothy M. Gujral <sup>4,5</sup>, Dominique Gouders <sup>3</sup>, Gervan Dissaux <sup>1,2</sup>, Olivier Pradier <sup>1,2</sup>, Florent Tixier <sup>2</sup>, Vincent Jaouen <sup>2</sup>, Julien Bert <sup>2,†</sup>, Mathieu Hatt <sup>2,†</sup> and Ulrike Schick <sup>1,2,†</sup>



Features	GU Late				
	P	OR	10th–90th Perc. for OR	AUC	95% CI
Clinical					
• FIGO	0.54	1.29	0.37–4.91	0.56	0.42–0.70
DVH					
• D1 Gy %_EBRT + BT	0.0046	1.72	1.18–2.51	0.89	0.77–0.96
RA					
• Energy_hist	0.28	1.15	0.36–10.02		
• Inv_diff_norm_coc	0.13	5.09	0.13–19.75	0.79	0.66–0.89
Clinical + DVH					
• FIGO	0.38	0.28	0.017–4.71	0.90	0.78–0.97
• D1 Gy %_EBRT + BT	0.0050	1.78	1.19–2.66		
Clinical + RA					
• Energy_hist	0.28	1.15	0.36–10.02	0.79	0.66–0.89
• Inv_diff_norm_coc	0.13	5.09	0.13–19.75		
Clinical + DVH + RA					
• D1 Gy %_EBRT + BT	0.029	2.15	1.08–4.28		
• Energy_hist	0.28	1.14	0.39–3.76	0.96	0.87–1.00
• Inv_diff_norm_coc	0.17	2.89	0.88–19.62		

Features	Vaginal Late				
	P	OR	10th–90th Perc. for OR	AUC	95% CI
Clinical					
• FIGO	0.38	1.82	0.47–6.96	0.57	0.42–0.71
DVH					
• V70 Gy%_EBRT + BT	0.015	1.30	1.05–1.60	0.72	0.58–0.84
RA					
• GLNU area	0.0097	0.93	0.87–0.98	0.78	0.64–0.88
Clinical + DVH					
• V70 Gy%_EBRT + BT	0.015	1.30	1.05–1.60	0.72	0.58–0.84
Clinical + RA					
• FIGO	0.39	1.94	0.42–8.89	0.79	0.65–0.89
• GLNU area	0.01	0.92	0.87–0.98		
Clinical + DVH + RA					
• V70 Gy%_EBRT + BT	0.013	1.38	1.07–1.79	0.89	0.77–0.96
• GLNU area	0.0092	0.91	0.84–0.98		

Features	Rectal Late				
	P	OR	10th–90th Perc. for OR	AUC	95% CI
Clinical					
• FIGO	0.13	3.56	0.69–18.28	0.65	0.50–0.78
DVH					
• D1 Gy %_EBRT + BT	0.34	1.19	0.84–1.68	0.57	0.43–0.71
RA					
• Coarseness vdif	0.044	17.01	1.69–41.93	0.86	0.74–0.94
• AUC-hist	0.48	11.90	0.013–10.86		
Clinical + DVH					
• FIGO	0.14	3.41	0.67–18.21		
• D1 Gy %_EBRT + BT	0.39	1.17	0.82–1.68	0.63	0.48–0.76
Clinical + RA					
• FIGO	0.069	5.99	0.87–41.13	0.87	0.74–0.95
• Coarseness vdif	0.020	11.71	1.54–89.35		
Clinical + DVH + RA					
• FIGO	0.069	5.99	0.87–41.13	0.87	0.74–0.95
• Coarseness vdif	0.020	11.71	1.54–89.35		

# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW

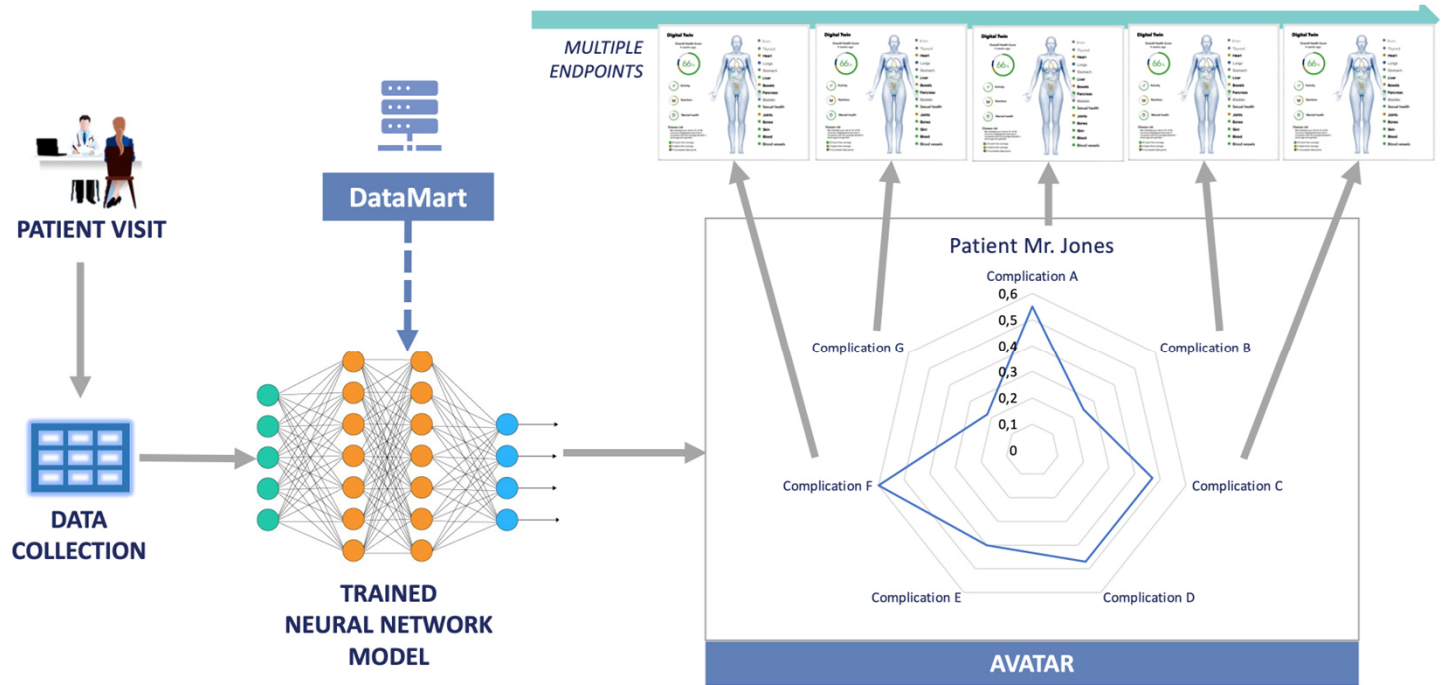


Providing clinical decision support

Mining –omics, analysing data

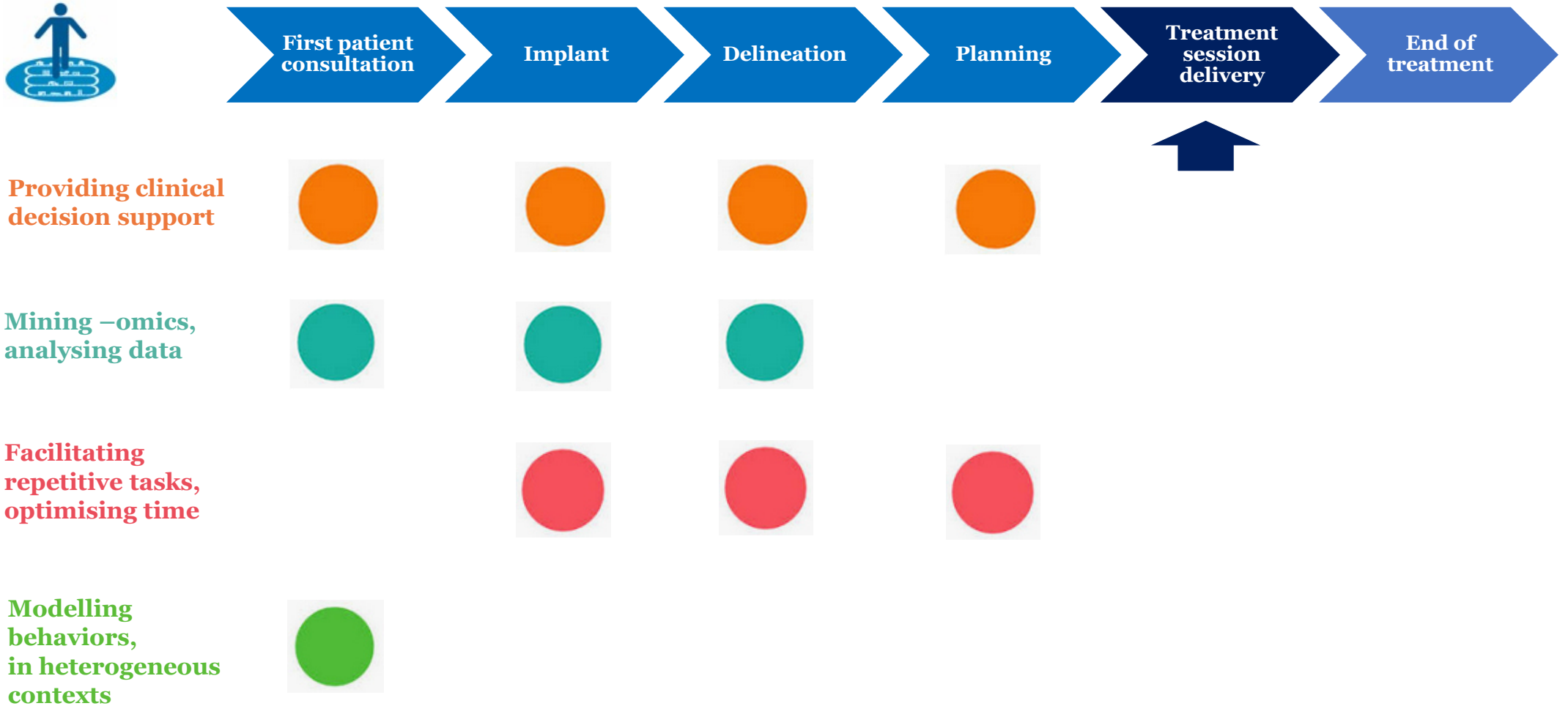
Facilitating repetitive tasks, optimising time

Modelling behaviors, in heterogeneous contexts



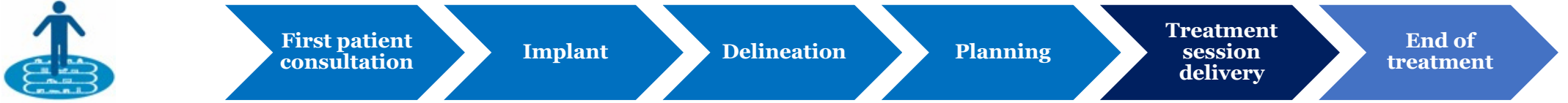
Courtesy of Professor Vincenzo Valentini

# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW





# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



Providing clinical decision support

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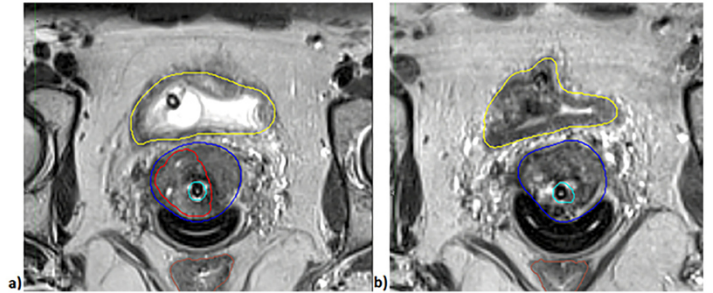
A general framework to develop a radiomic fingerprint for progression-free survival in cervical cancer

Christina Small<sup>1,#,\*</sup>, Phillip Prior<sup>1,#</sup>, Haidy Nasief<sup>1</sup>, Ross Zeitlin<sup>2</sup>, Hina Saeed<sup>3</sup>, Eric Paulson<sup>1</sup>, Natalya Morrow<sup>1</sup>, Jason Rownd<sup>1</sup>, Beth Erickson<sup>1</sup>, Meena Bedi<sup>1</sup>

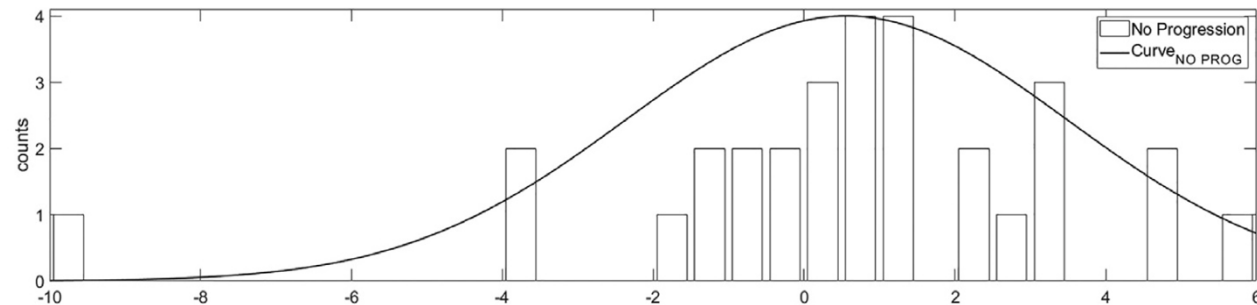
<sup>1</sup>Department of Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI

<sup>2</sup>Department of Radiation Oncology, John H Stroger, Jr. Hospital of Cook County, Chicago, IL

<sup>3</sup>Department of Radiation Oncology, Lynn Cancer Institute, Baptist Health South Florida, Boynton Beach, FL



Depiction of the first (1a on left) and last (1b on the right) brachytherapy fraction above shows the GTV (red colored contour)



Small C, Prior P, Nasief H, Zeitlin R, Saeed H, Paulson E, Morrow N, Rownd J, Erickson B, Bedi M. A general framework to develop a radiomic fingerprint for progression-free survival in cervical cancer. Brachytherapy. 2023

# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW

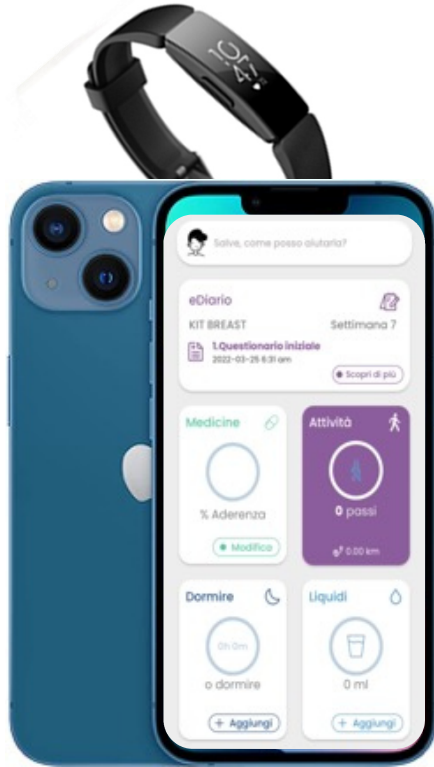


Providing clinical decision support

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## KIT (Keep In Touch)

A mobile application

to monitor Symptoms and outcomes for cancer patients during and after treatment

- Monitoring AI driven
- Tutoring AI driven
- Chat-BOT AI based



GemelliGenerator  
beyond ontology awareness

# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



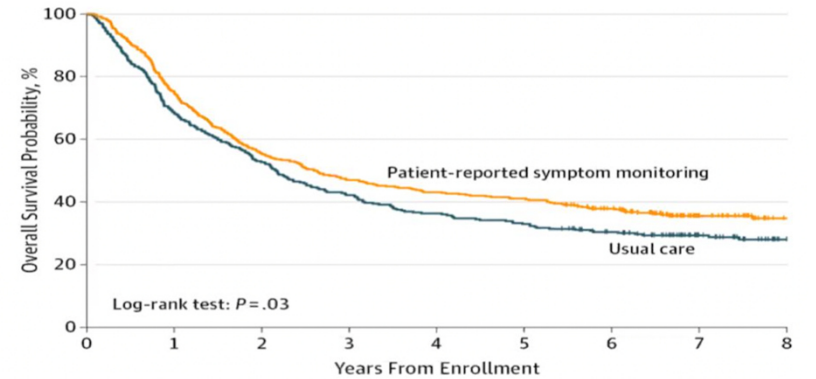
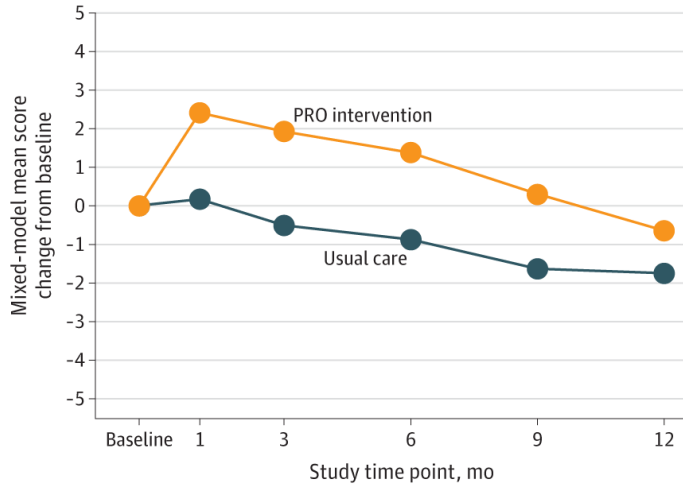
Providing clinical decision support

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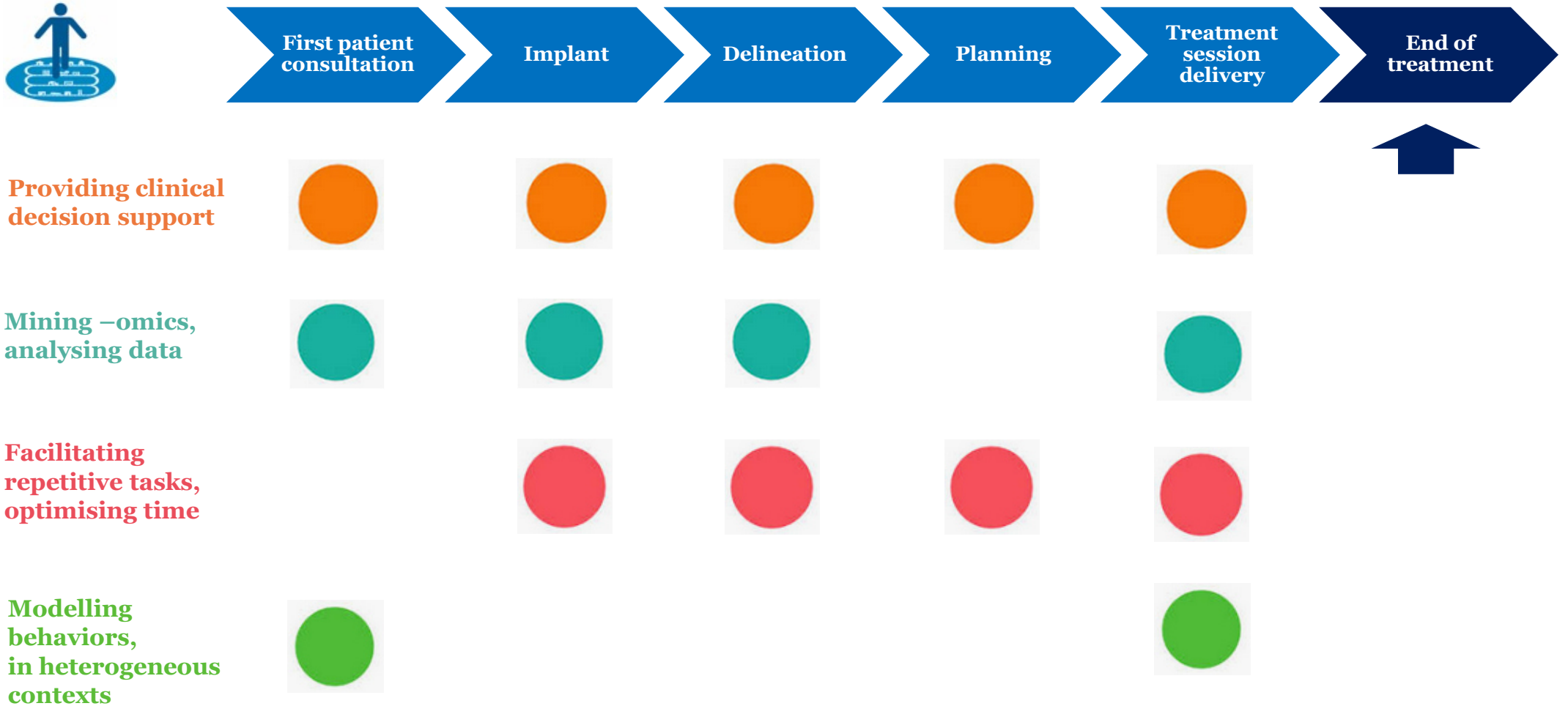
C Mean change in health-related quality-of-life score



No. at risk	0	1	2	3	4	5	6	7	8
Patient-reported symptom monitoring	441	331	244	207	190	181	148	65	33
Usual care	325	223	171	137	118	107	89	50	27

- Basch E, Schrag D, Henson S, et al. Effect of Electronic Symptom Monitoring on Patient-Reported Outcomes Among Patients With Metastatic Cancer: A Randomized Clinical Trial. JAMA. Published online June 05, 2022. doi:10.1001/jama.2022.9265
- Basch E, Deal AM, Dueck AC, Scher HI, Kris MG, Hudis C, Schrag D. Overall Survival Results of a Trial Assessing Patient-Reported Outcomes for Symptom Monitoring During Routine Cancer Treatment. JAMA. 2017

# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



Providing clinical decision support

Mining –omics, analysing data

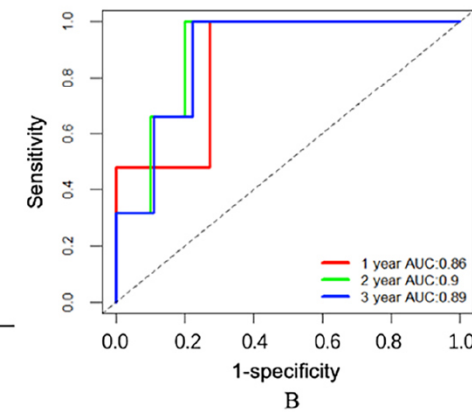
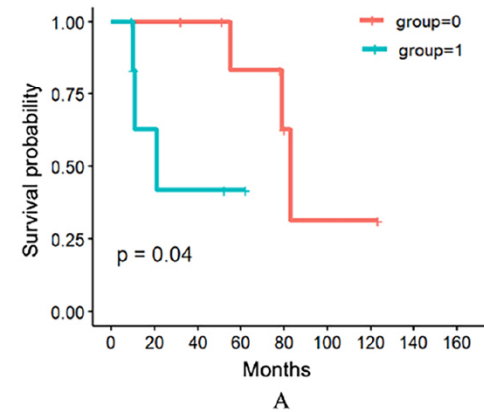
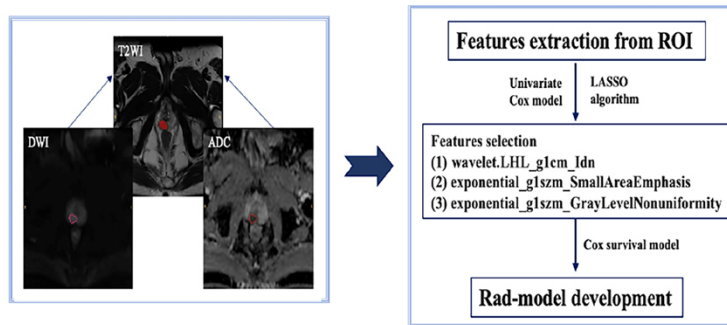
Facilitating repetitive tasks, optimising time

Modelling behaviors, in heterogeneous contexts

Decision Support for adjuvant approach

## MRI-Derived Radiomics Model to Predict the Biochemical Recurrence of Prostate Cancer Following Seed Brachytherapy

Xuehua Zhu<sup>1</sup>, Zenan Liu<sup>1</sup>, Jide He<sup>1</sup>, Ziang Li<sup>1</sup>, Yi Huang<sup>1</sup>, Jian Lu<sup>1,\*</sup>



# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



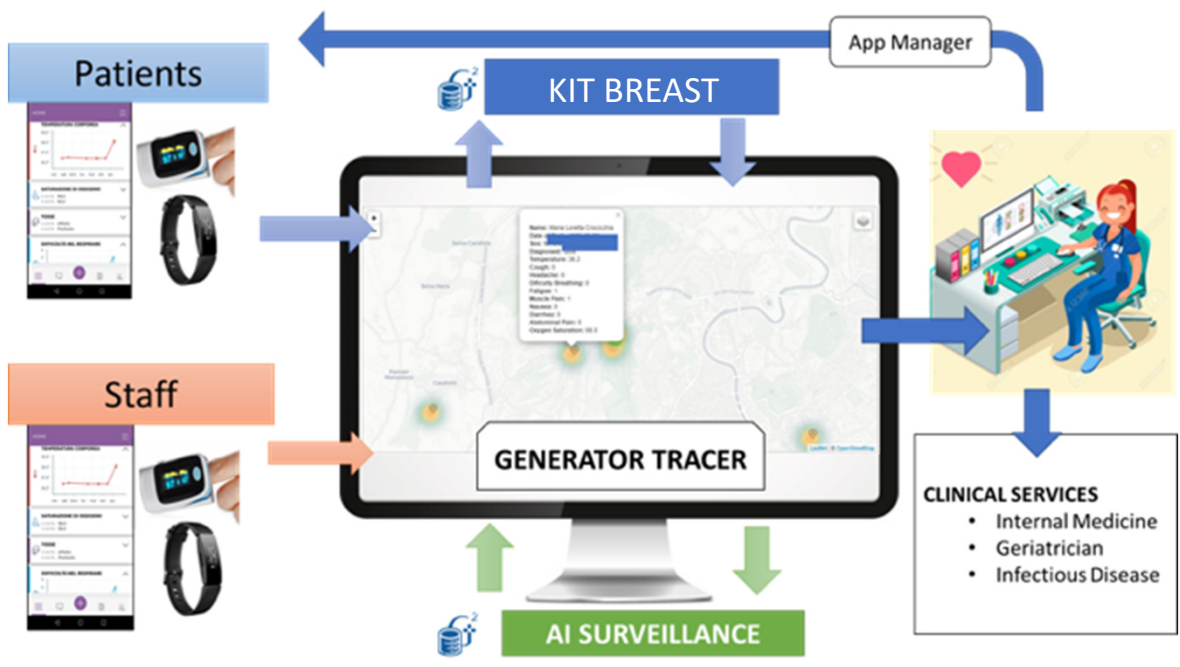
**Providing clinical decision support**

Mining –omics, analysing data

Facilitating repetitive tasks, optimising time

**Modelling behaviors, in heterogeneous contexts**

## Decision Support for Follow-Up timing Triage





# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



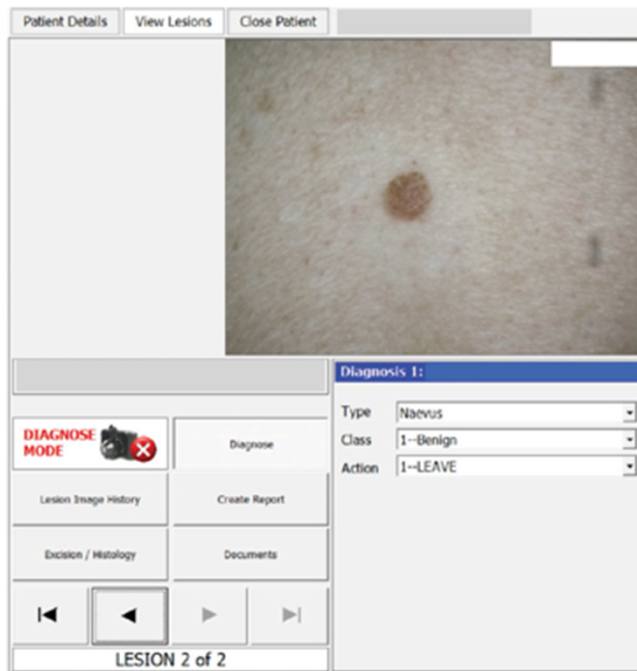
Providing clinical decision support

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Early detection of relapses and toxicity



BMJ Open Improving Skin cancer Management with ARTificial Intelligence (SMARTI): protocol for a preintervention/postintervention trial of an artificial intelligence system used as a diagnostic aid for skin cancer management in a specialist dermatology setting

Table 2 Management decision definitions

Management decision	Definition
Leave	Reassure patient and take no further action.
Manage—monitor	Reassessment of lesion at later time point according to Australian Guidelines.
Manage—biopsy	Partial or complete biopsy of the lesion required to confirm diagnosis.
Treat—elective	Benign or pre-cancerous lesion where treatment is not essential.
Treat—essential	Malignancy requiring non-surgical intervention.

# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW



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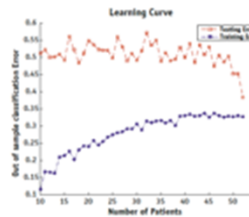
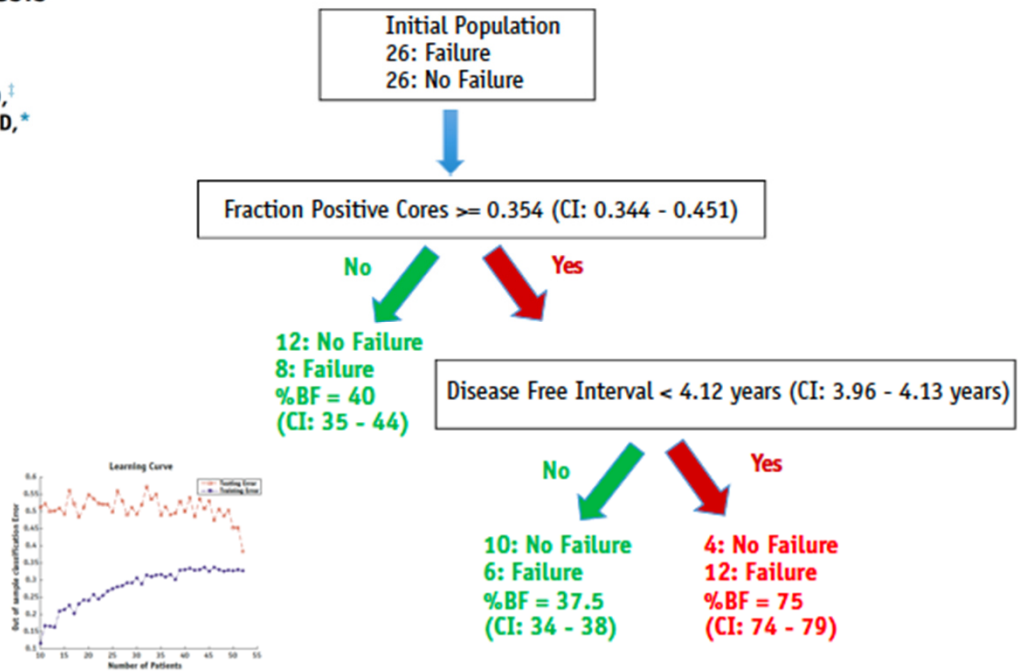
Modelling behaviors, in heterogeneous contexts

## Decision Support for Salvage approach

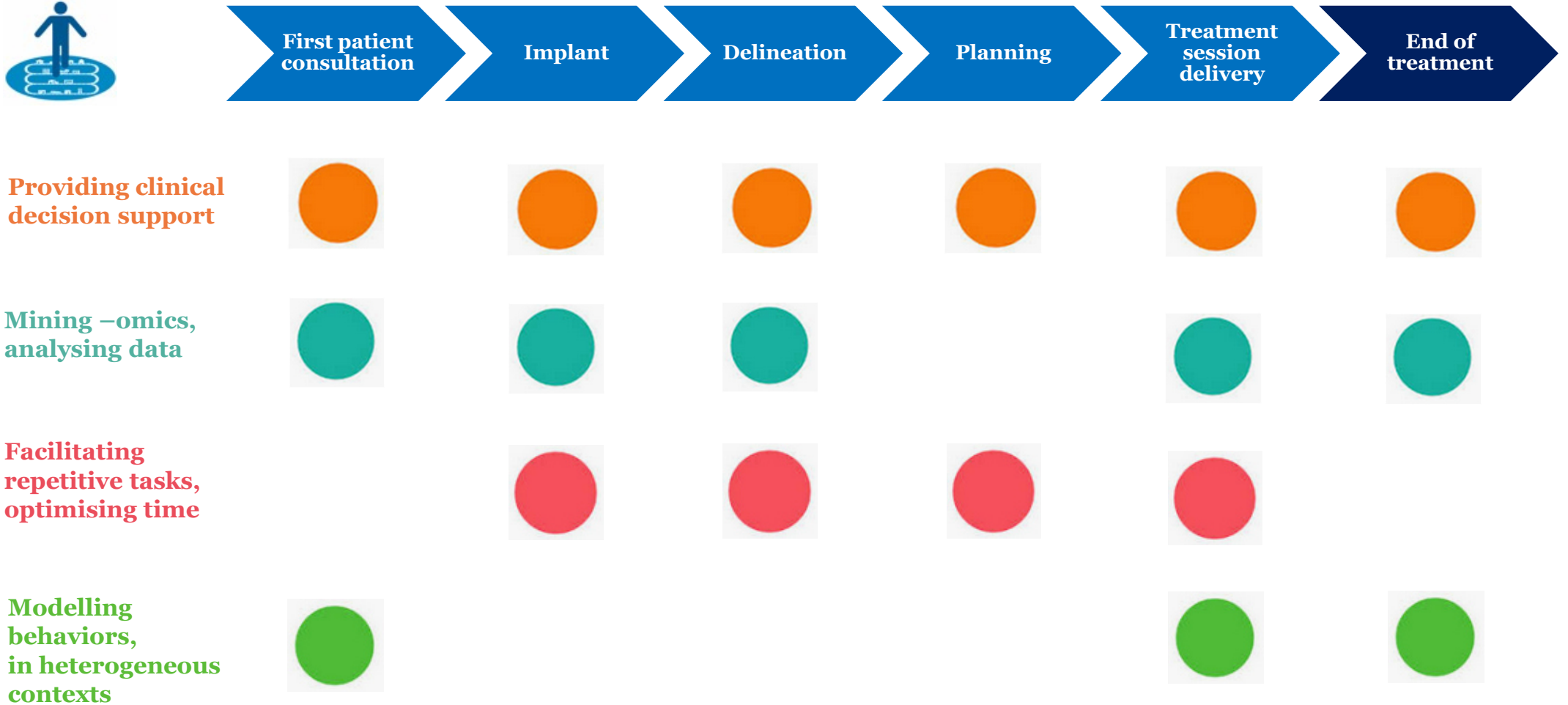
### Salvage HDR Brachytherapy: Multiple Hypothesis Testing Versus Machine Learning Analysis

Gilmer Valdes, PhD,\* Albert J. Chang, MD, PhD,\*  
 Yannet Interian, PhD,† Kenton Owen, MS,\* Shane T. Jensen, PhD,‡  
 Lyle H. Ungar, PhD,§ Adam Cunha, PhD,\* Timothy D. Solberg, PhD,\*  
 and I-Chow Hsu, MD\*

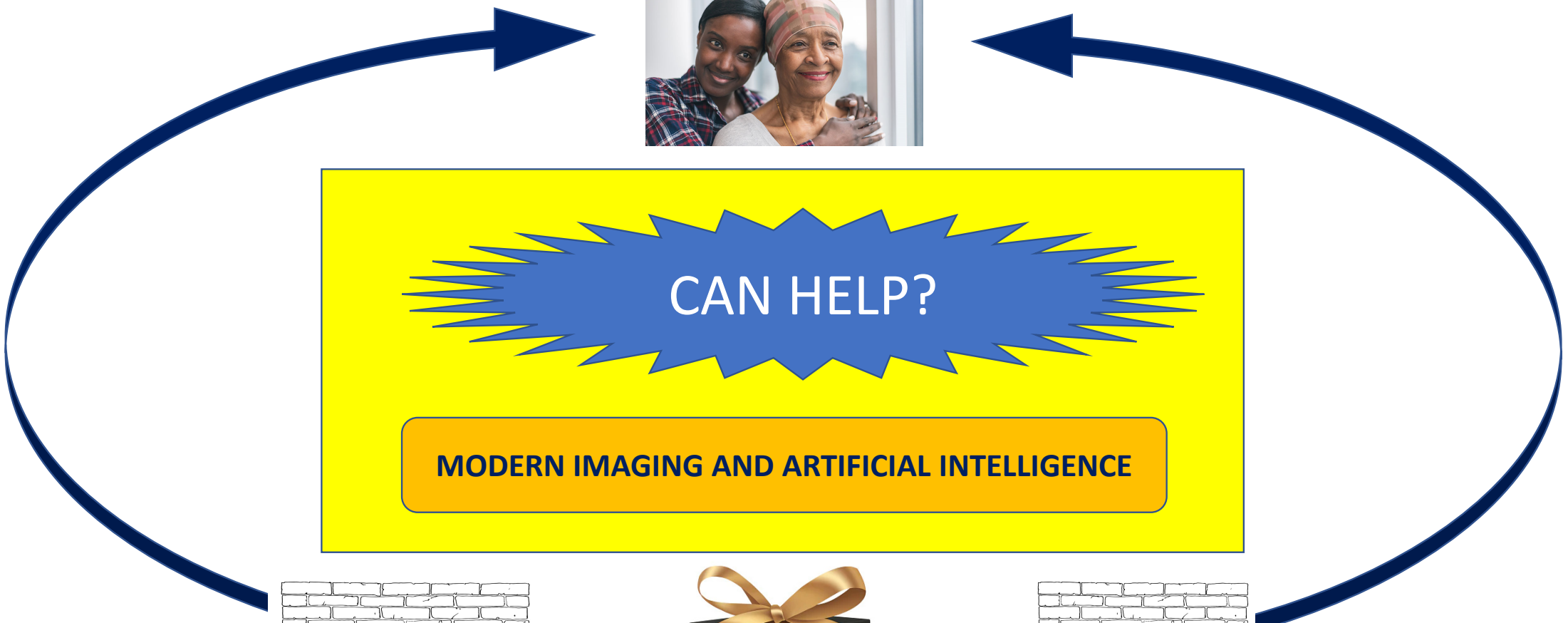
- identification of characteristics that can help select patients who may benefit most from HDRB is critical
- Machine learning may be used to identify characteristics that predict outcome following sHDRB.



# AI IN INTERVENTIONAL RADIOTHERAPY WORKFLOW

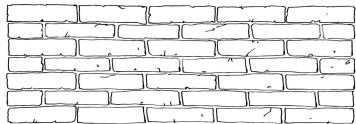


# MODERN ONCOLOGY APPROACH



**CAN HELP?**

**MODERN IMAGING AND ARTIFICIAL INTELLIGENCE**



**TIME**



**PERSONALIZED**

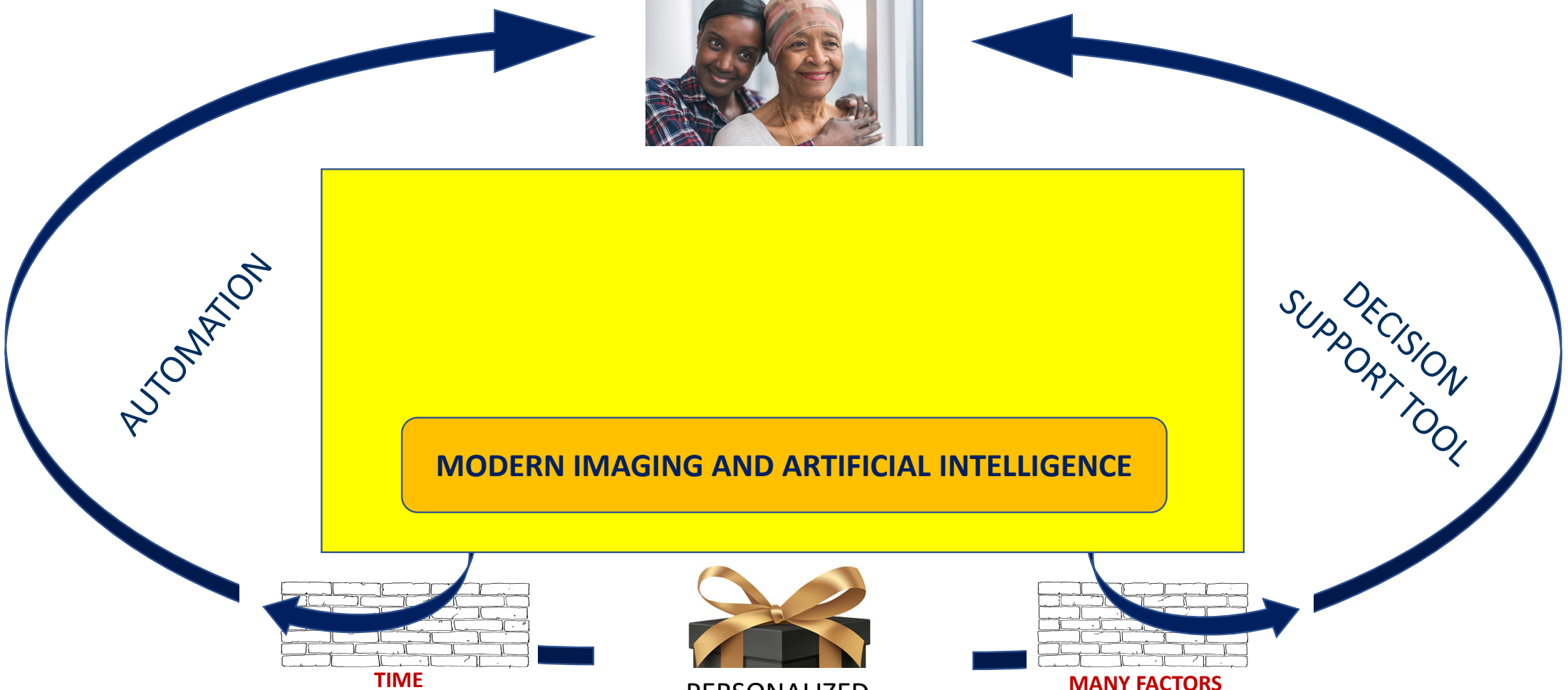


**MANY FACTORS**

**DISEASE CONTROL**

**QUALITY OF LIFE**

# MODERN ONCOLOGY APPROACH



**MODERN IMAGING AND ARTIFICIAL INTELLIGENCE**

**AUTOMATION**

**DECISION SUPPORT TOOL**

**TIME**

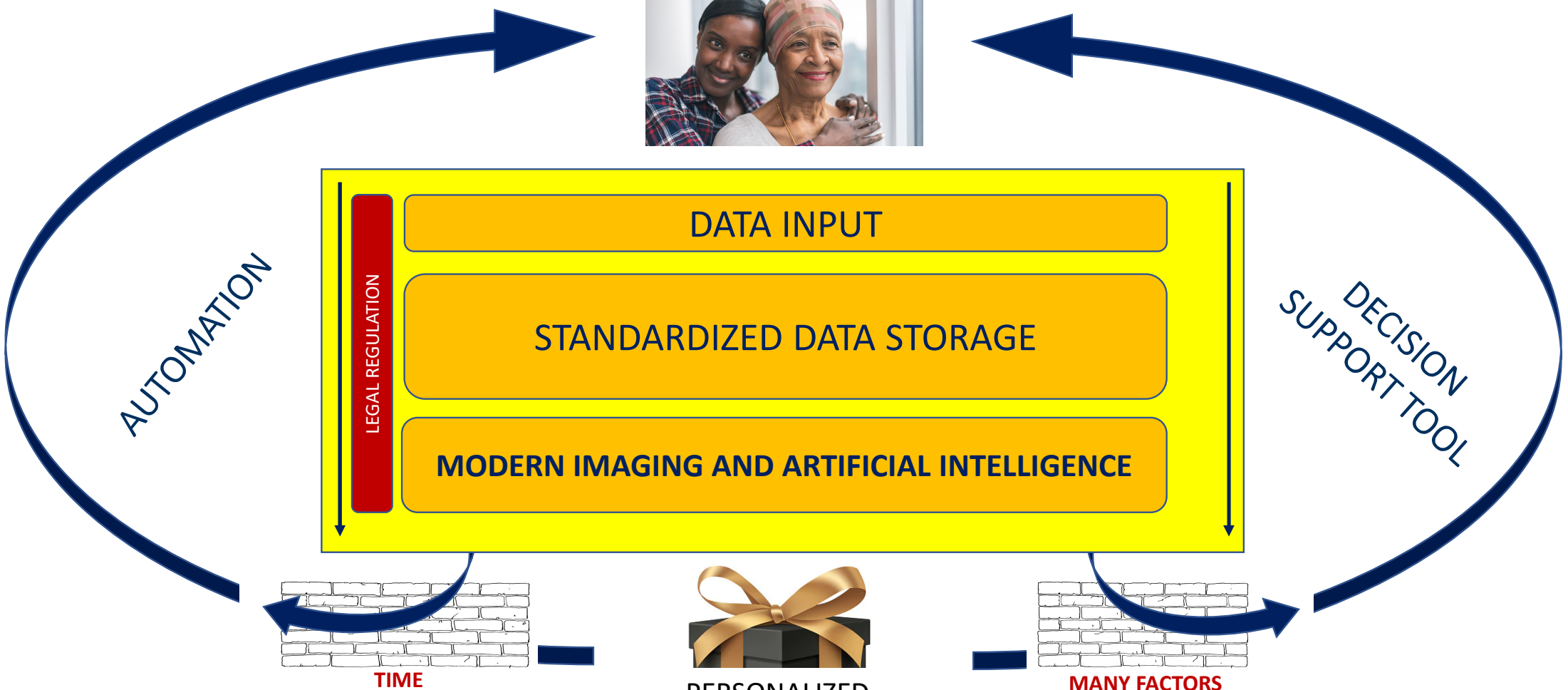
**PERSONALIZED**

**MANY FACTORS**

**DISEASE CONTROL**

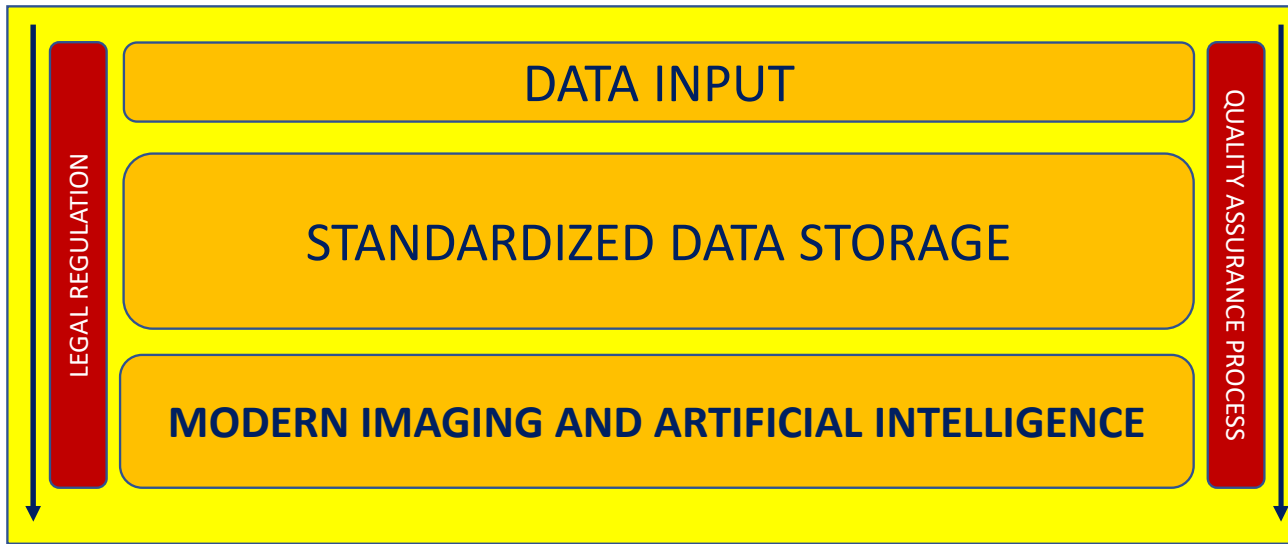
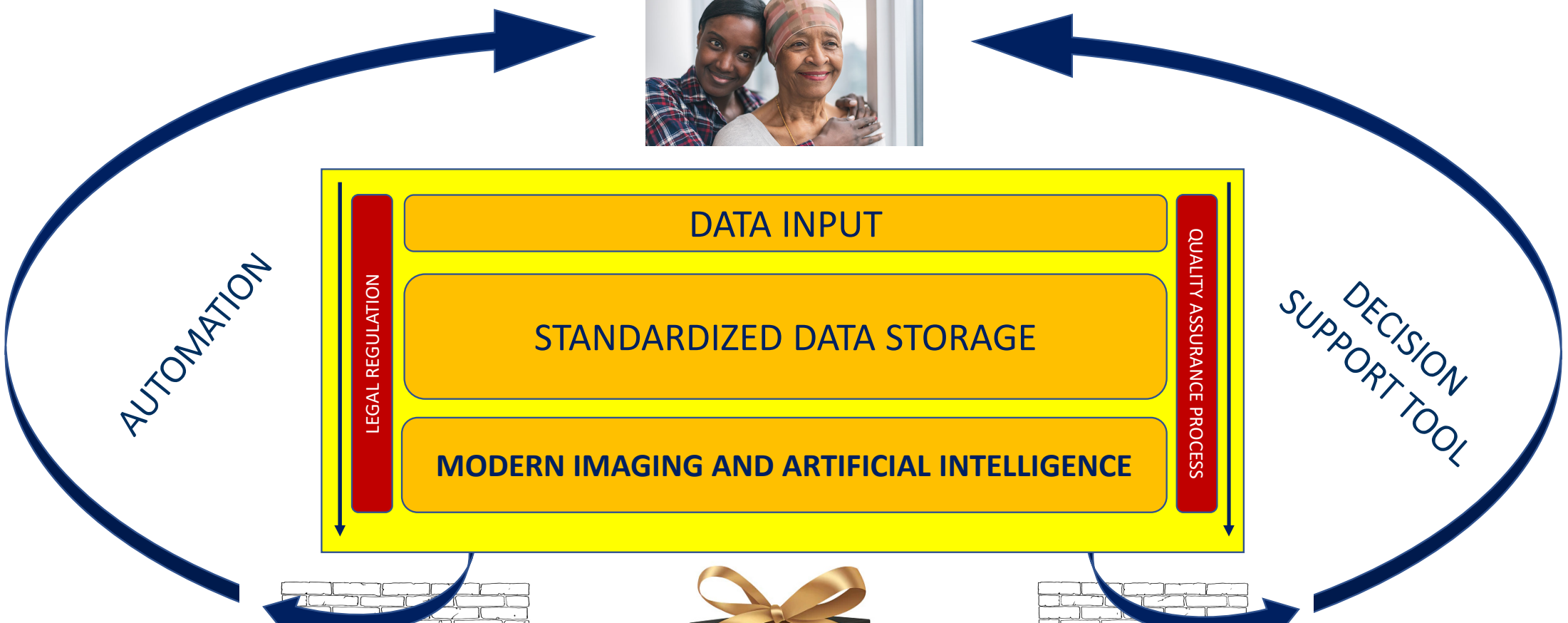
**QUALITY OF LIFE**

# MODERN ONCOLOGY APPROACH



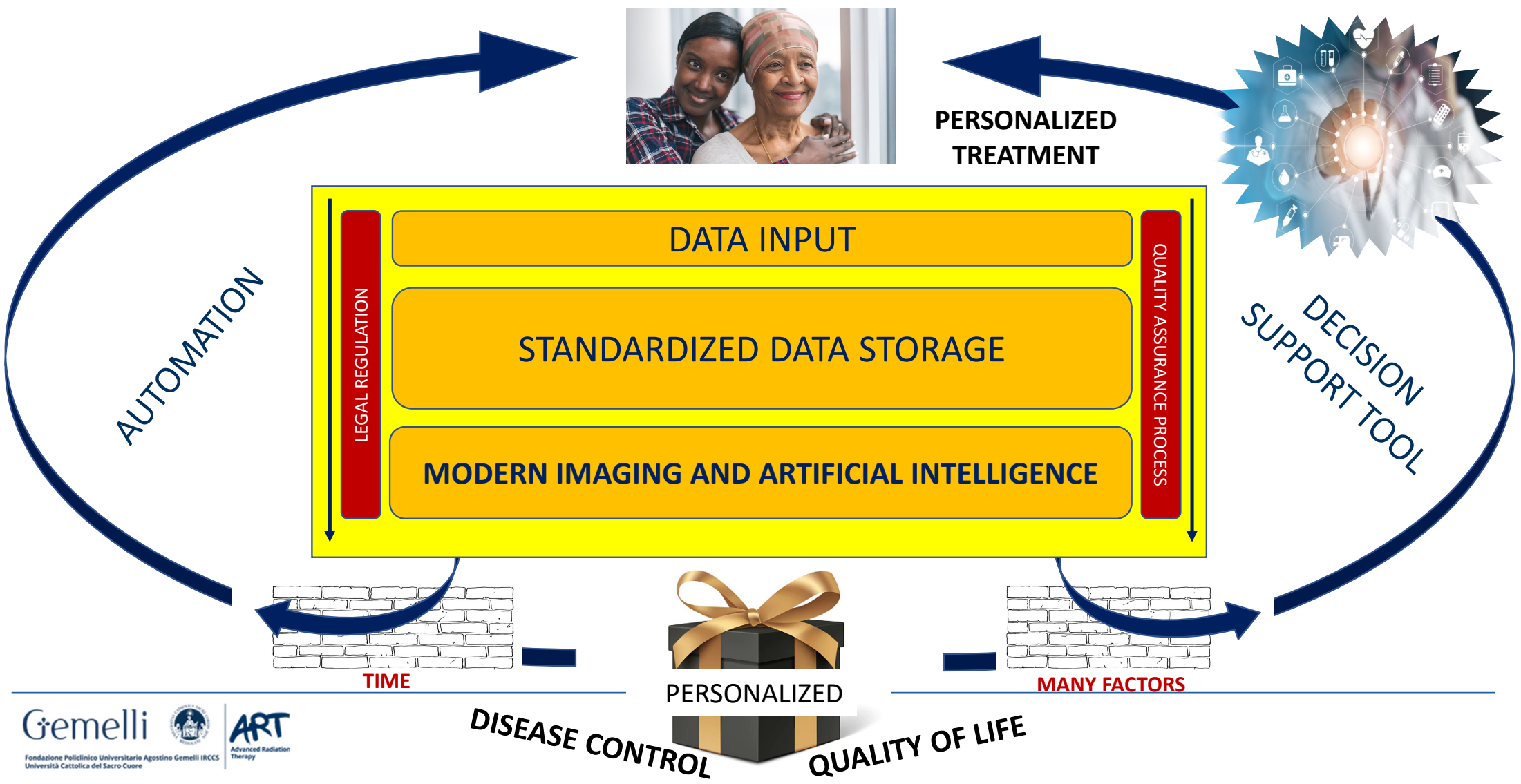


# MODERN ONCOLOGY APPROACH

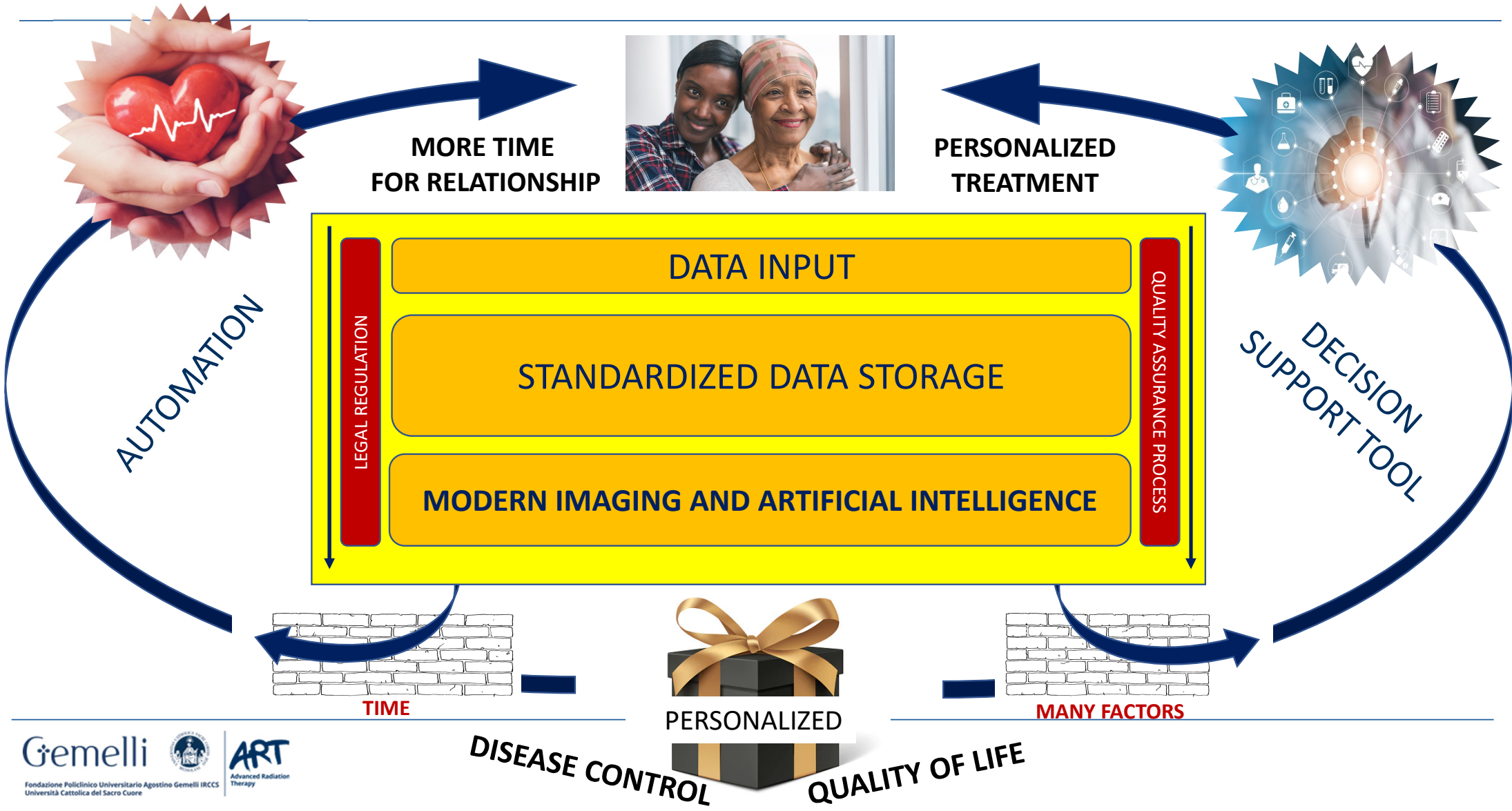


**DISEASE CONTROL**      **PERSONALIZED**      **QUALITY OF LIFE**

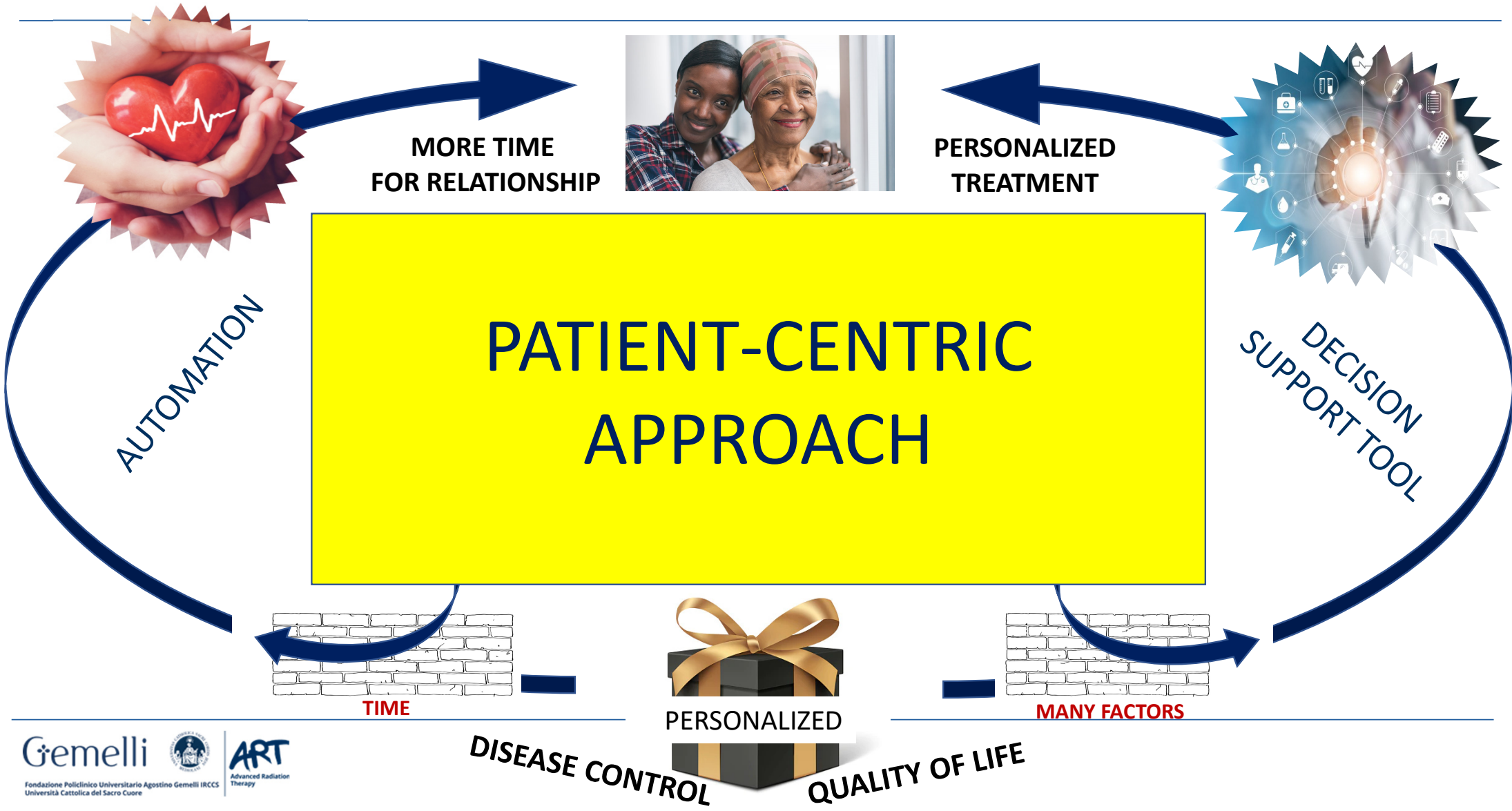
# MODERN ONCOLOGY APPROACH



# MODERN ONCOLOGY APPROACH



# MODERN ONCOLOGY APPROACH





# Thank you for your attention

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Fondazione Policlinico Universitario Agostino Gemelli IRCCS  
Università Cattolica del Sacro Cuore

ART

Advanced Radiation  
Therapy



Interventional Oncology Center  
Centro di Oncologia Interventistica



Organization Accredited  
by JCI Commission International

Interventional and External beam

**INTERACTS**

Radiotherapy Active Teaching School