

Prostate-Checker: Prostate cancer assessment by multi-parametric MRI studies

Presenter:

David García-Juan, Quibim SL
davidgarcia@quibim.com

Co-authors:

Angel Alberich-Bayarri, Quibim SL
Fabio García-Castro, Quibim SL
Balaji Ganeshan, Feedback PLC
Luis García-Bonmatí, La Fé University and Polytechnic Hospital



quibim

@quibimbiomarker

www.quibim.com

Outline



- Clinical context
- Prostate-Checker: A multi-parametric tool
- Analysis modules
 - Texture Analysis
 - Pharmacokinetic modelling
 - Apparent Diffusion Coefficient
- Prostate-Checker
 - User Interface
 - Nosologic images generation
 - Structured report
- Conclusion

Prostate Cancer: Some Relevant facts



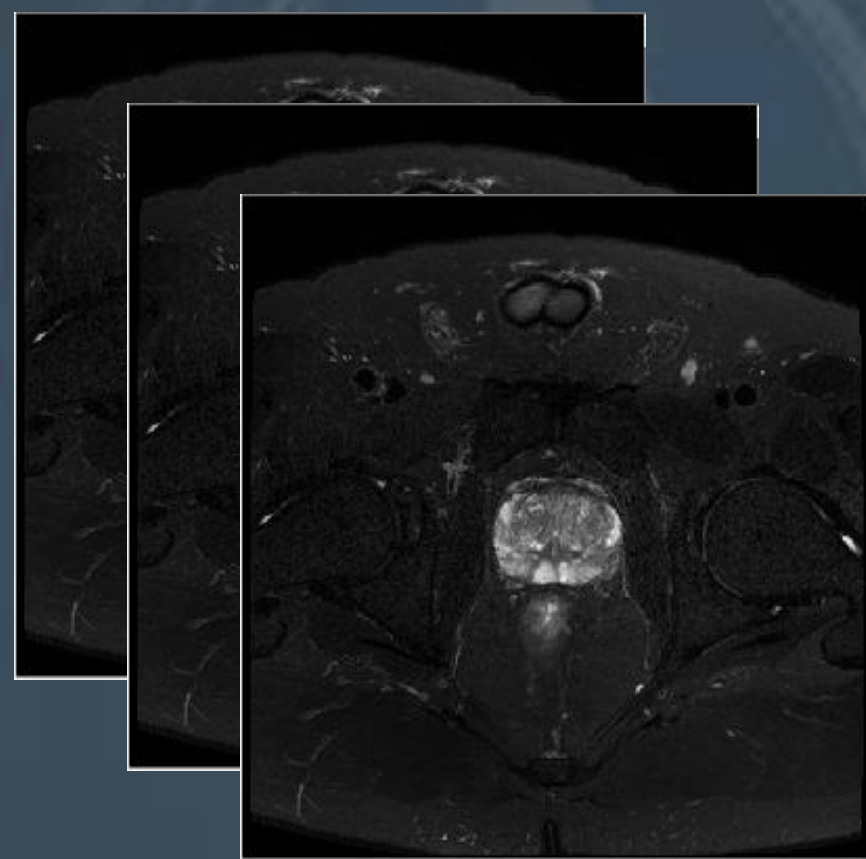
Prostate cancer (PC) is the second most diagnosed type of cancer

PC It is the fifth leading cause of cancer-related death in men worldwide (most frequent cause of cancer death in men in developed countries)

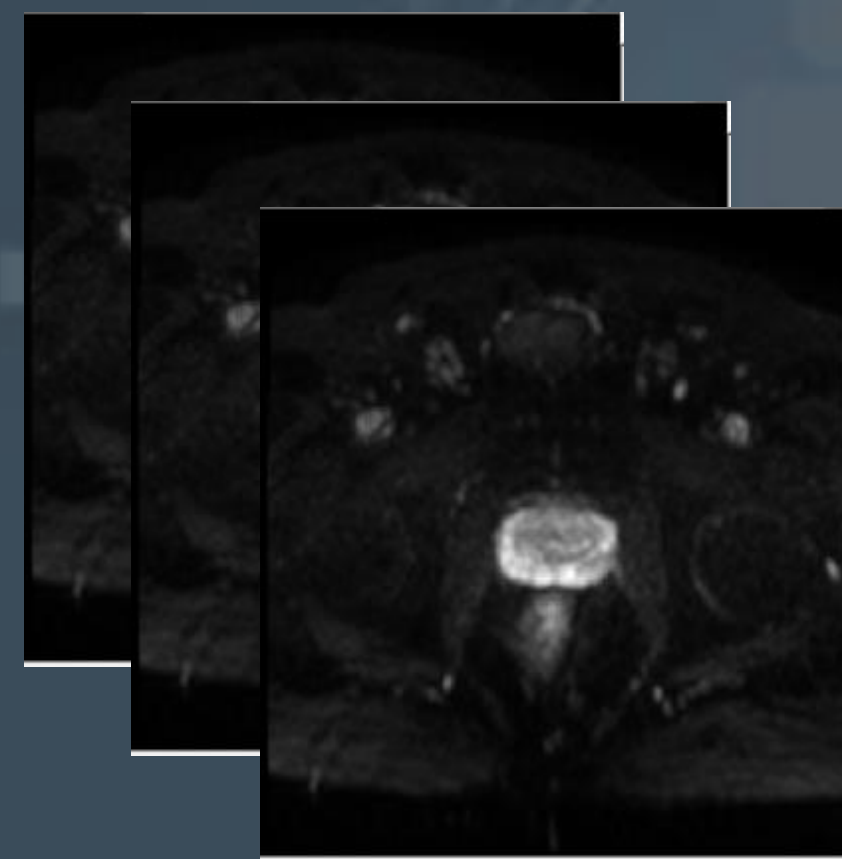
Guidelines about prostate magnetic resonance (MR) imaging published by the European Society of Urogenital Radiology (ESUR) in 2012 recommended a multi-parametric approach for a better characterization of PC

Prostate-Checker: a multi-parametric approach

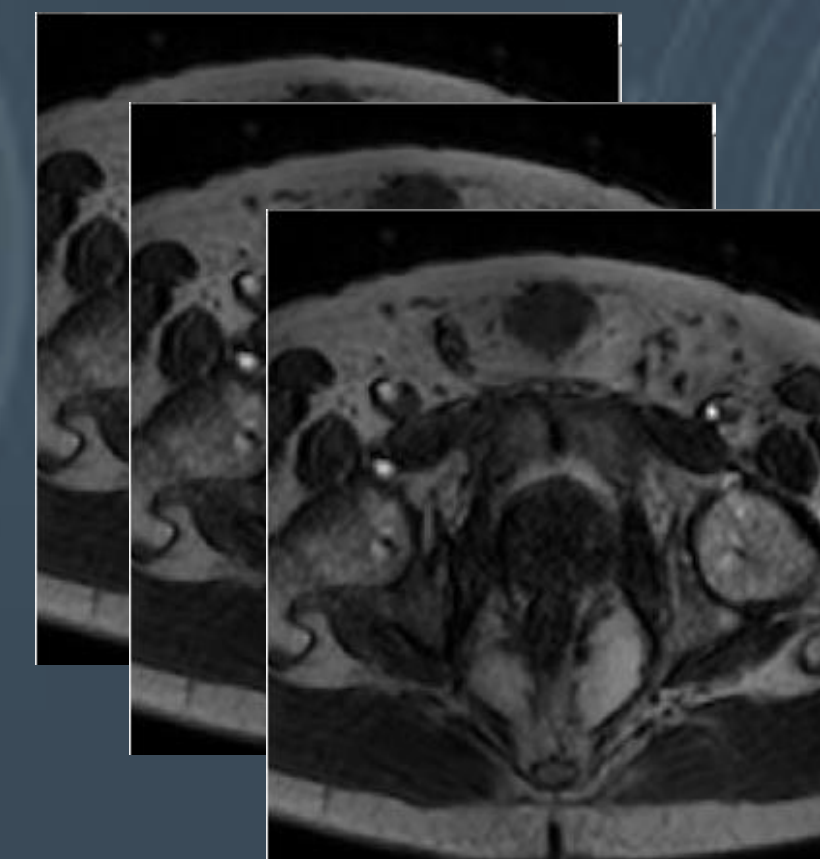
Prostate-Checker performs voxelwise multi-parametric analysis from T2W, DW and DCE MR images



Texture

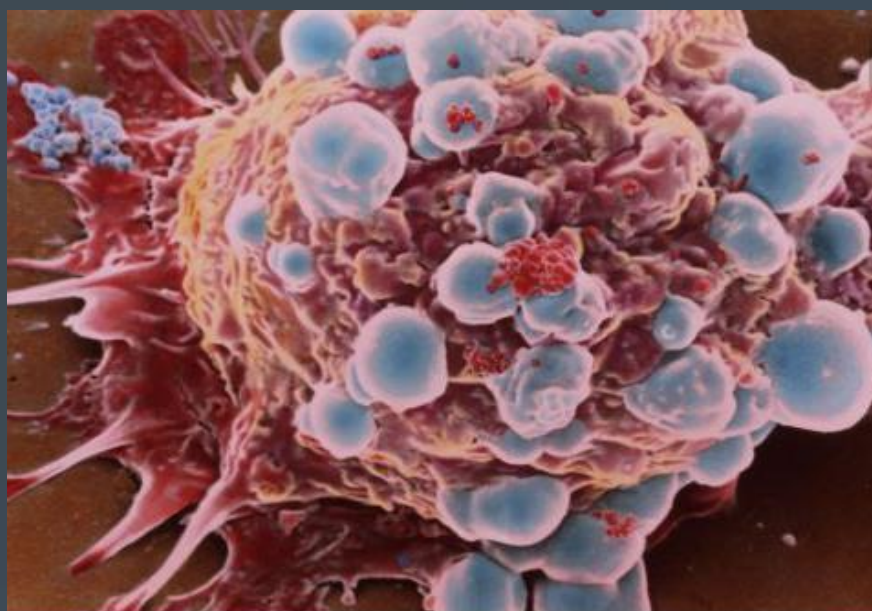


Cellularity



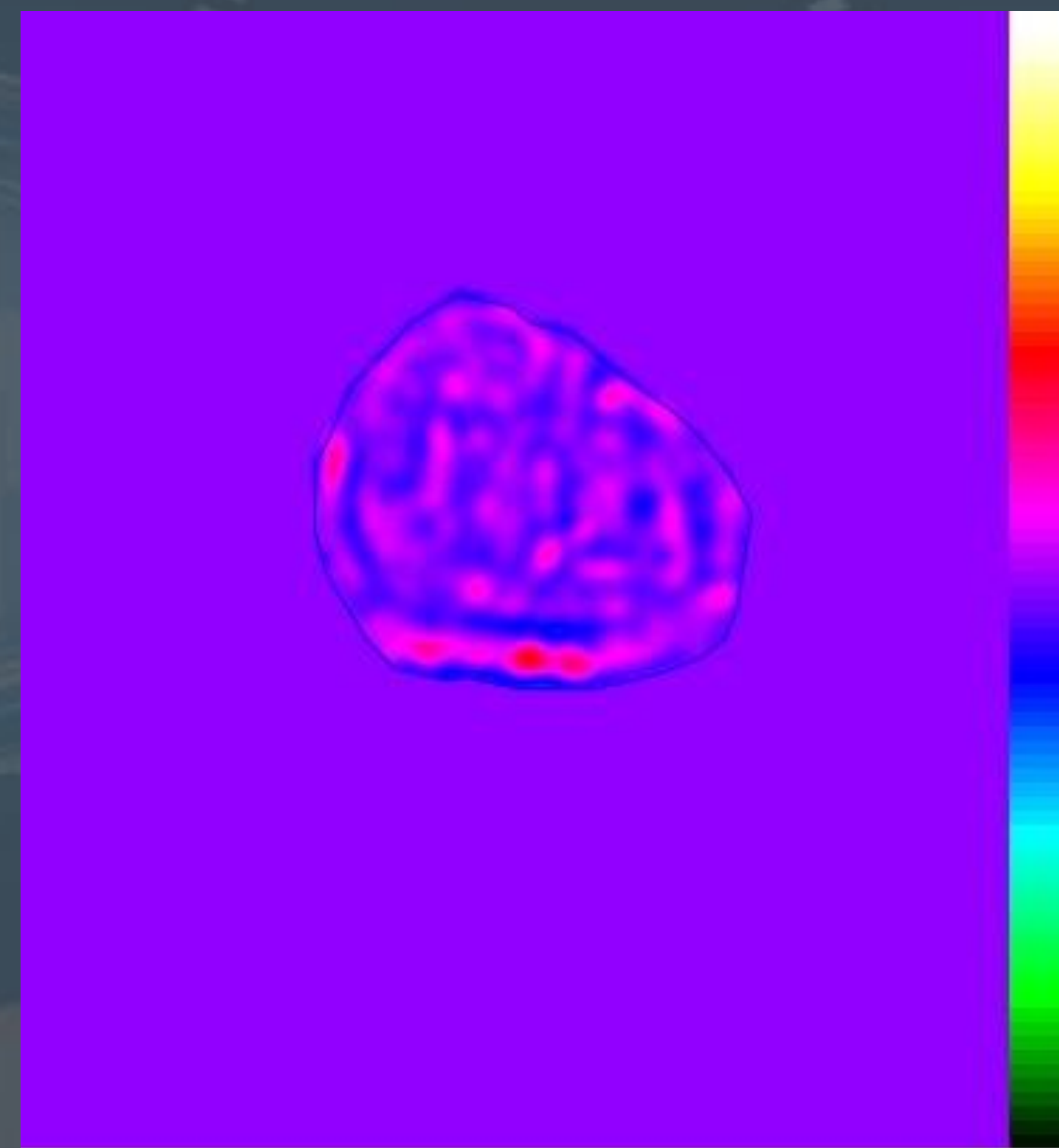
Micro-vascularity

TexRAD[®] module texture analysis

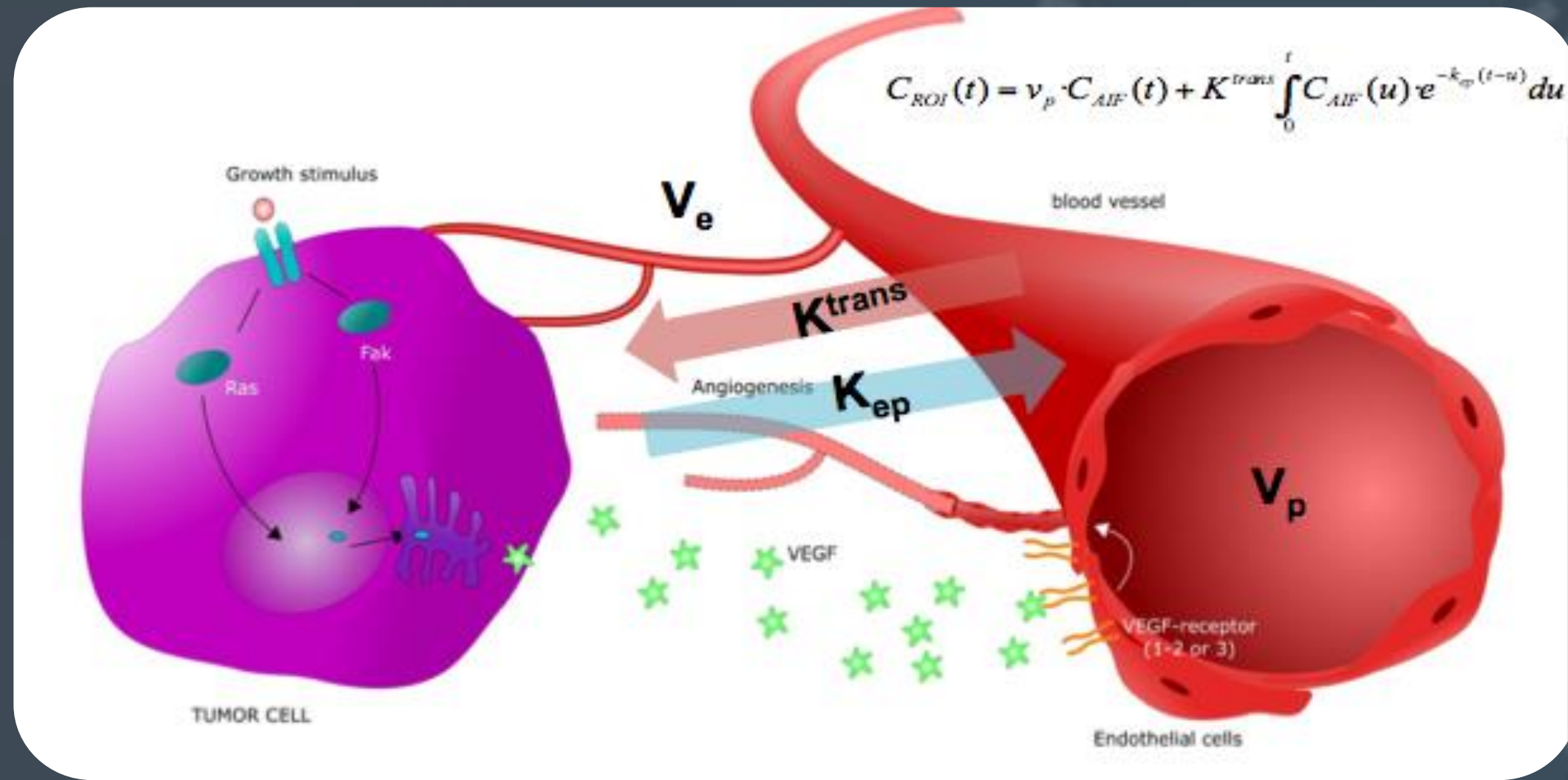


- Tumor is a heterogeneous structure in its morphological and vascular structure.
- Texture analysis can reveal changes in apparently disease-free areas.

- Histogram-derived parameters such as kurtosis, skewness and standard-deviation as quantitative biomarkers.



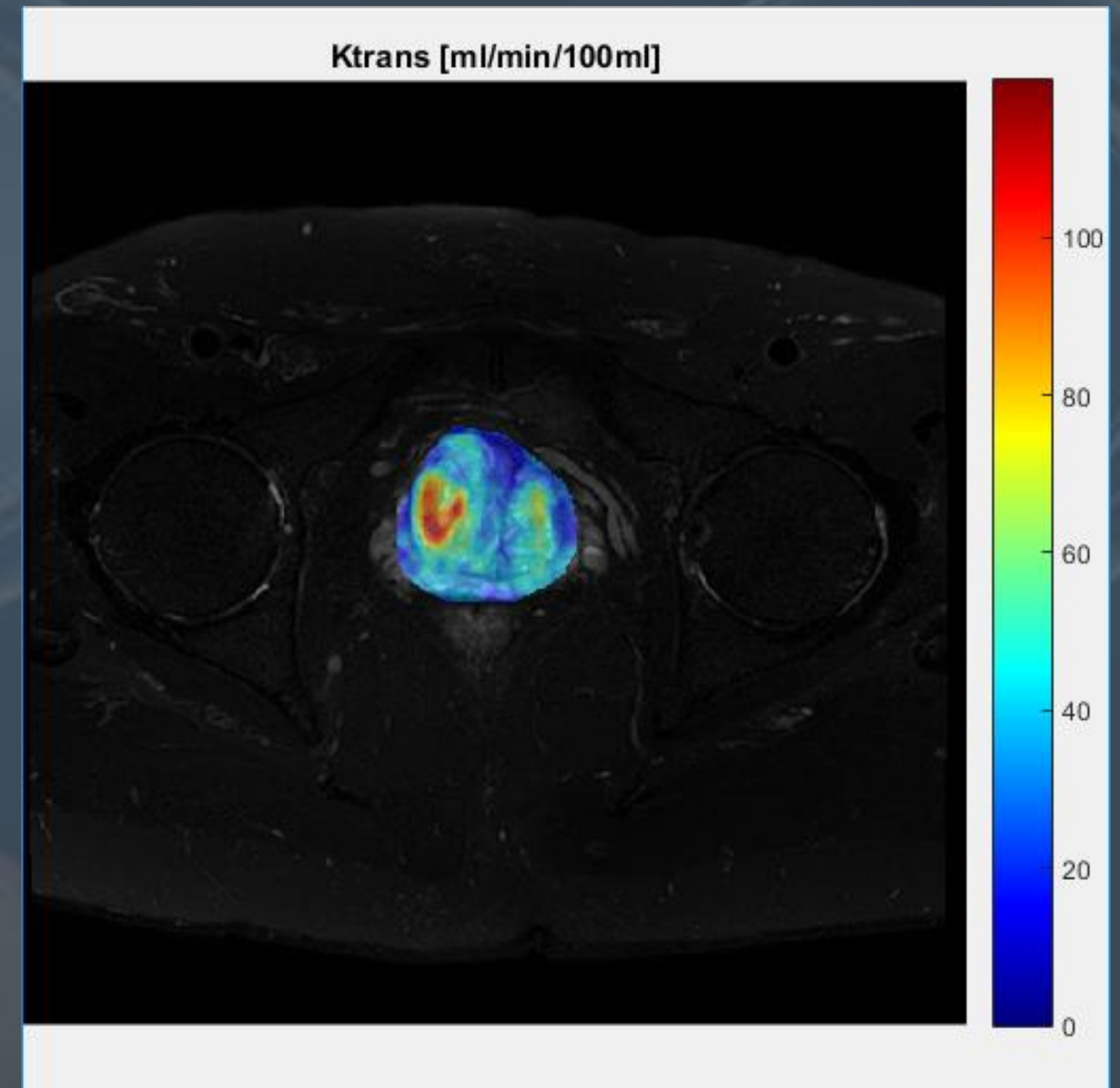
Pharmacokinetic modeling



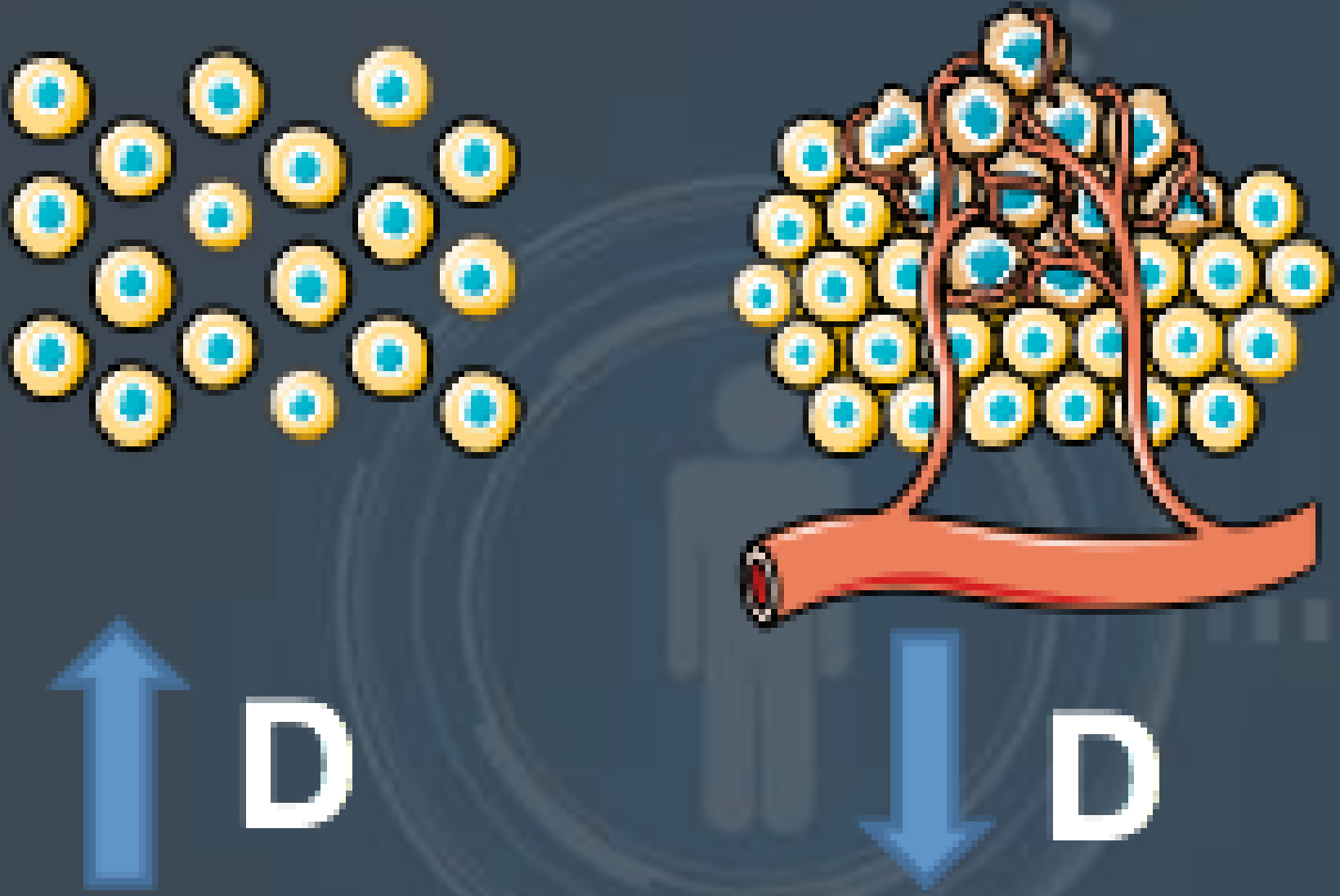
- 2-compartment 1-input model for the analysis of pharmacokinetic properties of the tissues (K^{trans} , k_{ep} , V_e).

- Tumor development increases the blood supply and changes the morphology of the microvascular environment
- Accurate methods to evaluate pharmacokinetics properties and angiogenesis are a growing need

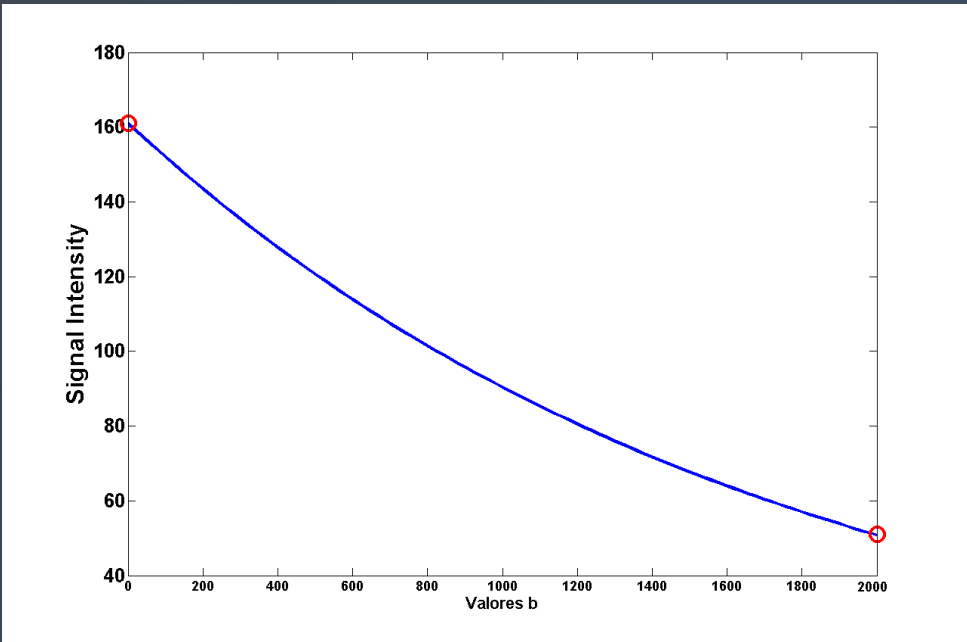
$$C_t(t) = v_p C_a(t) + K^{trans} \int_0^t C_a(\tau) e^{-k_{ep}(t-\tau)} d\tau$$



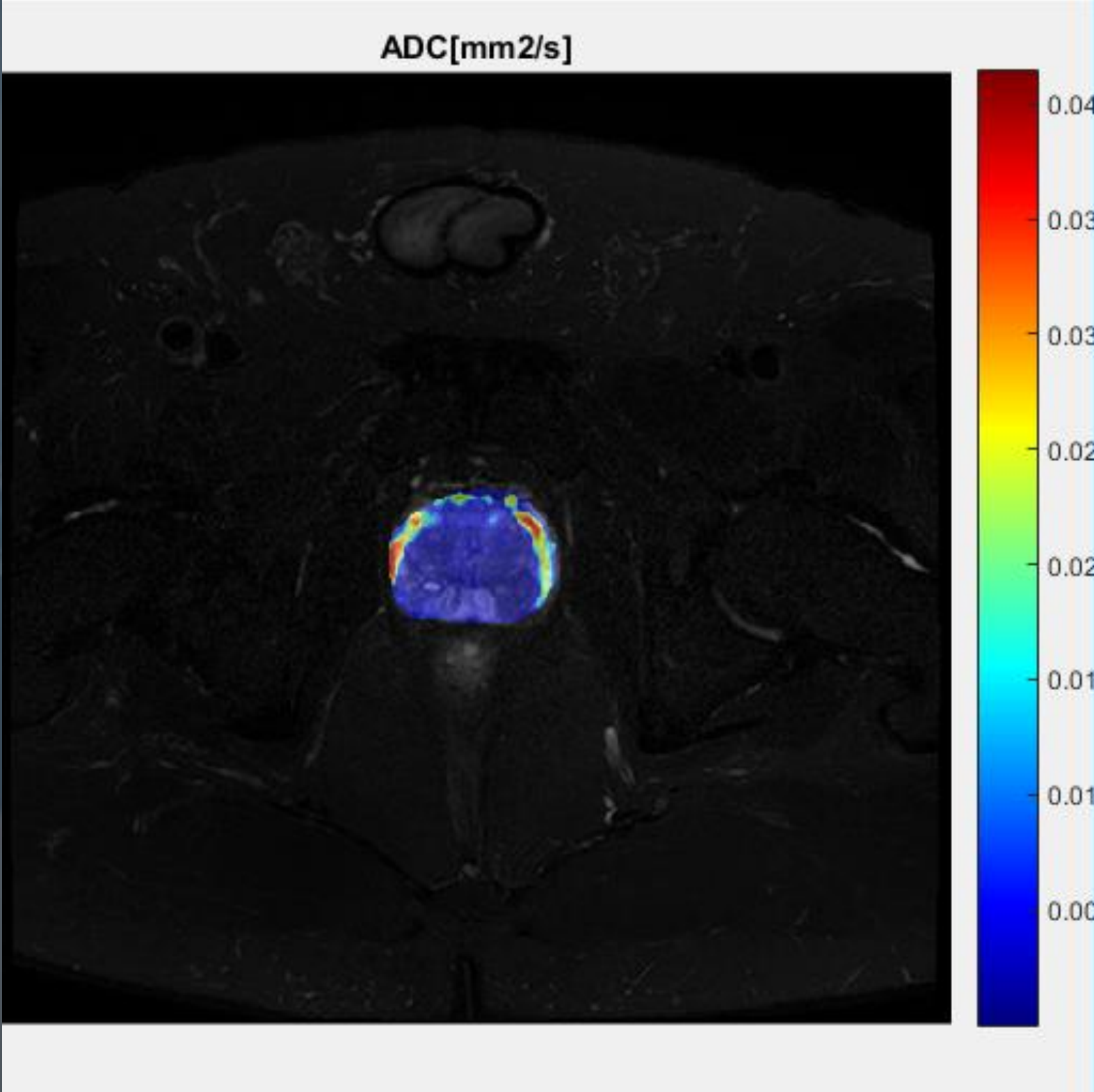
Diffusion studies



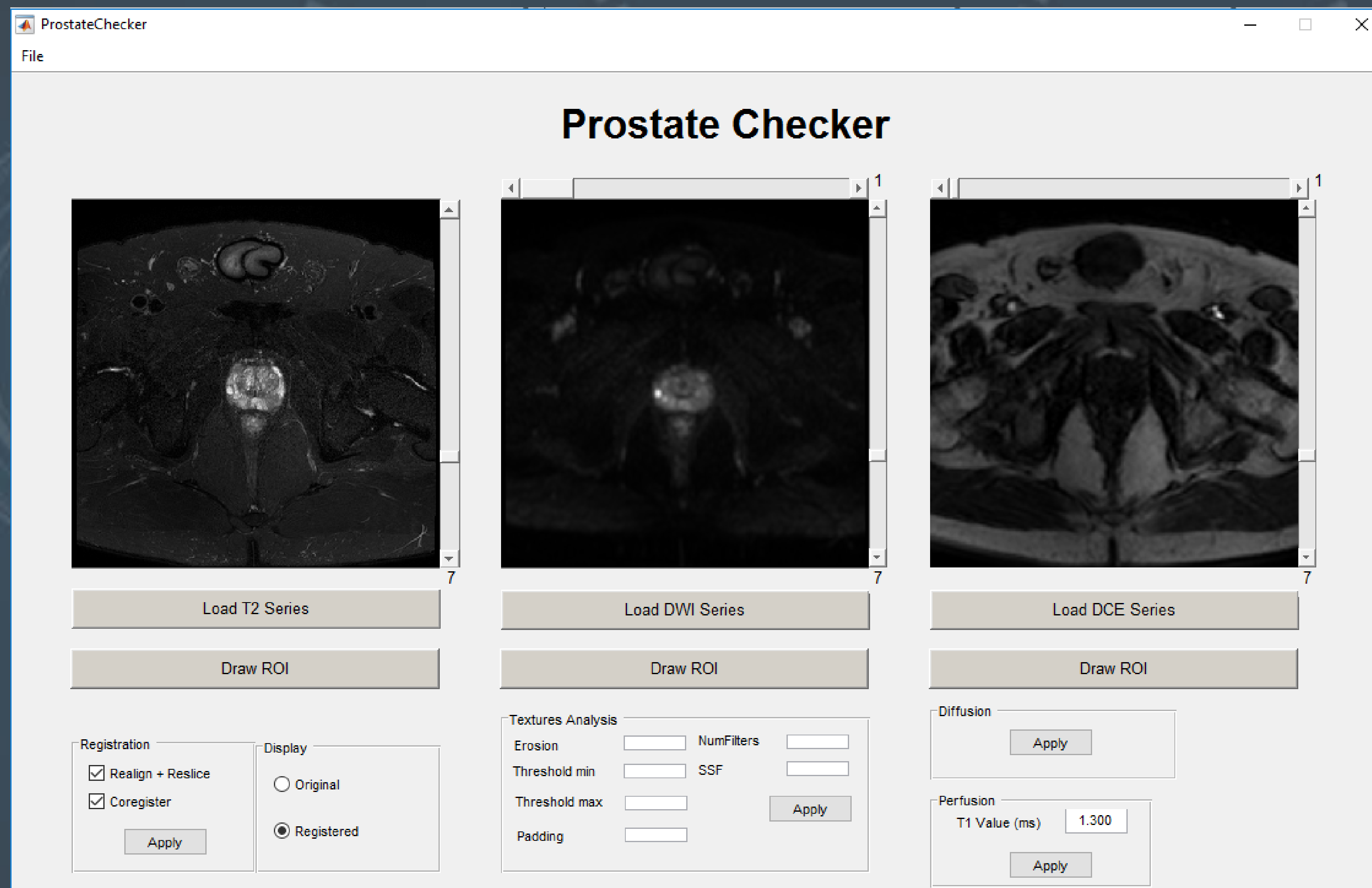
- Pathological processes produce an alteration in cells distribution in tissues modifying the water diffusion properties in the interstitial space.



- Monoexponential modeling of the MR signal decay to calculate the apparent diffusion coefficient (ADC).



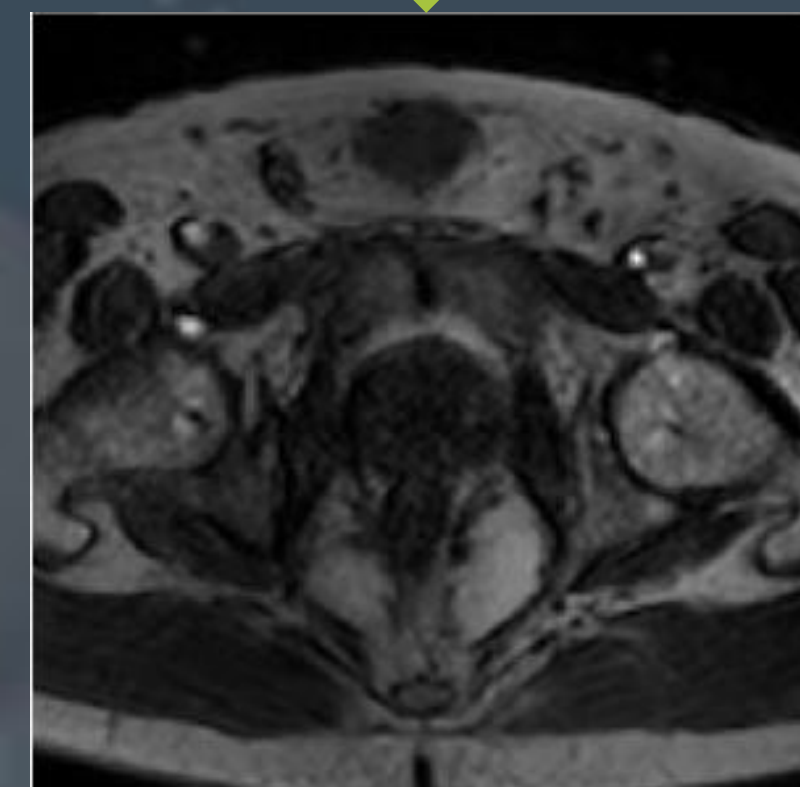
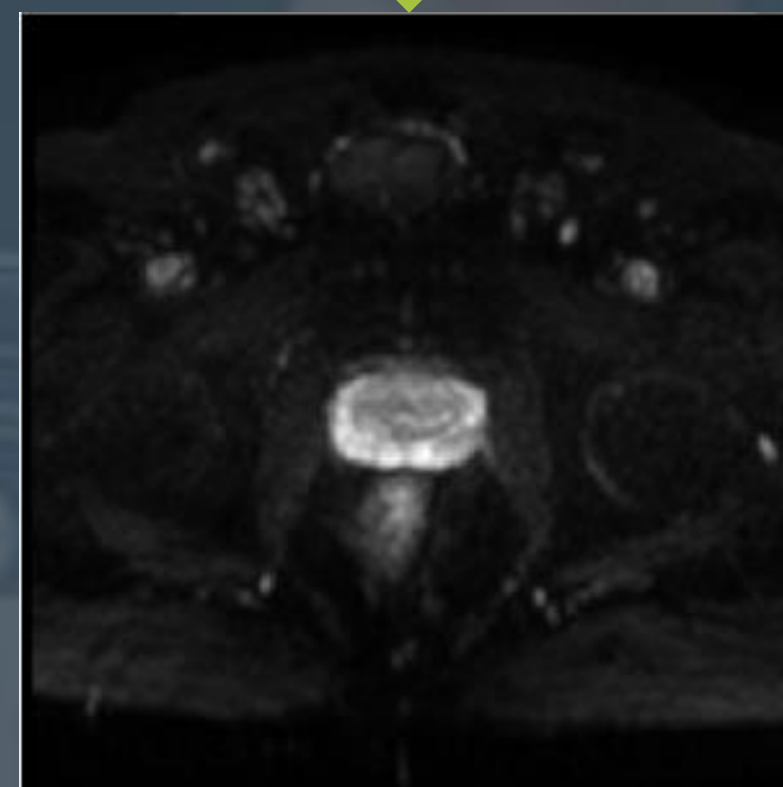
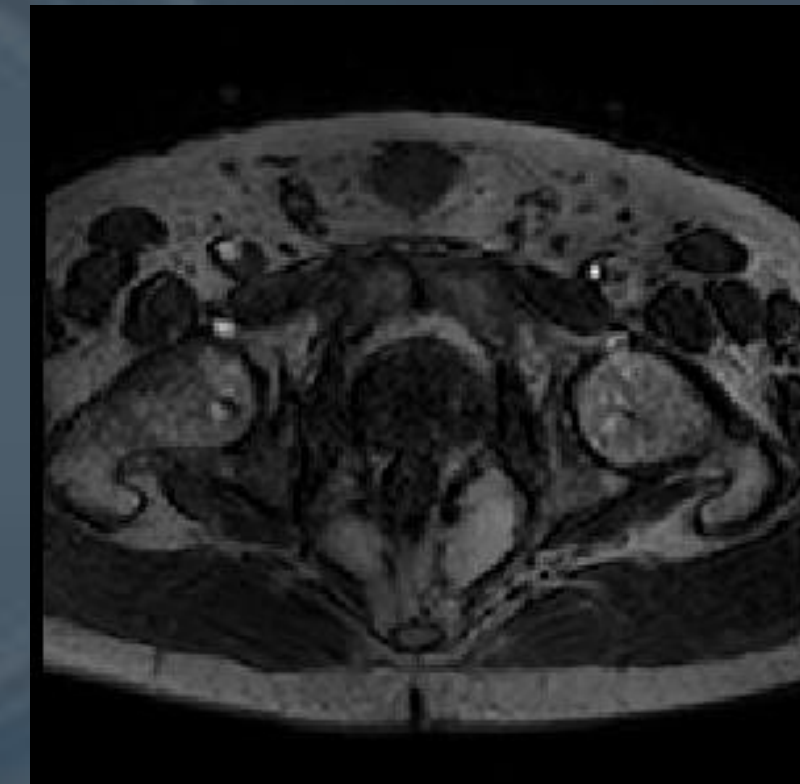
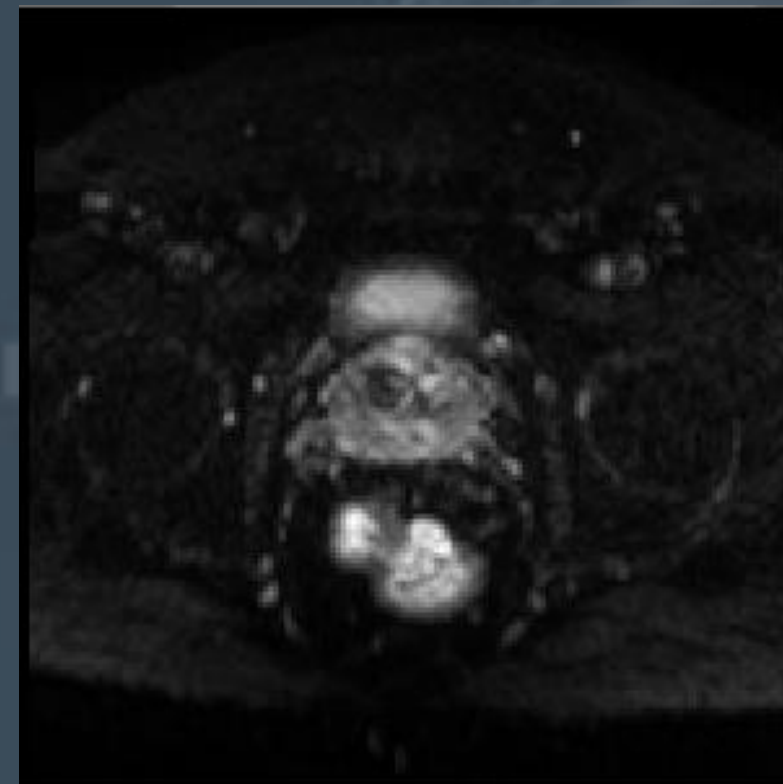
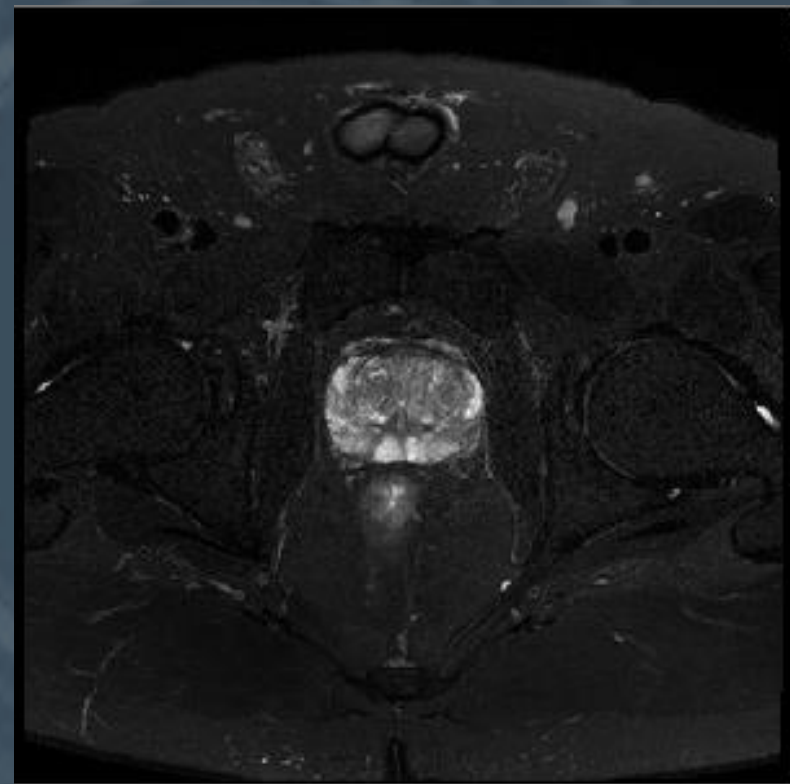
Prostate Checker GUI



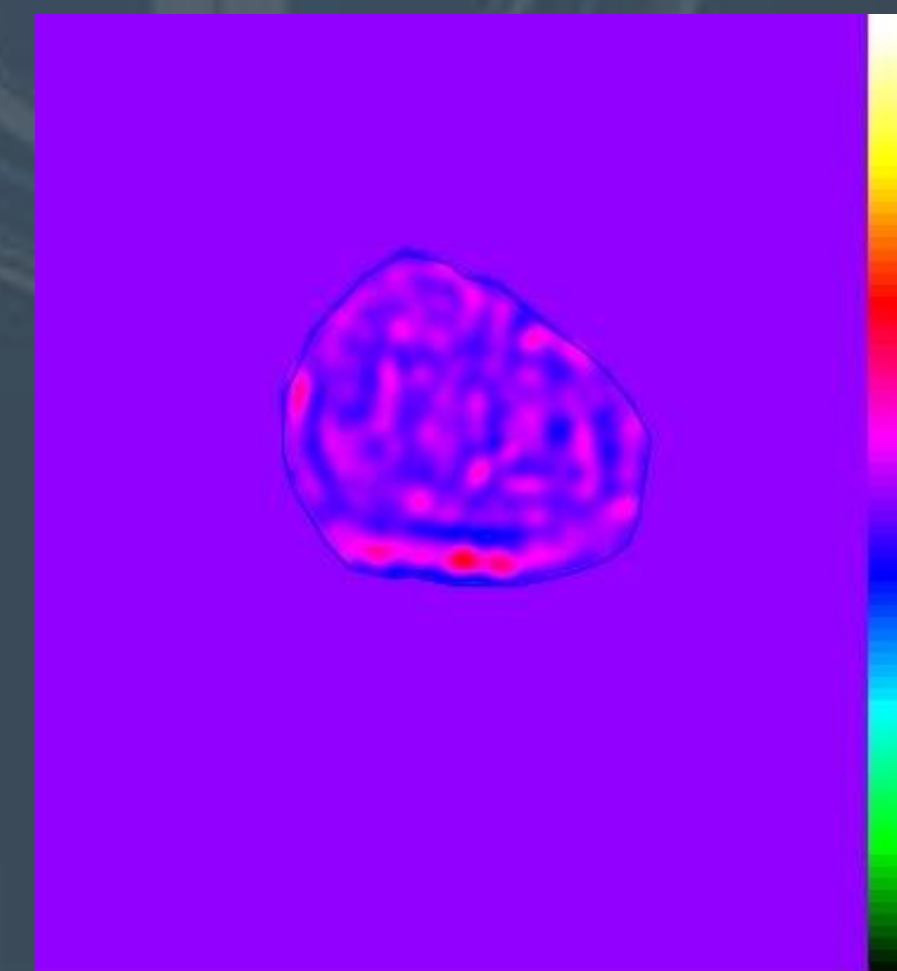
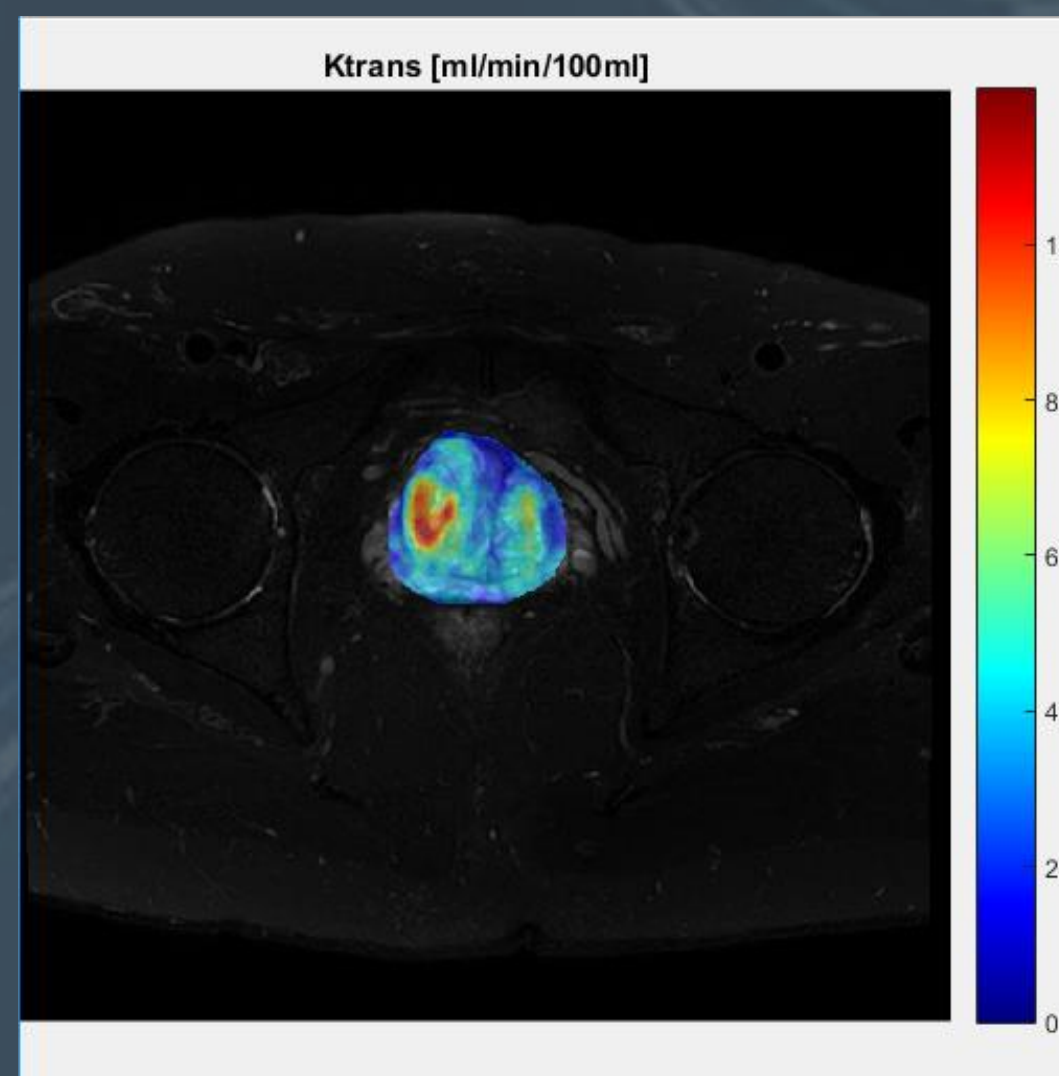
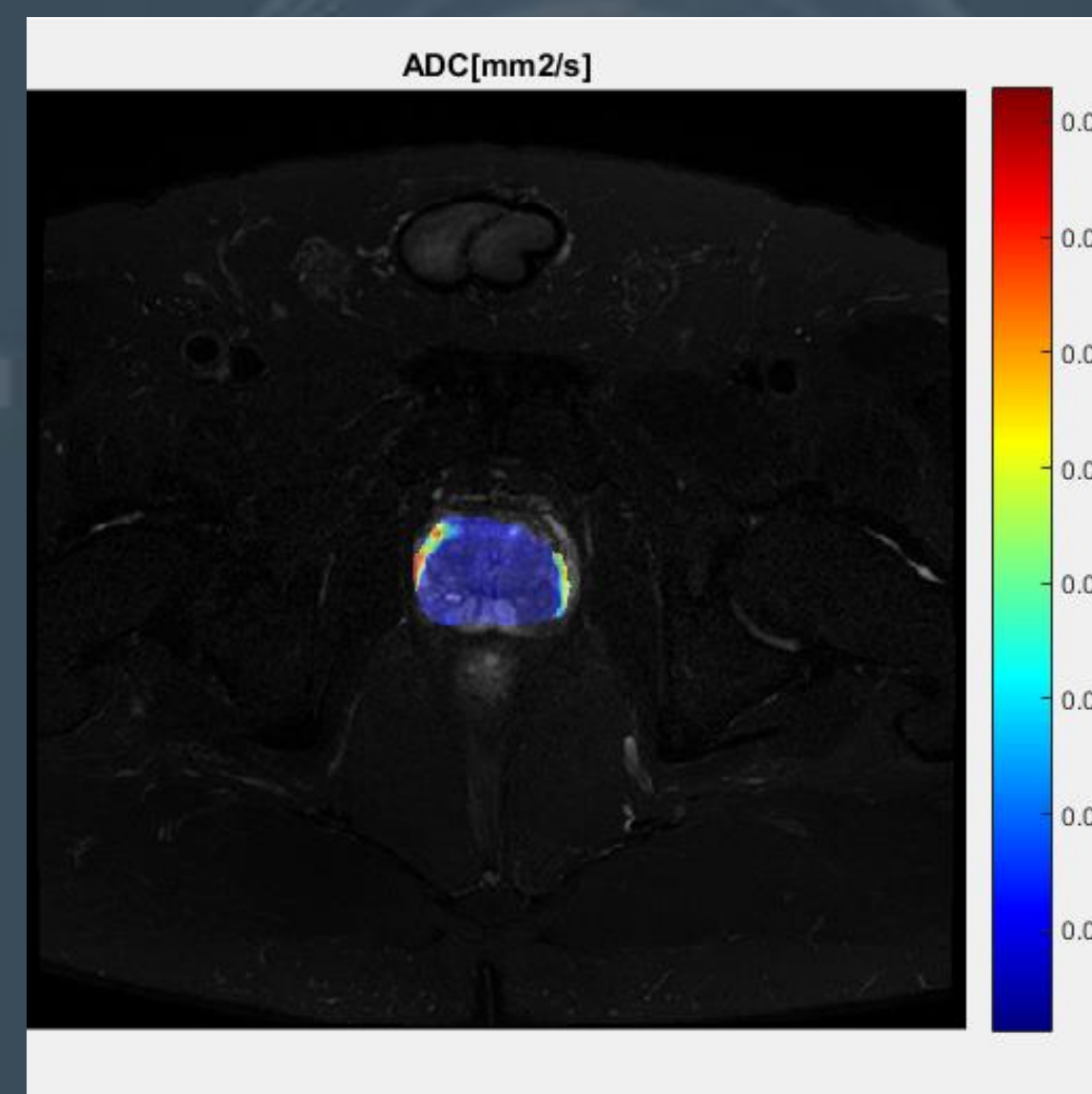
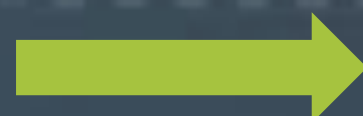
Re-slicing and co-registration



Re-slicing and elastic co-registration to share same reference space and resolution



Re-slicing and co-registration



Generation of Nosologic images



- Prostate segmentation
- Volumetric visualization of information



AX



COR



SAG

Prostate Geometry Reconstruction



TRA

COR

SAG

ADC

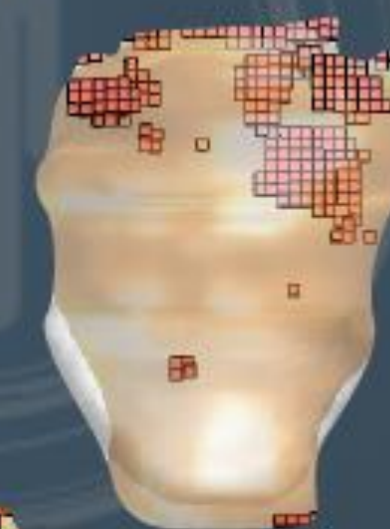
0

300

ADC

300

Diffusion & Perfusion 3D volumetric visualization



Suspicious regions 3D representation

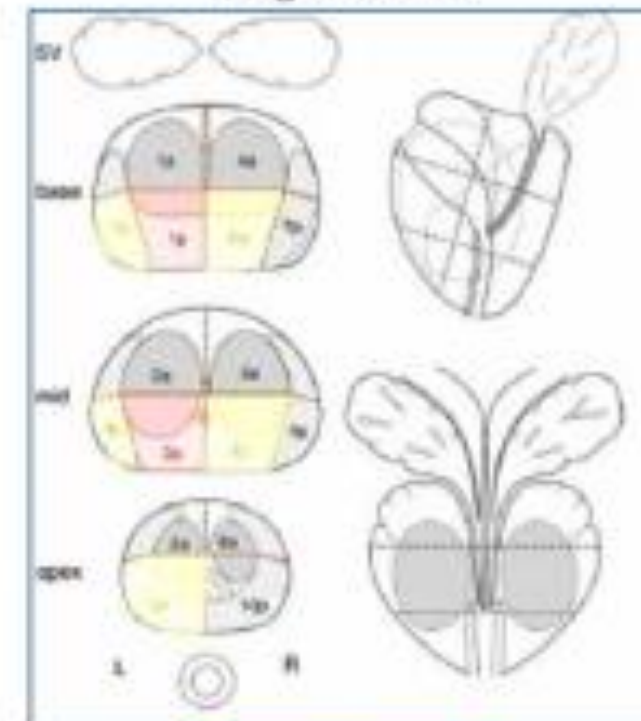
Structured Report



DATOS DEL PACIENTE

Nombre: -	Id. Estudio: 12345	Edad: 99
Prueba: RM Próstata	Fecha de prueba: 14/02/2014	Fecha nacimiento: 01/01/1111

Diagrama ESUR



VALORES NORMALES

Difusión			
D (-10 ⁻³)	D*	f	ADC (µm ²)
>0.8	-	-	-

Permeabilidad			
K ^{trans}	K _{ep}	V _e	V _p
>150	-	-	-

Referencia: E. Apollonio, Vandozzi (1995). "Método de revisión de la clasificación de Gleason".
 D (Coeficiente de difusión), D* (Coeficiente de difusión de porosa), f (Fracción de porosa), ADC (Coeficiente de difusión aparente),
 K^{trans} (Constante de permeabilidad), K_{ep} (Ratio de extracción), V_e (Fracción de volumen de espacio extravascular extracelular), V_p (Fracción de volumen vascular).

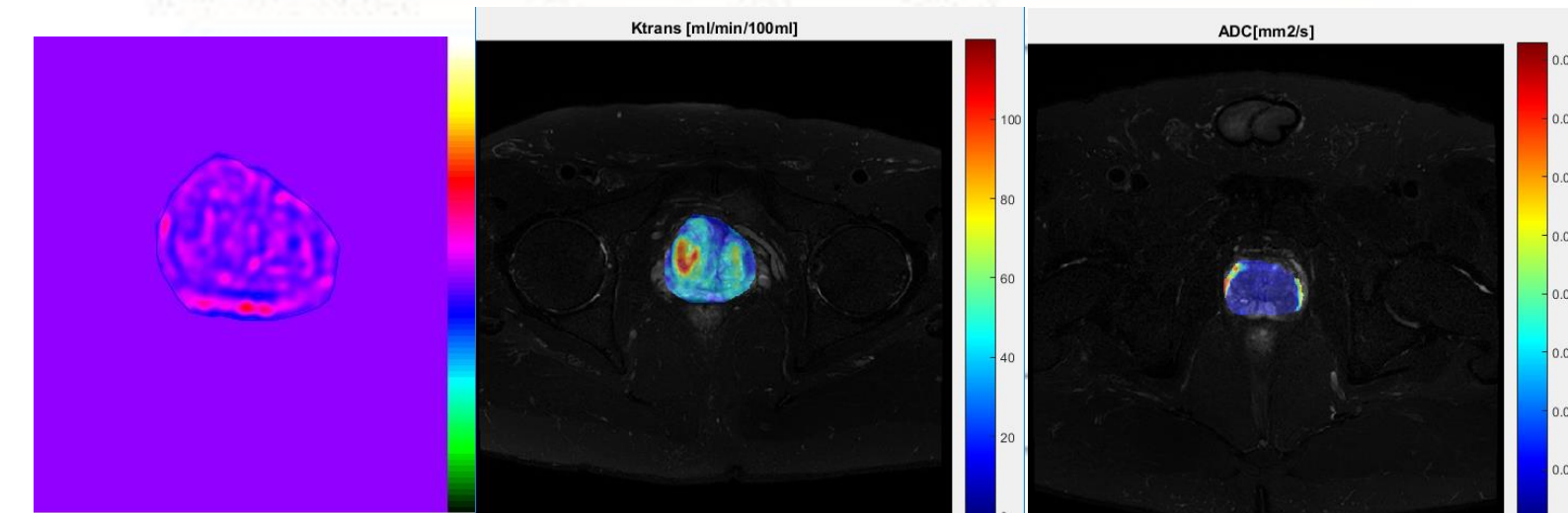
SEC 2P	Difusión			
	D (-10 ⁻³)	D*	f	ADC (µm ²)
	0.8 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	0.8 ± 0.1
	Permeabilidad			
	K ^{trans}	K _{ep}	V _e	V _p
	150 ± 5	150 ± 5	150 ± 5	150 ± 5

SEC 2P	Difusión			
	D (-10 ⁻³)	D*	f	ADC (µm ²)
	0.8 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	0.8 ± 0.1
	Permeabilidad			
	K ^{trans}	K _{ep}	V _e	V _p
	150 ± 5	150 ± 5	150 ± 5	150 ± 5

SEC 3P	Difusión			
	D (-10 ⁻³)	D*	f	ADC (µm ²)
	0.8 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	0.8 ± 0.1
	Permeabilidad			
	K ^{trans}	K _{ep}	V _e	V _p
	150 ± 5	150 ± 5	150 ± 5	150 ± 5

SEC 4P	Difusión			
	D (-10 ⁻³)	D*	f	ADC (µm ²)
	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1
	Permeabilidad			
	K ^{trans}	K _{ep}	V _e	V _p
	170 ± 5	170 ± 5	170 ± 5	170 ± 5

SEC 4P	Difusión			
	D (-10 ⁻³)	D*	f	ADC (µm ²)
	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1
	Permeabilidad			
	K ^{trans}	K _{ep}	V _e	V _p
	170 ± 5	170 ± 5	170 ± 5	170 ± 5



Conclusions



Prostate Checker provides an unique imaging tool in the early detection and diagnosis of prostate cancer by using a multi-parametric analysis of magnetic resonance imaging.

Prostate Checker software development is currently at the proof of concept stage

The prototype will be further evaluated in a pilot clinical study to assess initial performance and capabilities and the results will be published in a high-impact scientific peer reviewed journal.

A last hint



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MARCH 2016

**DIAGNOSTIC
IMAGING
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BREAST CANCER
The Malmö Breast
Tomosynthesis Screening Trial



Initial results show a
substantially increased
cancer detection rate
compared to mammography

**Mammography
screening in average
risk women:**
25-year follow-up in
the Canadian National
Breast Screening Study

**Towards a Rebalancing
of Mammography's
Harms and Benefits**

**Overcoming workflow
inefficiencies with
a single, integrated
Advanced Visualization
platform**

**Sustainable, Healthy,
and High-Quality
Overnight Radiology
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**MULTIPARAMETRIC MRI
OF THE PROSTATE:
THE ROLE OF CAD**



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Questions ?



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