

# Nové trendy v nukleární medicíně

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**D. Zogala**

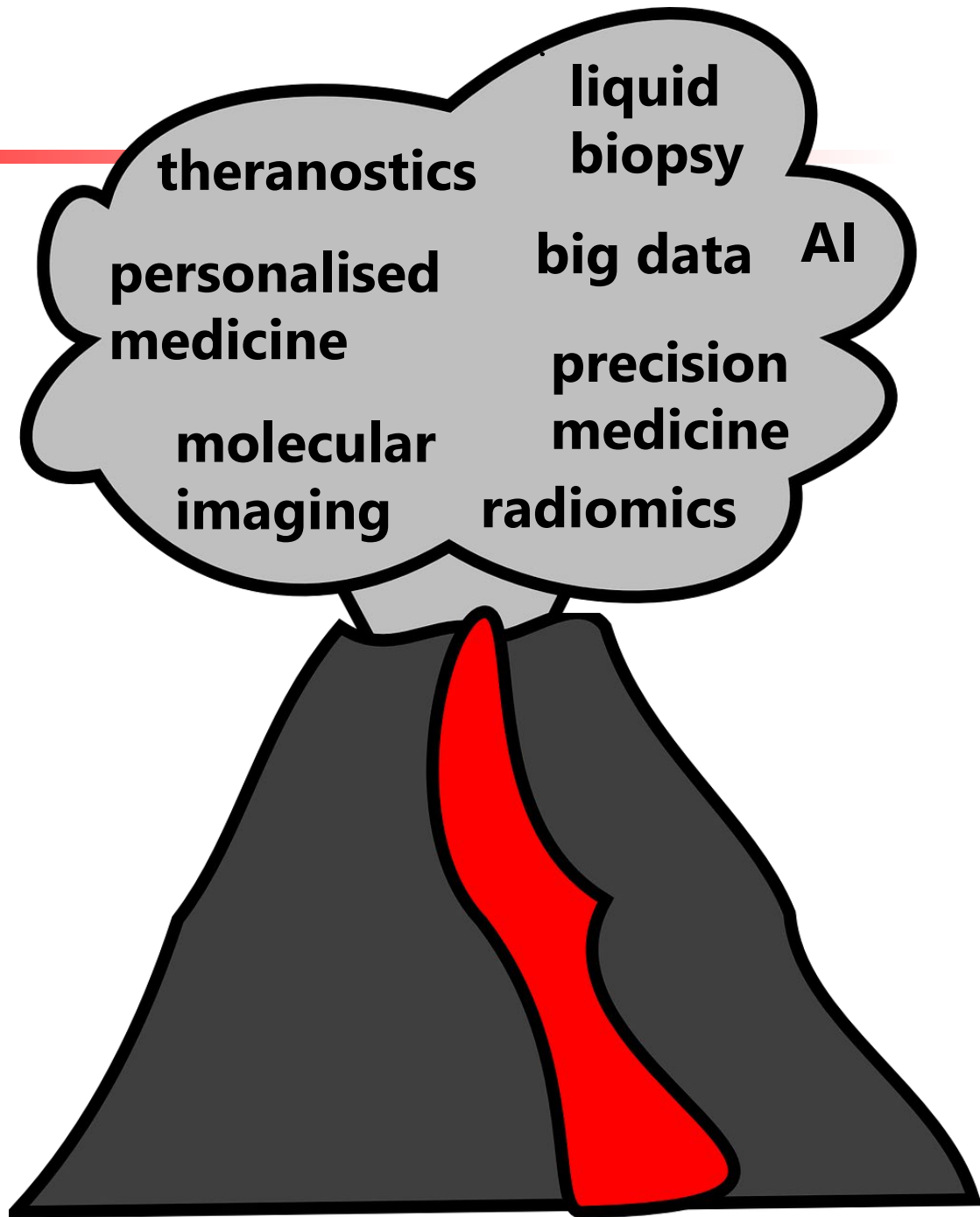
*Ústav nukleární medicíny*

*1. LF UK a VFN*

# Úvod

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*BUZZWORDS*  
*HYPER*



theranostics

liquid  
biopsy

personalised  
medicine

big data AI

molecular  
imaging

precision  
medicine

radiomics

# Úvod

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**precision  
medicine**

**molecular  
imaging**

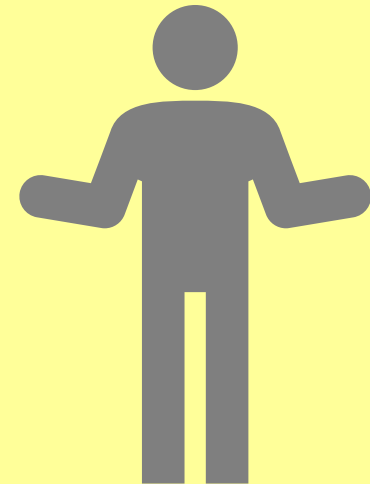
**radiomics**

**theranostics**

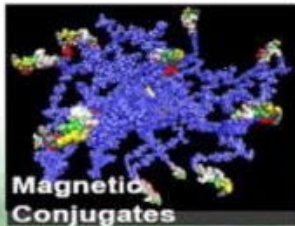
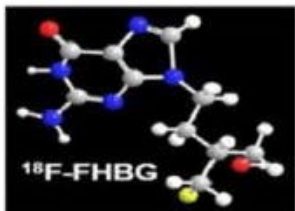
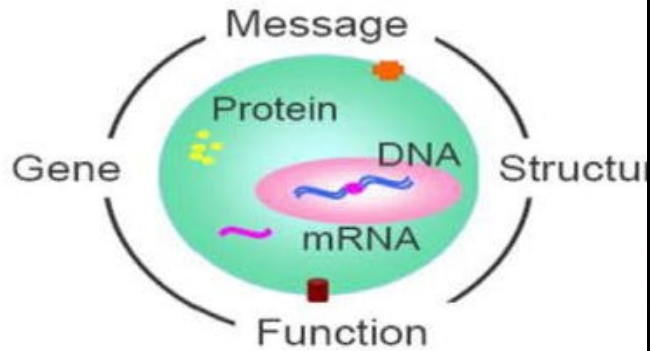
**AI**

**big data**

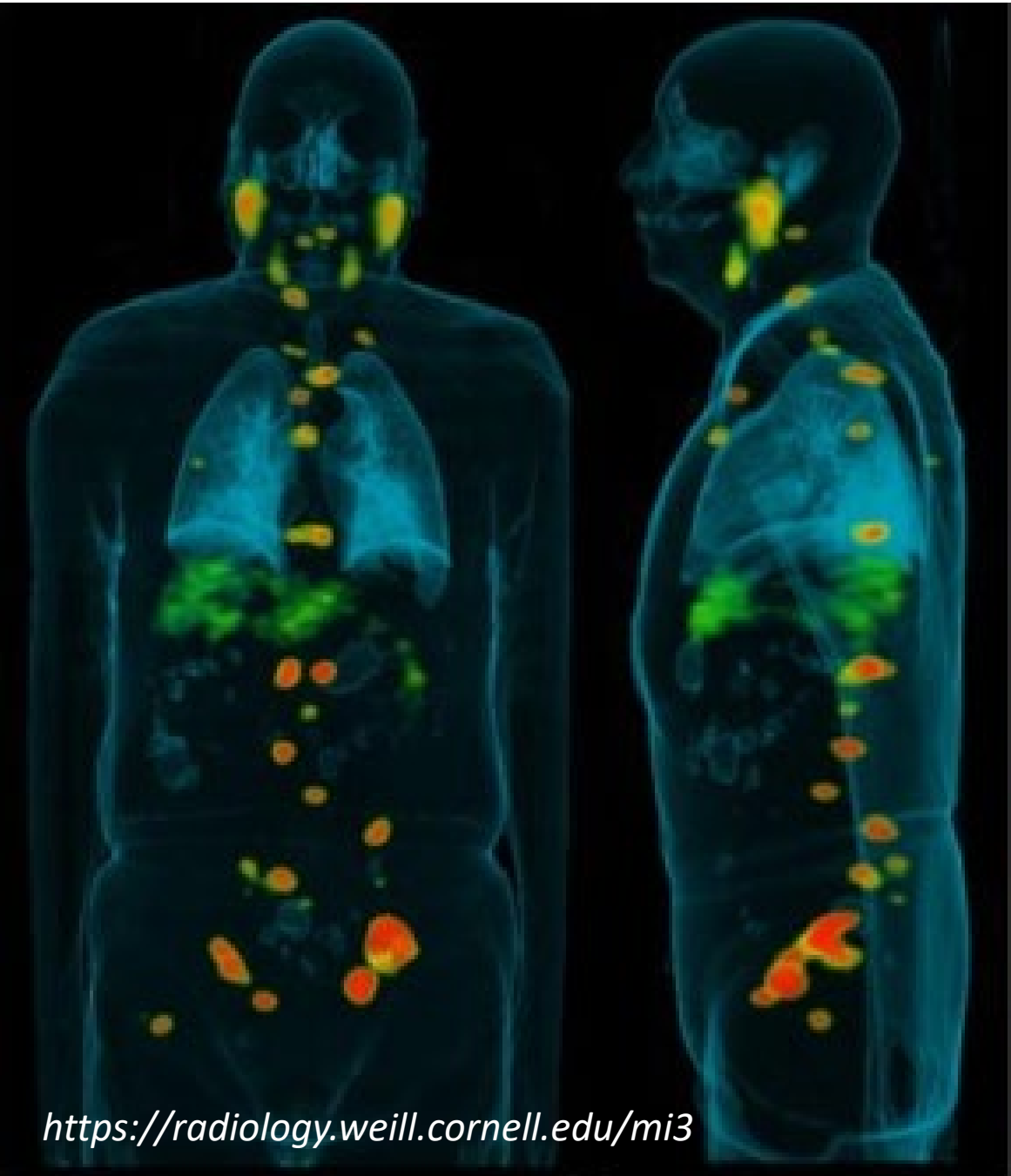
**personalised  
medicine**



# Molekulárn



Feng Ding, Seng Chen, Wanshu Zhang, Yufeng Tu, Yao S  
molecule-based probes,  
*Bioorganic & Medicinal Chemistry*, Volume 25, Issue 20,  
2017, Pages 5179-5184,



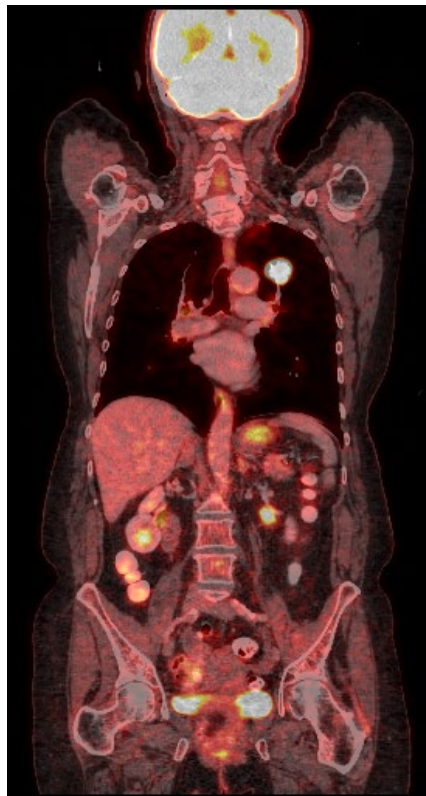
<https://radiology.weill.cornell.edu/mi3>

# Hybridní zobrazování

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- poskytuje komplementární diagnostickou obrazovou informaci získanou **ze dvou nebo více** zobrazovacích technik **bez nutnosti přemístování pacienta**
- fúze dvou nebo více zobrazovacích technik do jedné, nové formy zobrazení

# Hybridní zobrazování



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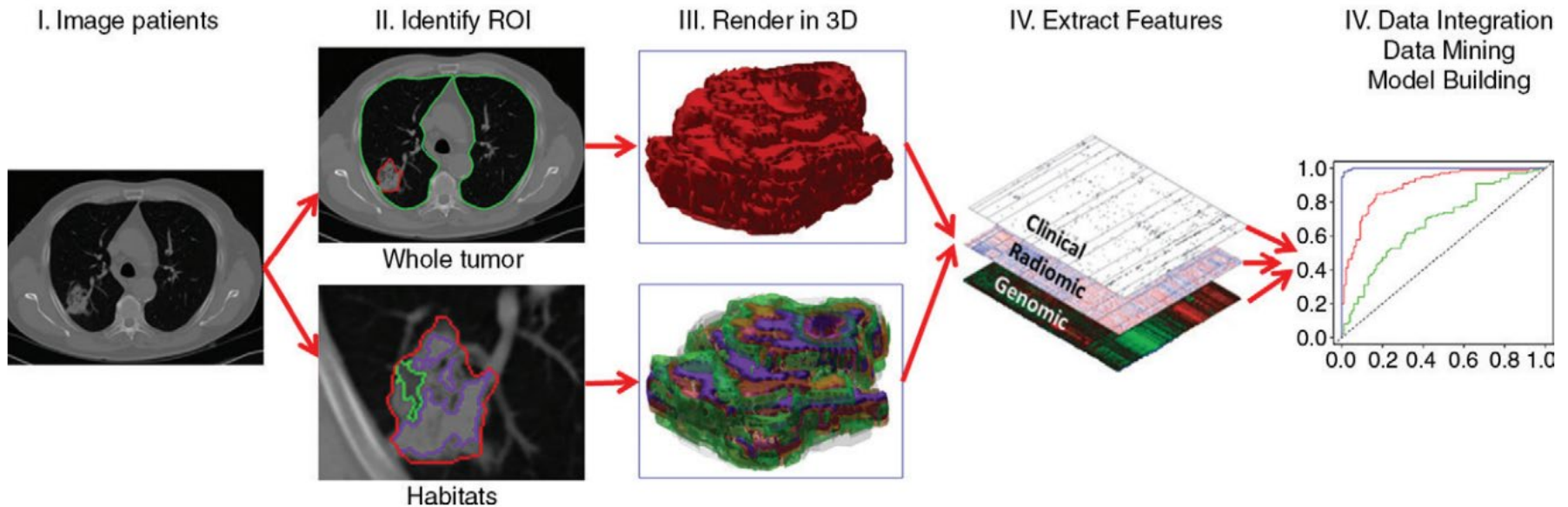
# Radiomika

Radiology

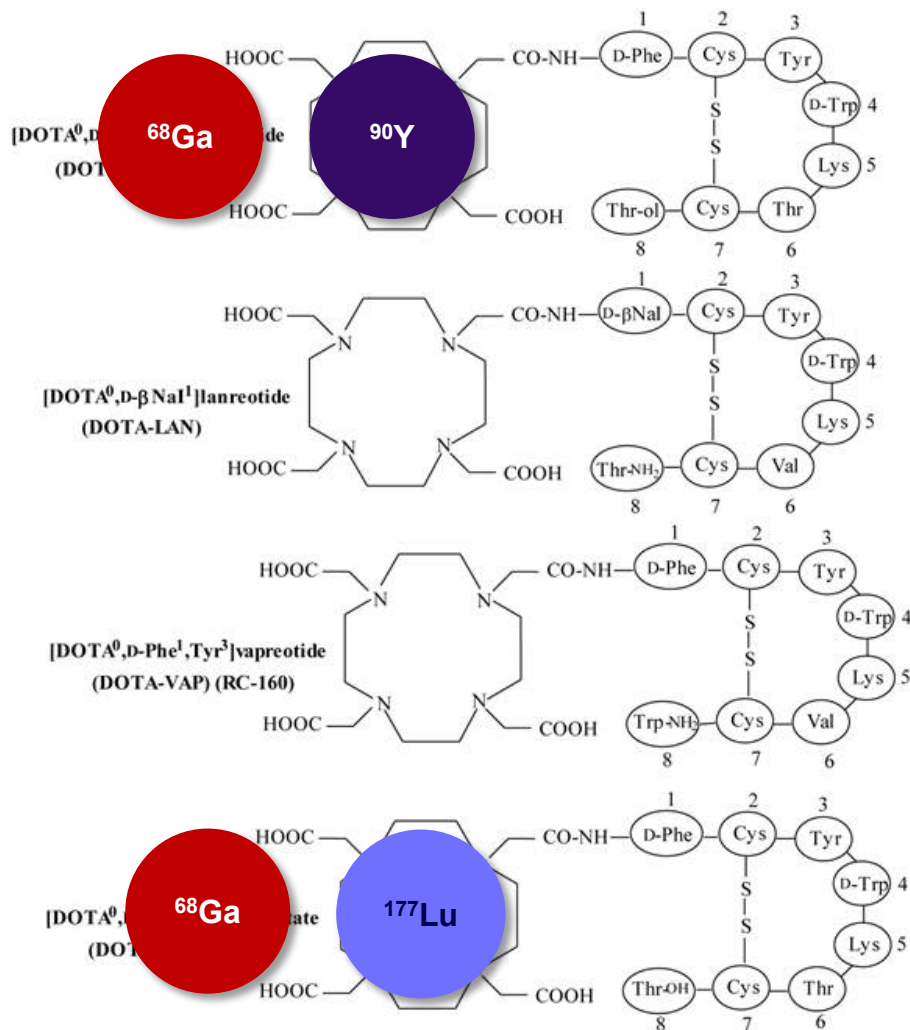
Robert J. Gillies, PhD  
Paul E. Kinahan, PhD  
Hedvig Hricak, MD, PhD, Dr(hc)

**Radiomics:** Images Are More than Pictures, They Are Data<sup>1</sup>

*Radiology*: Volume 278: Number 2—February 2016

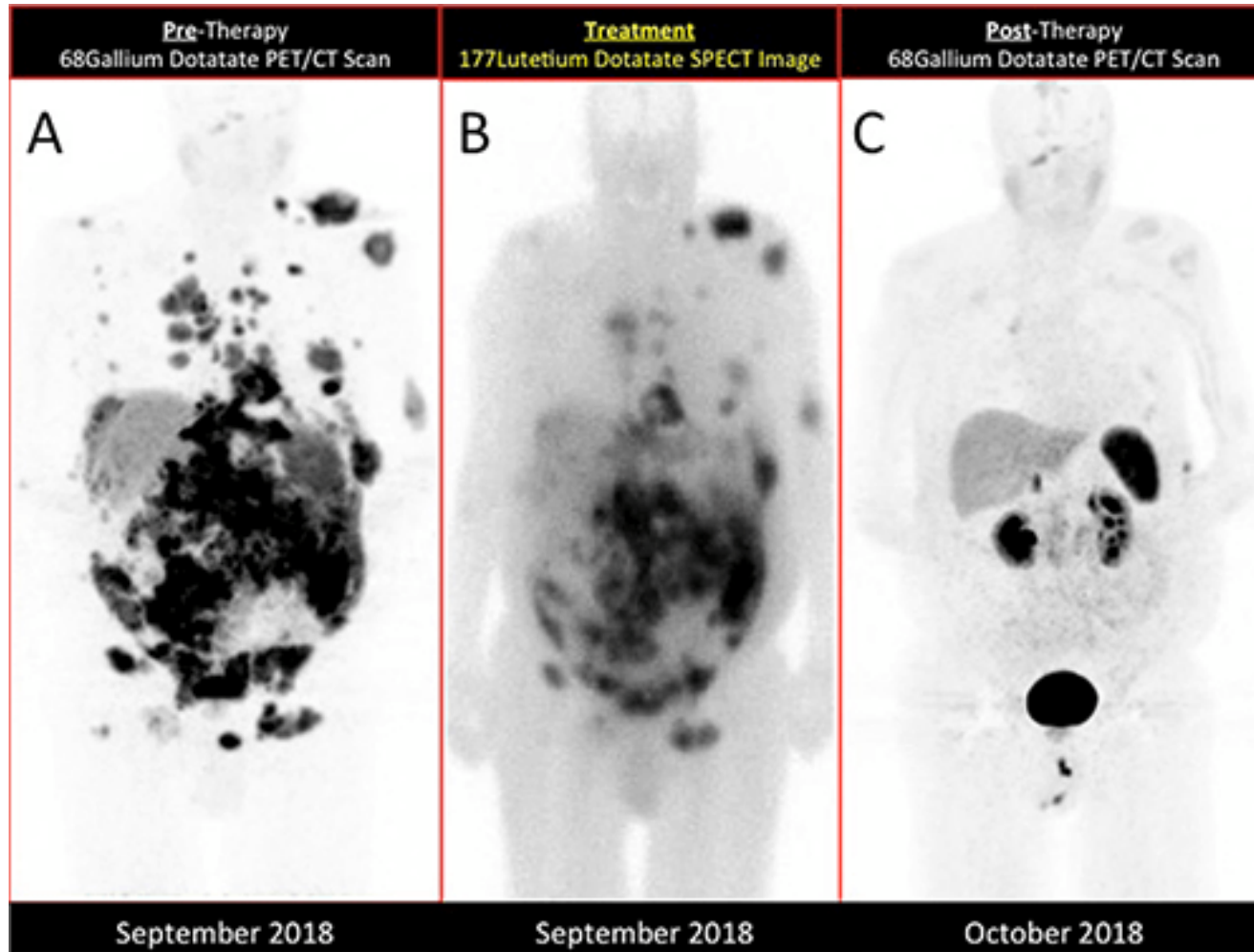


# Teranostika





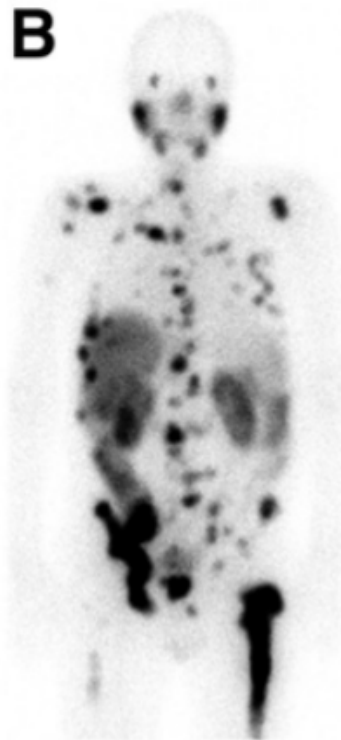
# Teranostika



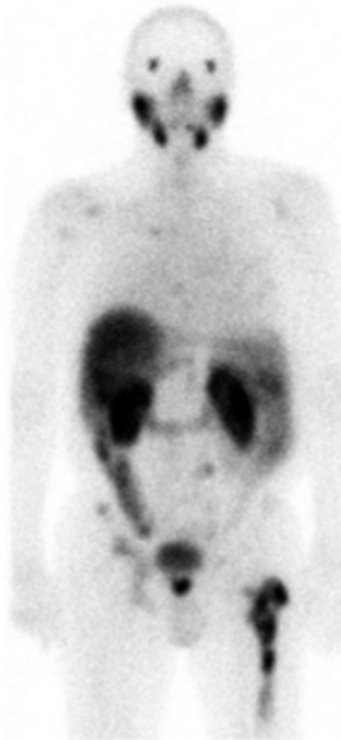
# Teranostika



12/2014  
PSA 387.06 ng/mL  
150 MBq  $^{68}\text{Ga}$ -PSMA11  
PET/CT (MIP) 1 h p.i.



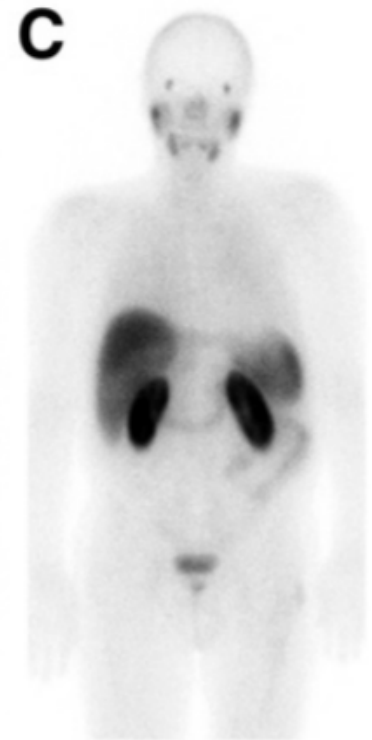
12/2014  
PSA 387.06 ng/mL  
6 GBq  $^{177}\text{Lu}$ -PSMA617  
Planar scan (GM) 20 h p.i.



02/2015  
PSA 9.21 ng/mL  
6 GBq  $^{177}\text{Lu}$ -PSMA617  
Planar scan (GM) 20 h p.i.



04/2015  
PSA 1.98 ng/mL  
6 GBq  $^{177}\text{Lu}$ -PSMA617  
Planar scan (GM) 20 h p.i.



06/2015  
PSA 1.08 ng/mL  
700 MBq  $^{99\text{m}}\text{Tc}$ -MIP1427  
Planar scan (GM) 3 h p.i.

# AI definice

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- **umělá inteligence je věda o vytváření strojů nebo systémů, které budou při řešení určitého úkolu užívat takového postupu, který, kdyby ho dělal člověk, bychom považovali za projev jeho inteligence.**

**Marek Minski, 1967**

- **schopnost stroje vykonávat činnost na základě řešení, které nebylo předem naprogramováno**
- **úsudek, prezentace znalostí, učení, plánování, vnímání, přirozený jazyk, fyzická manipulace**

# AI klasifikace

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- konkrétní x obecná
- sub-human x human x super-human

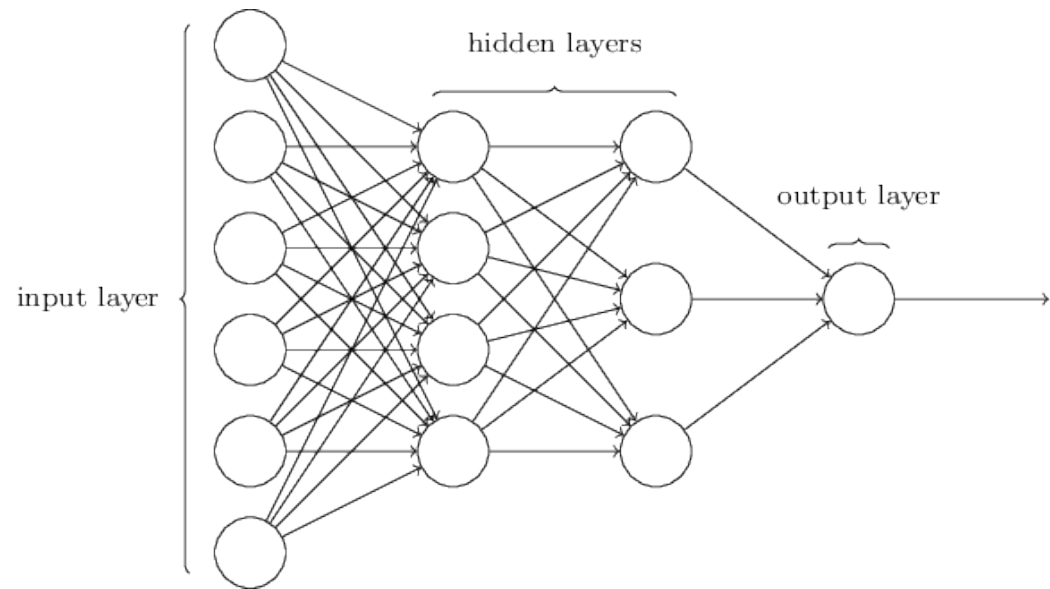
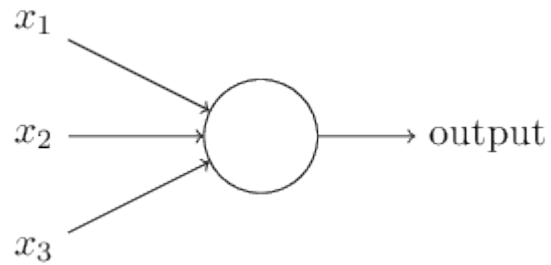
## artificial intelligence

### machine learning

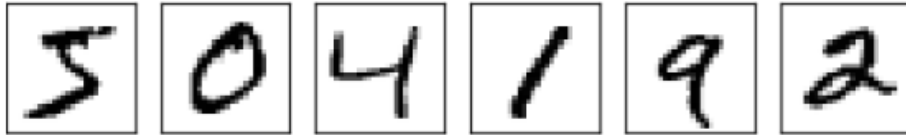
- *clustering*
- *tree decision learning*
- *inductive logic*
- *reinforcement learning*
- *Bayesian networks*

**deep learning**  
***neuronal networks***

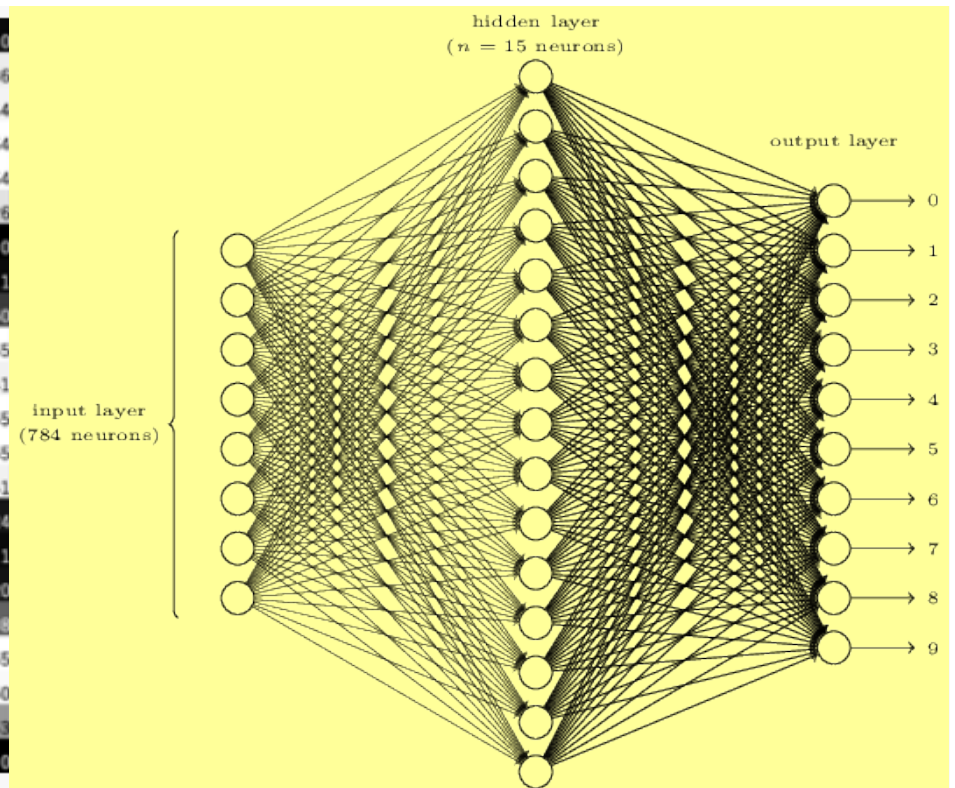
# AI princip



# AI princip

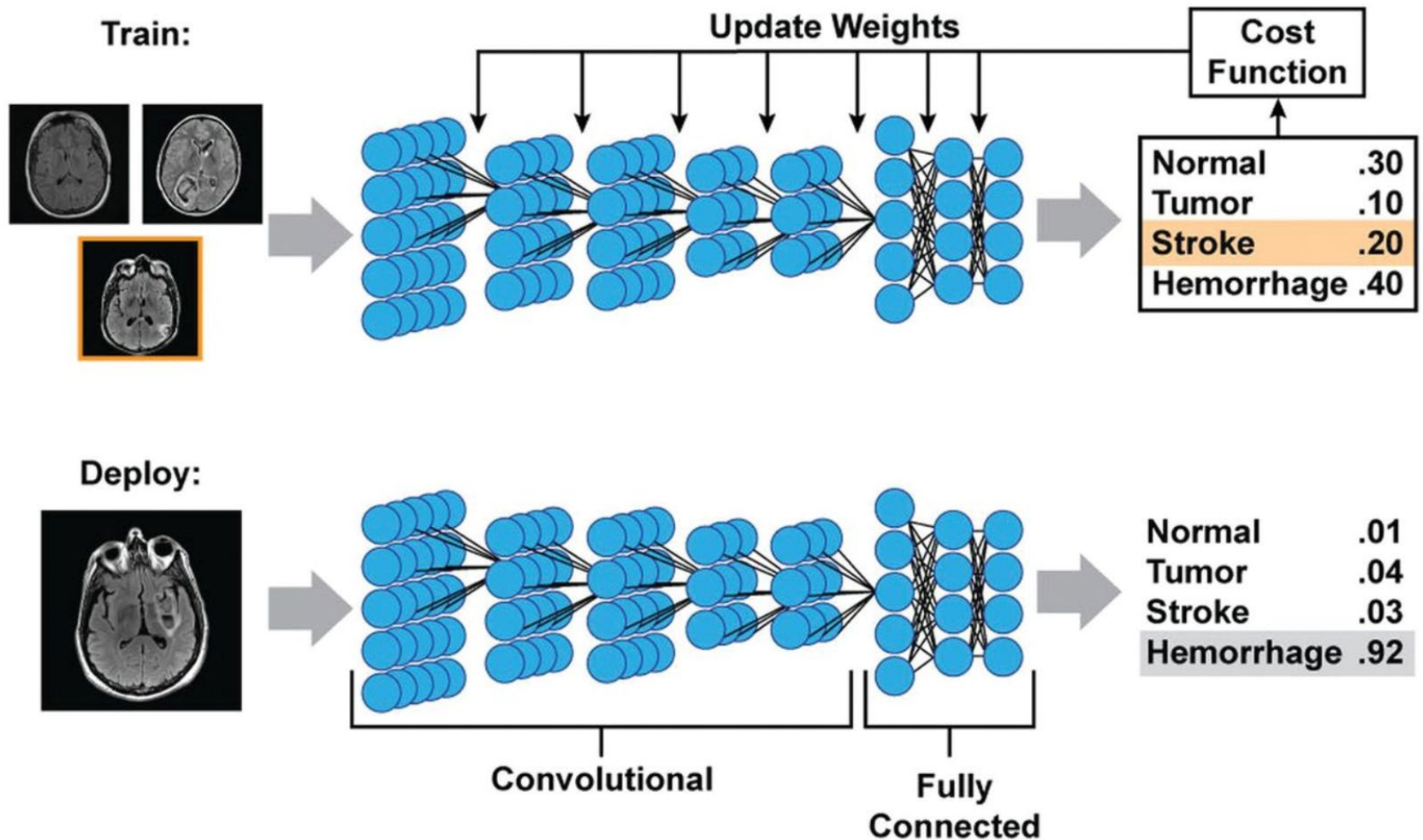


0	2	15	0	0	11	10
0	0	0	4	60	157	236
0	10	16	119	238	255	244
0	14	170	255	255	244	254
2	98	255	228	255	251	254
13	217	243	255	155	33	226
16	229	252	254	49	12	0
6	141	245	255	212	25	11
0	87	252	250	248	215	63
0	13	113	255	255	245	255
1	0	5	117	251	255	241
0	0	0	4	58	251	255
0	0	4	91	255	255	255
0	22	206	252	246	251	241
0	111	255	242	255	158	24
0	218	251	250	137	7	11
0	173	255	255	101	9	20
0	107	251	241	255	230	98
0	18	146	250	255	247	255
0	0	23	113	215	255	250
0	0	6	1	0	52	153
0	0	5	5	0	0	0



# AI zobrazovací metody

## Convolutional Neural Networks

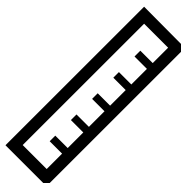


# AI zobrazovací metody

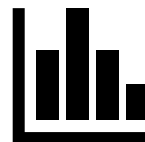
CAD



quantification



big data



scheduling



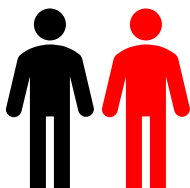
voice recognition

optimisation



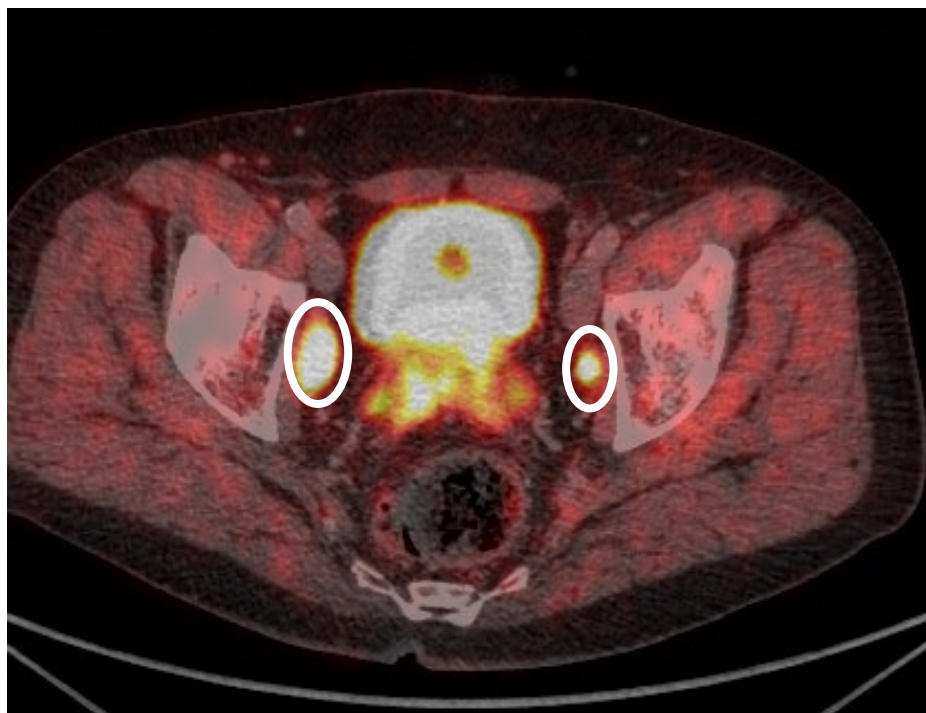
reporting

triage



report analysis

image enhancement





# AI VFN



# AI bude třeba lékařů zobr. metod?

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- AI člověka plně nenahradí
- změna úlohy- informační specialista?
- forenzní aspekty
  - dynamika učení
  - odpovědnost za škodu
- přenositelnost
- výpočetní výkon
- přijetí společností

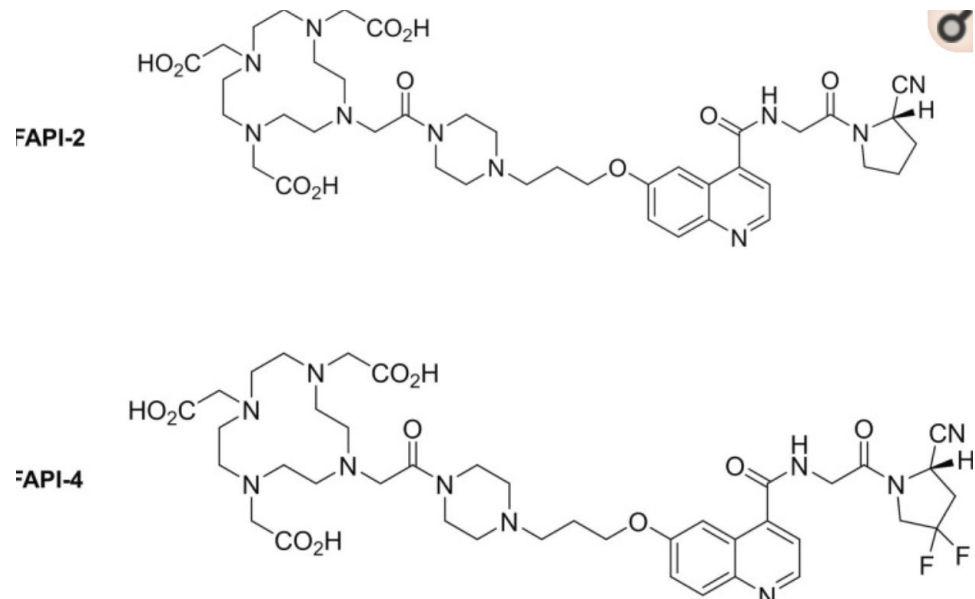
# Hot topics **diagnostika**

## FEATURED ARTICLE OF THE MONTH

### **$^{68}\text{Ga}$ -FAPI PET/CT: Biodistribution and Preliminary Dosimetry Estimate of 2 DOTA-Containing FAP-Targeting Agents in Patients with Various Cancers**

J Nucl Med 2019; 60:386–392  
DOI: 10.2967/jnumed.118.215913

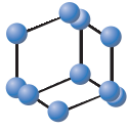
Frederik L. Giesel\*<sup>1</sup>, Clemens Kratochwil\*<sup>1</sup>, Thomas Lindner<sup>1</sup>, Manfred M. Marschalek<sup>1</sup>, Anastasia Loktev<sup>1</sup>, Wencke Lehnert<sup>2</sup>, Jürgen Debus<sup>3,4</sup>, Dirk Jäger<sup>5</sup>, Paul Flechsig<sup>1</sup>, Annette Altmann<sup>1</sup>, Walter Mier<sup>1</sup>, and Uwe Haberkorn<sup>1,6,7</sup>



# Hot topics **therapie**

*Current Radiopharmaceuticals*, 2018, 11, 200-208

REVIEW ARTICLE



**BENTHAM  
SCIENCE**

## An Overview of Targeted Alpha Therapy with $^{225}\text{Ac}$ Actinium and $^{213}\text{Bi}$ Bismuth



Alfred Morgenstern<sup>1\*</sup>, Christos Apostolidis<sup>1</sup>, Clemens Kratochwil<sup>2</sup>, Mike Sathekge<sup>3</sup>, Leszek Krolicki<sup>4</sup> and Frank Bruchertseifer<sup>1</sup>

# Hot topics **přístroje**

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## Total-body PET Scanner

