



# Multidisciplinary approach to genitourinary cancers



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Polskie Towarzystwo  
Onkologii Klinicznej

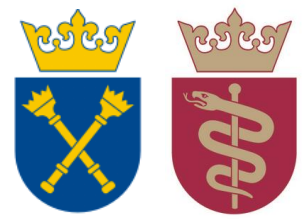
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# Introduction

# How to choose treatment modality?

## **Systemic therapy for systemic disease ... unless:**

- Minority of cancer mass responsible for a majority of clinical picture (obstruction; neurologic deficit; pain; bleeding; recurrent infections etc)
- Few types of cancers with good results from localized treatment of oligometastatic disease (OMD): colorectal; NET low grade; kidney; prostate.

## **Localized therapy for localized disease ... unless:**

- Curation rate can be improved by eradication of micrometastases – adjuvant treatment
  - Typically after localized treatment
  - Sometimes before localized treatment (oesophageal, gastric, rectal, bladder, aggressive breast cancer subtypes)
- Localized treatment not possible due to tumour extent – induction treatment
- Systemic treatment much more effective than localized – „chemo-curable” cancers (lymphomas, SCLC, germ-cell tumours)

# Simplified strategy algorithm

Clinical picture suggests malignancy

emergency?

Y

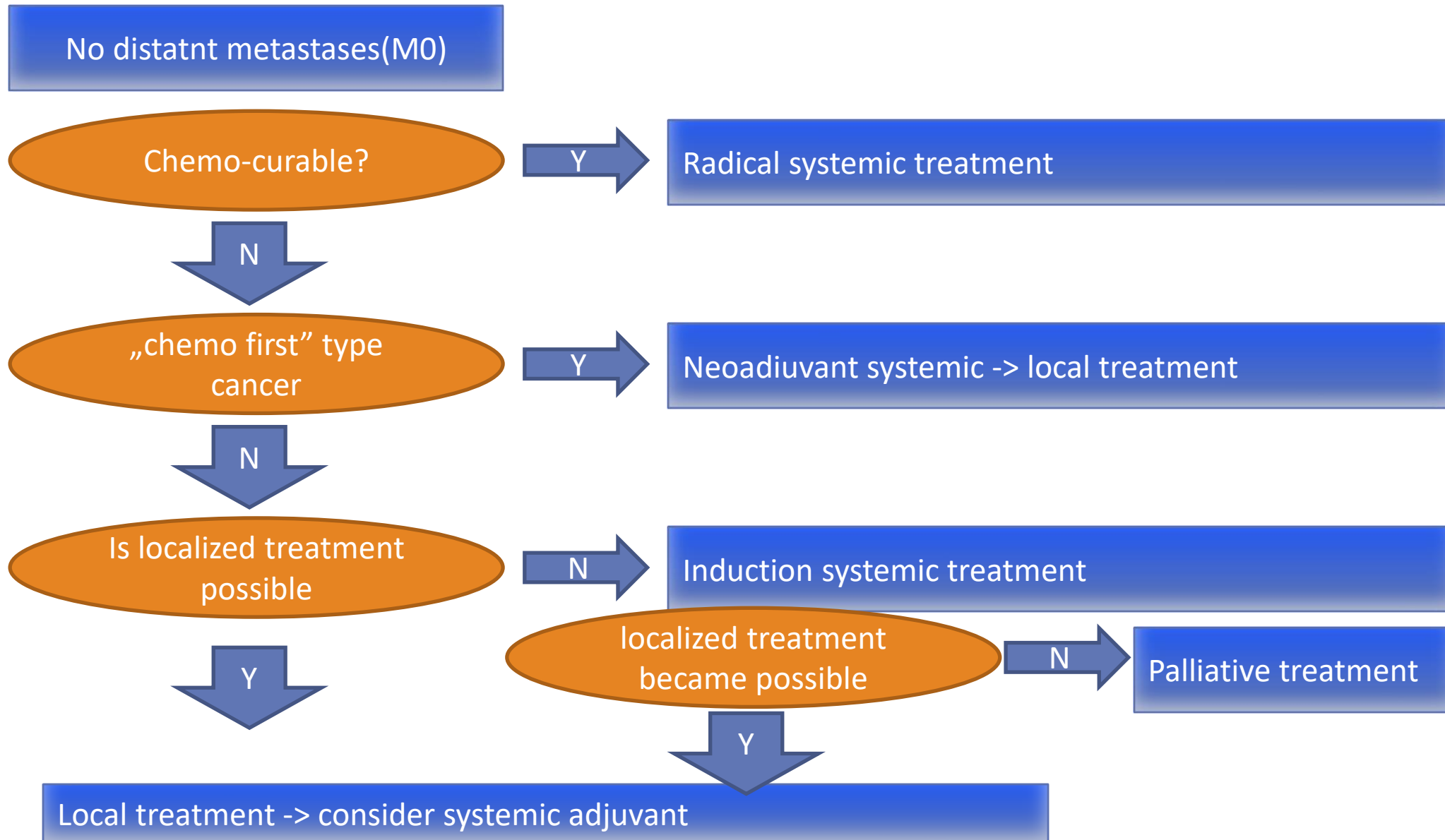
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N

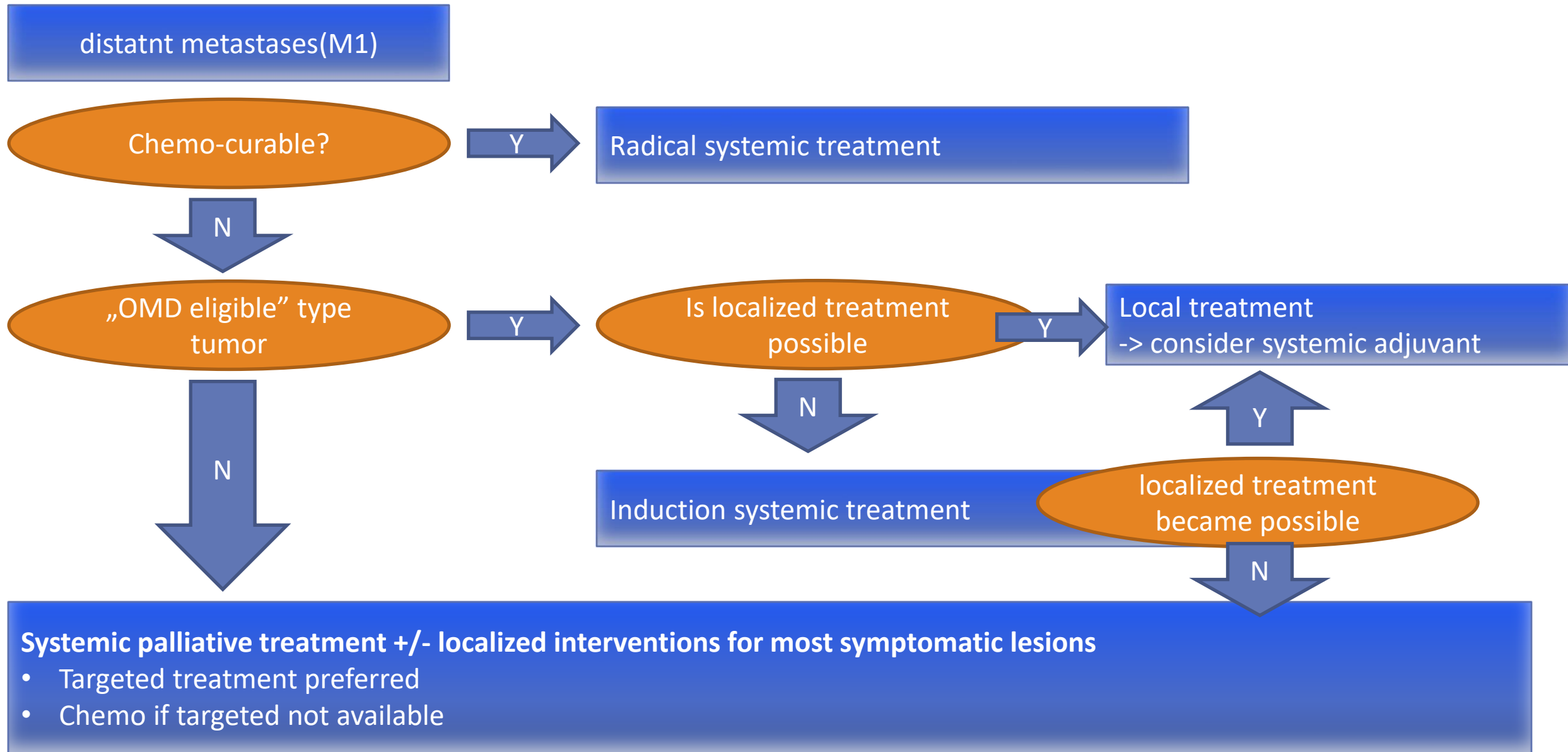
- Inform the patient
- Refer to a comprehensive cancer centre (MDT)
- Schedule typical lab studies
  - CBC, coagulation, blood group, viral serology (some form of biopsy/surgery is anticipated)
  - creatinine, TSH, info on implants and allergies (some form of imaging is anticipated)
- Prehabilitate

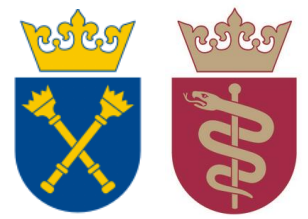
- Diagnostics by MDT
  - Histo-pathological verification
  - Staging

# Simplified strategy algorithm

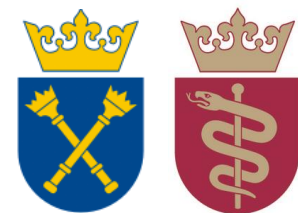


# Simplified strategy algorithm



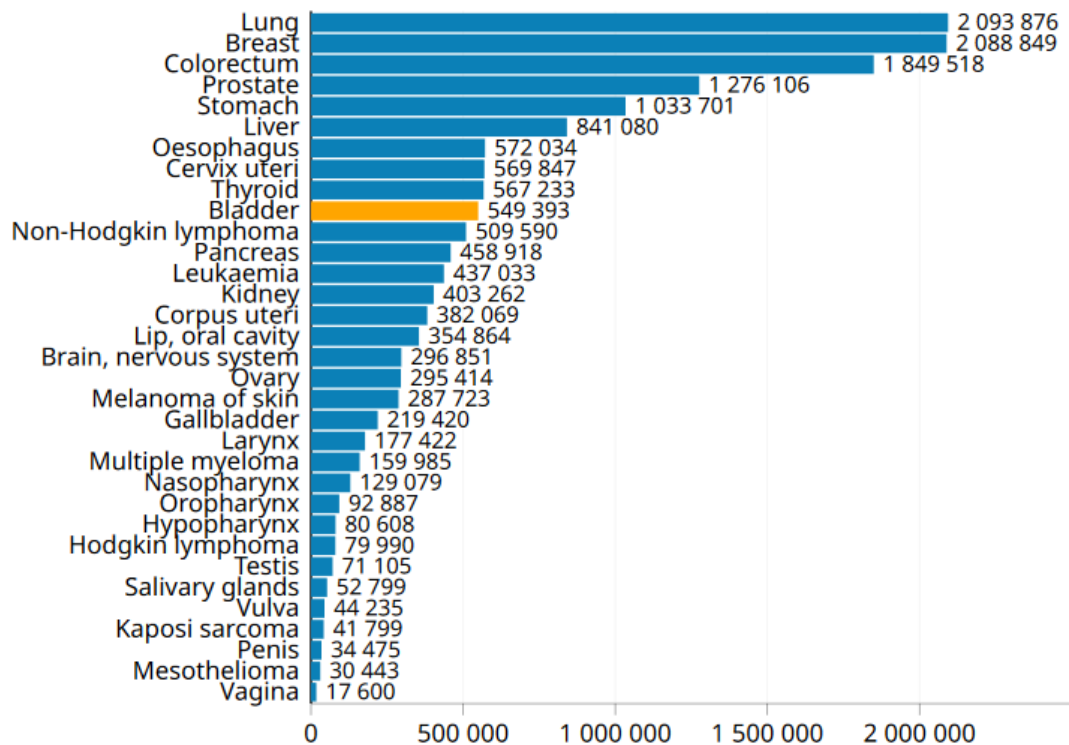


# Bladder Cancer

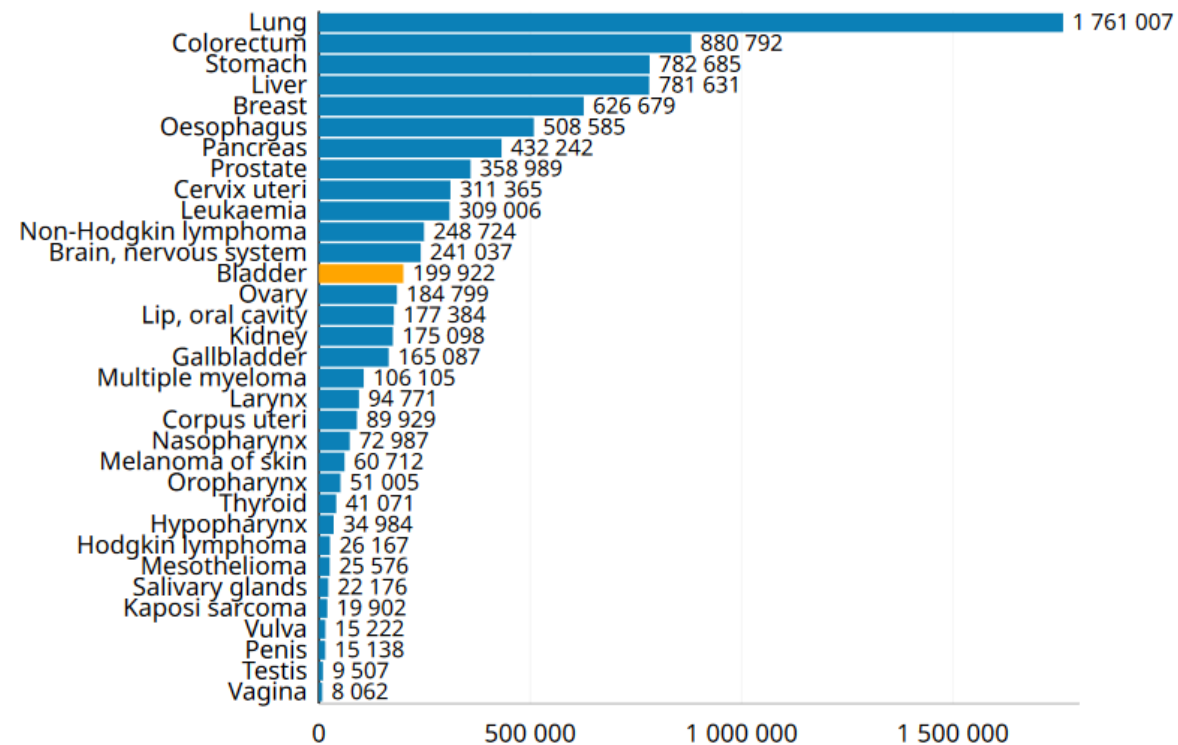


# Bladder cancer - epidemiology

Number of new cases in 2018, both sexes, all ages



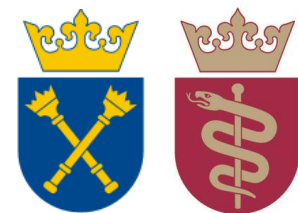
Number of deaths in 2018, both sexes, all ages



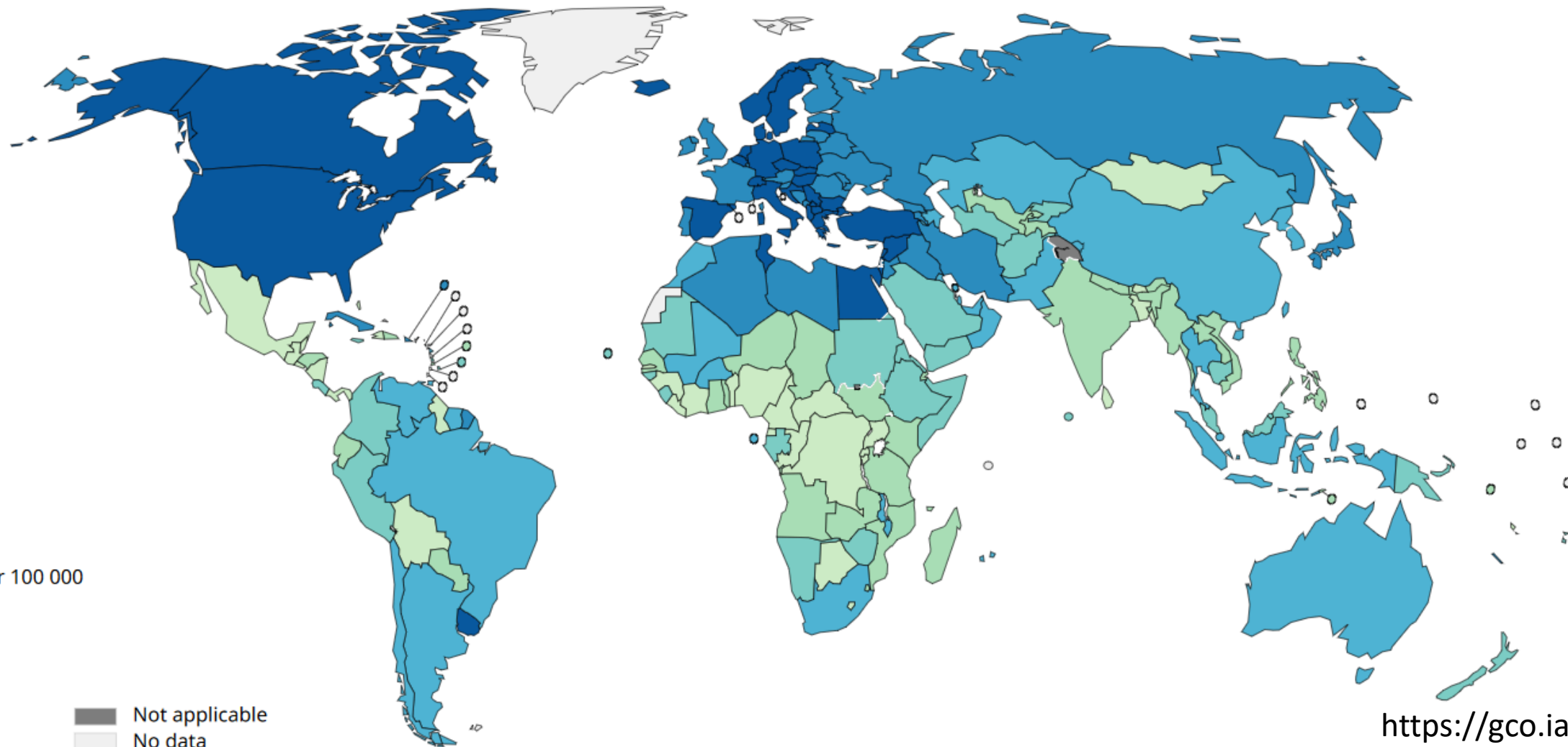


# Bladder cancer

## – male incidence rates worldwide

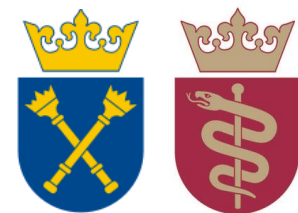


Age standardized (World) incidence rates, bladder, males, all ages

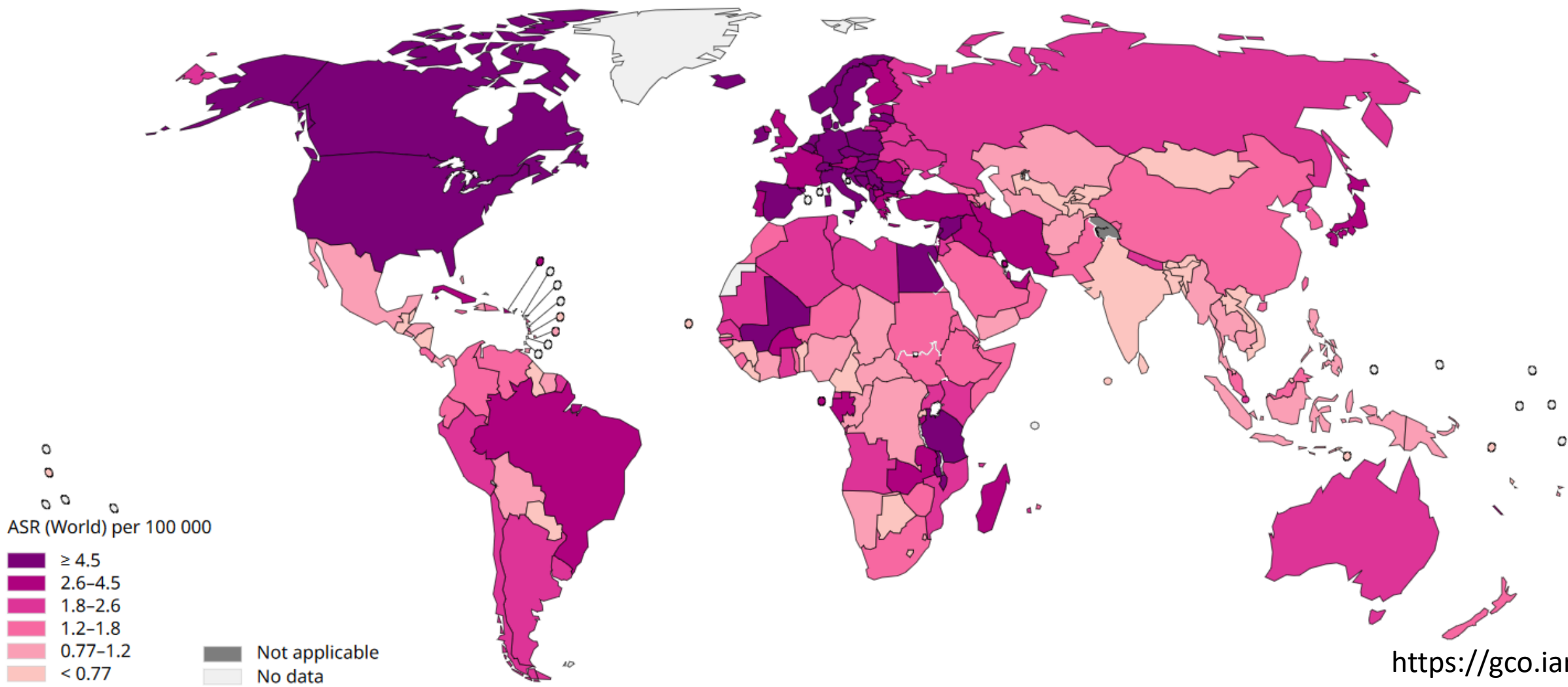


# Bladder cancer

## – female incidence rates worldwide



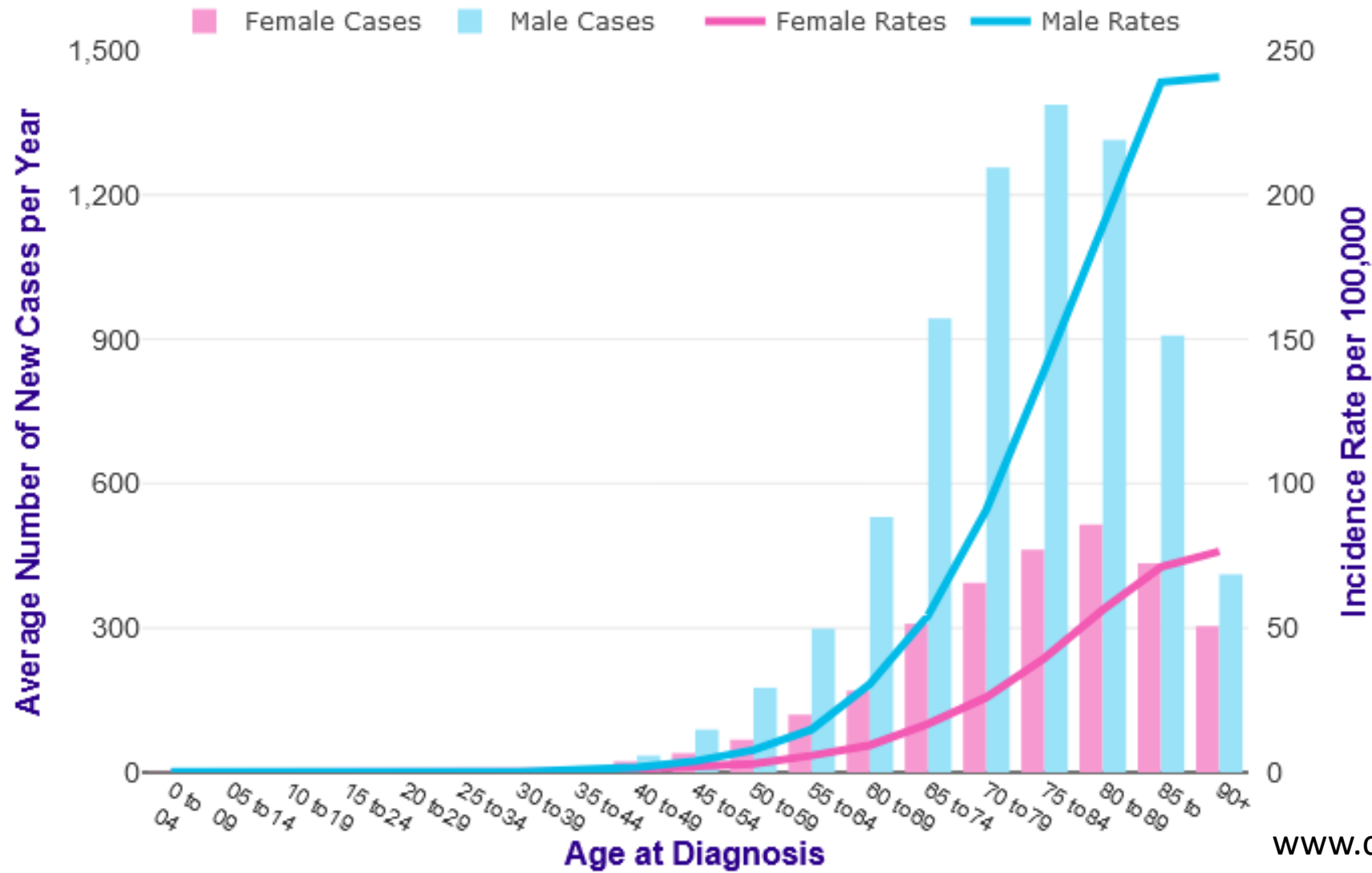
Age standardized (World) incidence rates, bladder, females, all ages

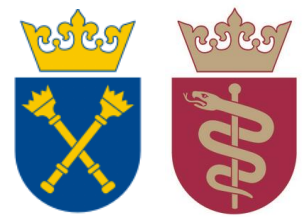




# Bladder cancer

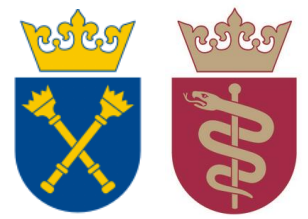
– incidence by age and gender





# Bladder cancer – risk factors

- M > F (HR ~2-3)
- chemical exposure:
  - Tobacco
  - Carbohydrates: plastics, coal, tar, asphalt, aristolochic acid
  - Arsenic, chlorine
  - cyclophosphamide
- chronic irritation:
  - catheters
  - recurrent urinary track infections
  - Irradiation
- gene abnormalities
  - multiple possible defects with low prevalence
  - Lynch syndrome

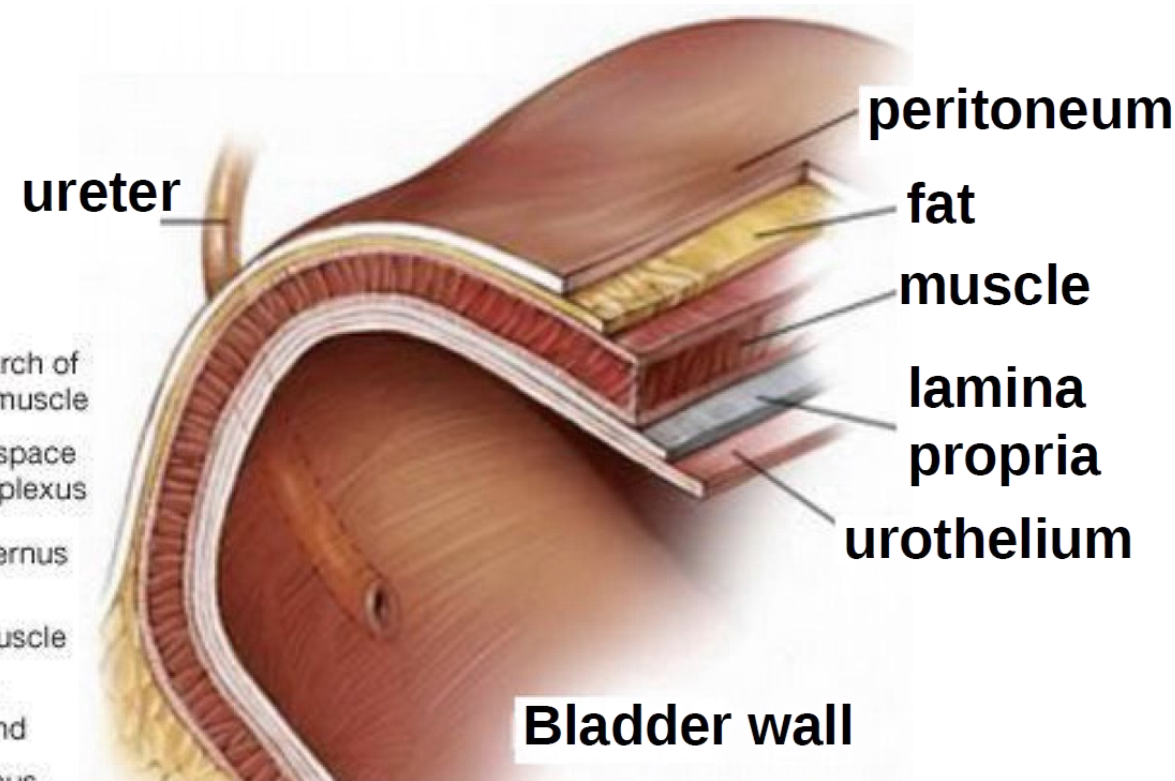
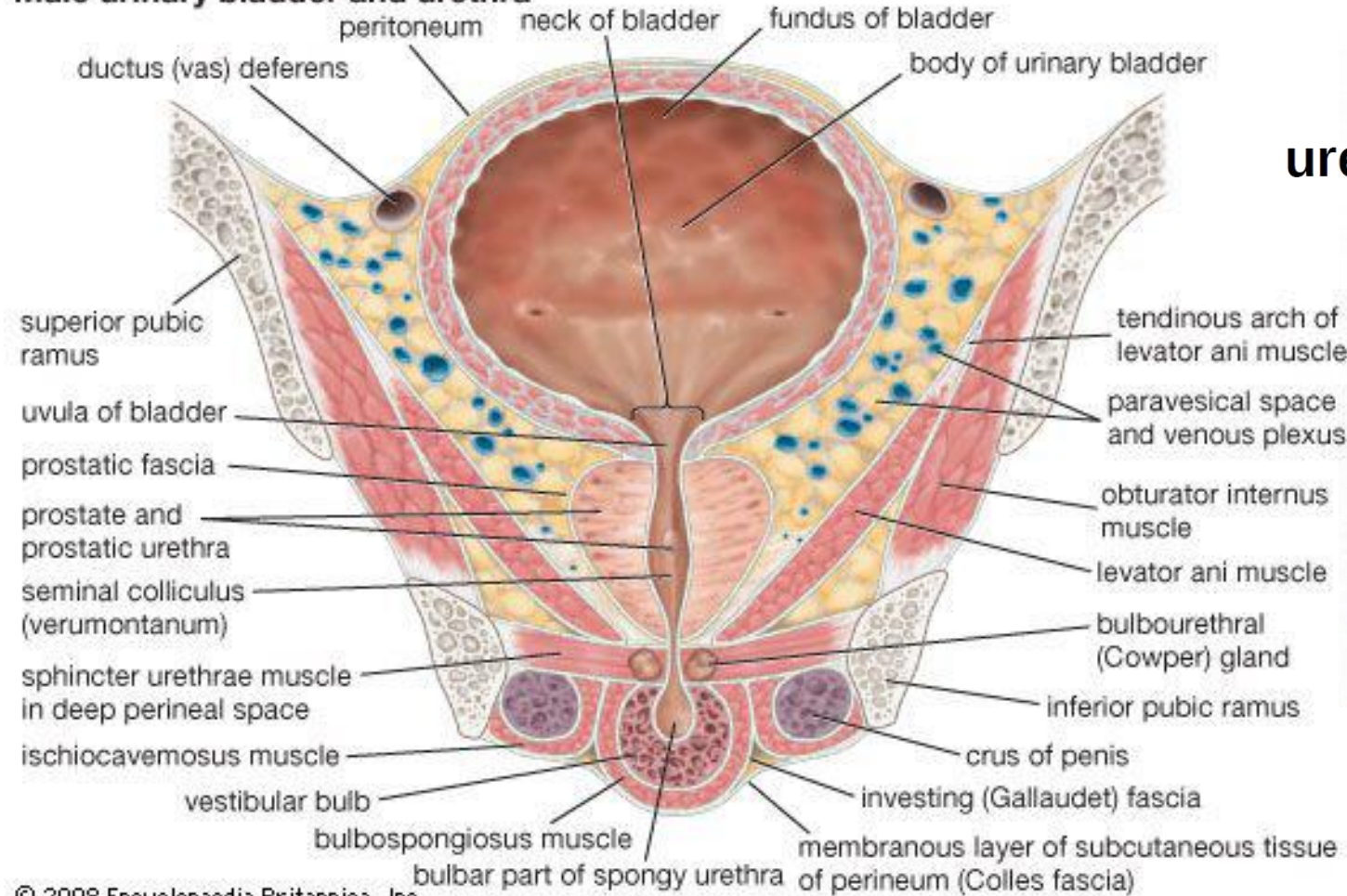


# Bladder cancer – presentation

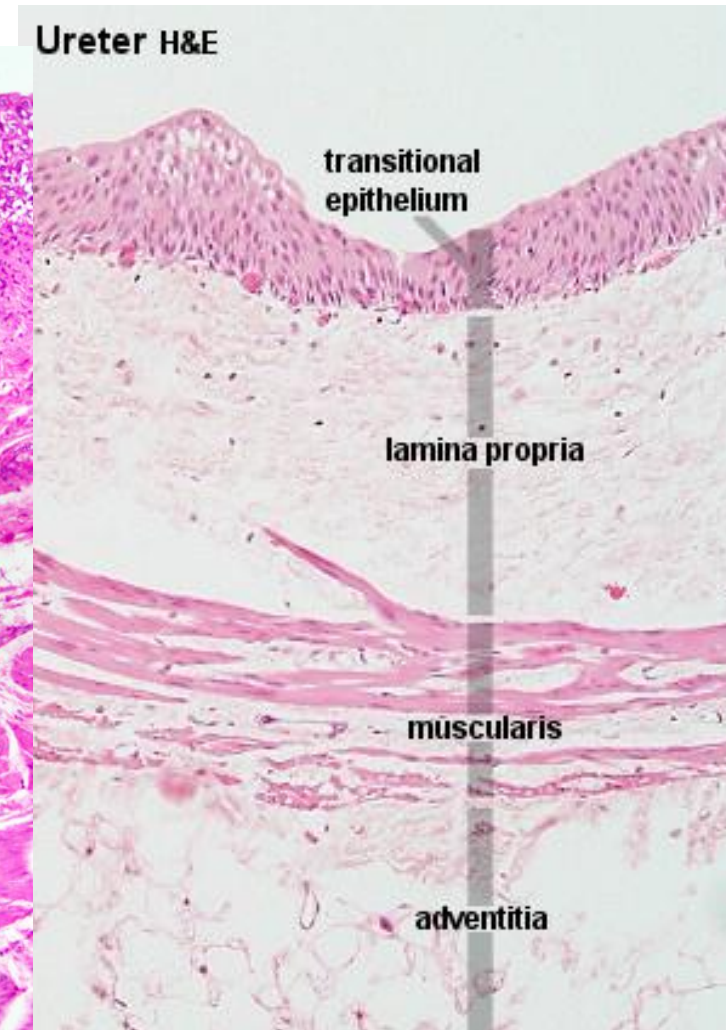
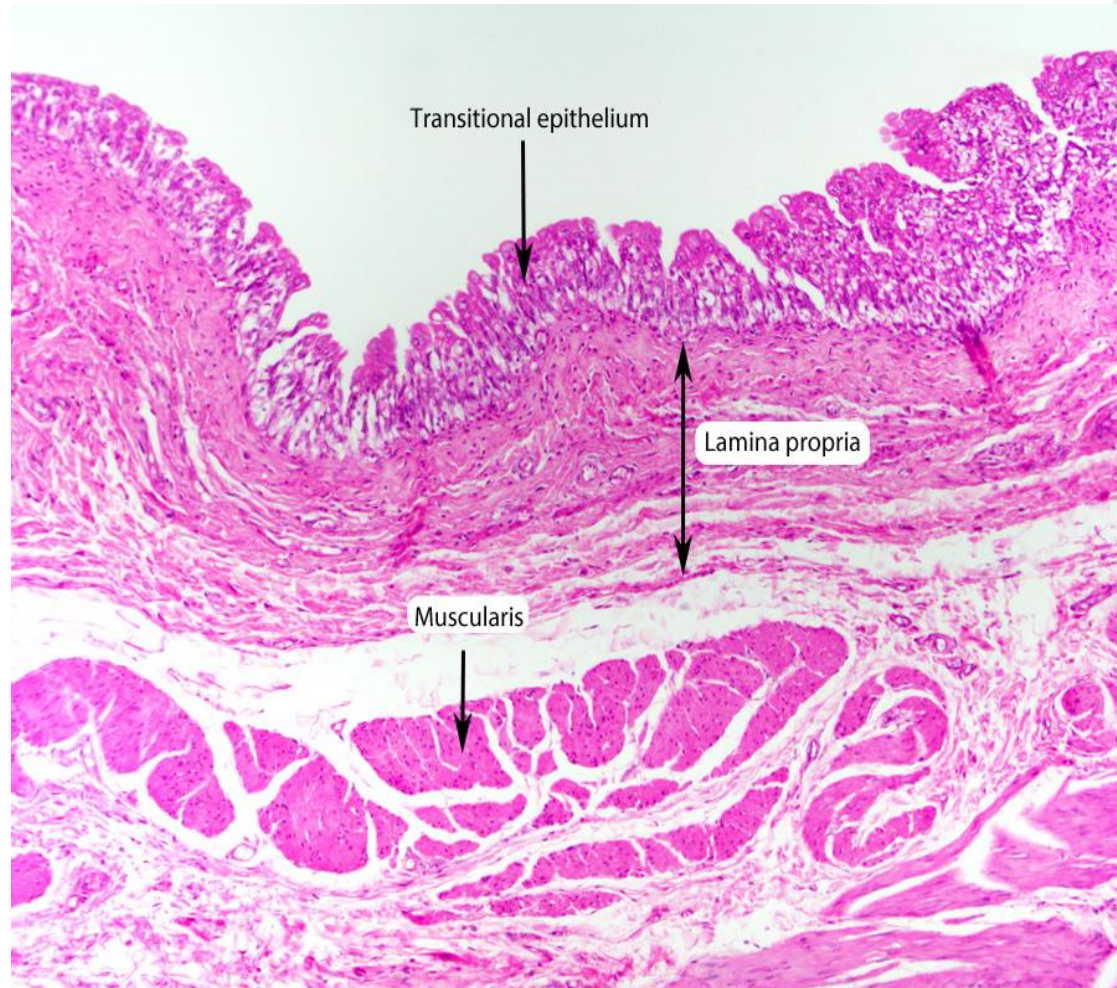
- Hematuria
- Pain
  - lower abdomen from primary
  - various locations from metastases
- Voiding symptoms:
  - Dysuria: urgency, frequency
  - Obstruction: training, intermittent stream,
- Recurrent urinary tract infections
  
- Screening not viable

# Bladder cancer – anatomy

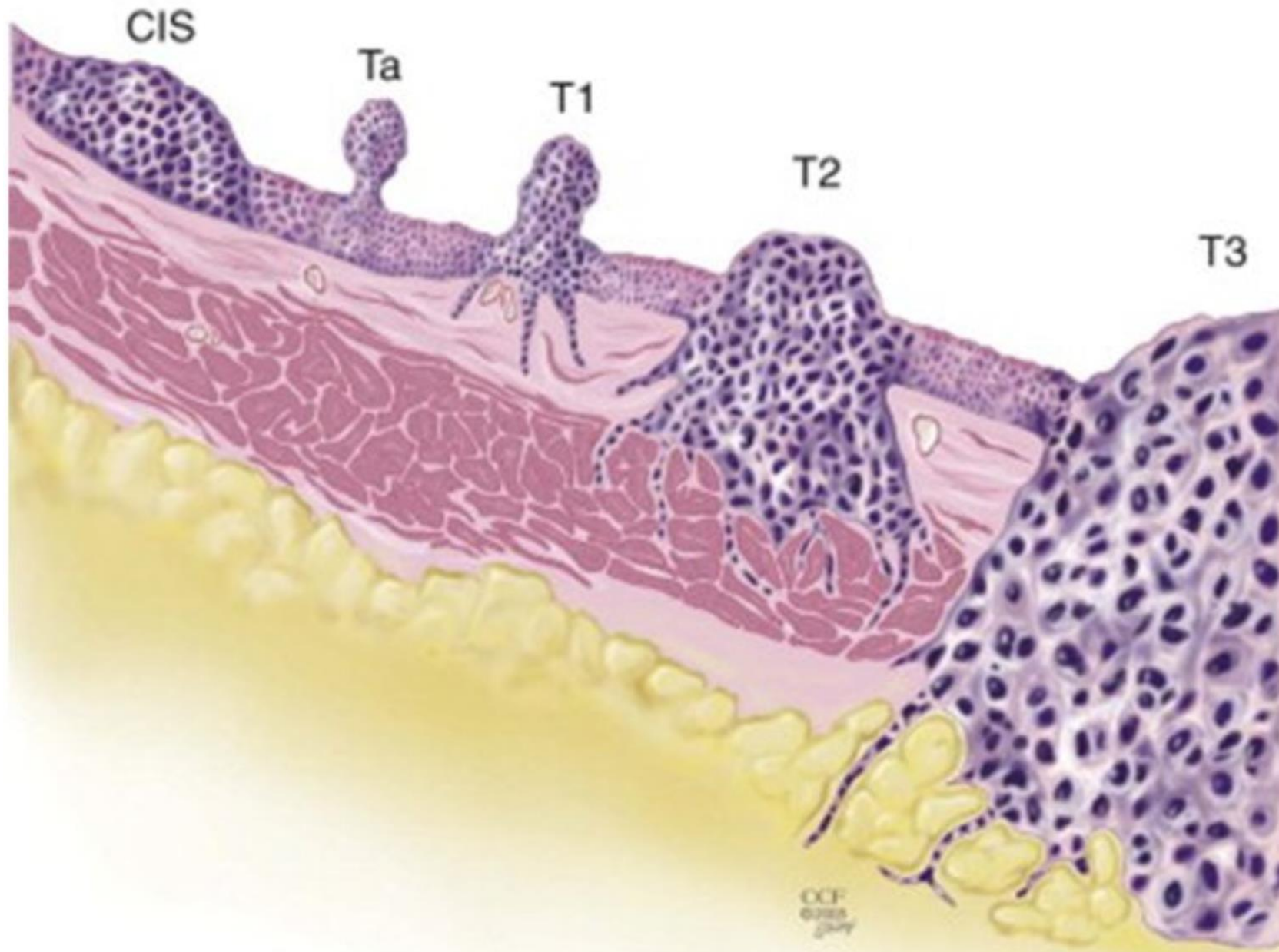
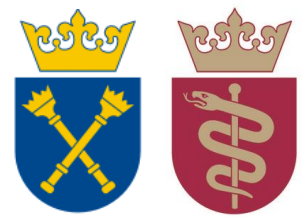
## Male urinary bladder and urethra



# Bladder cancer - histology



# Bladder cancer – staging

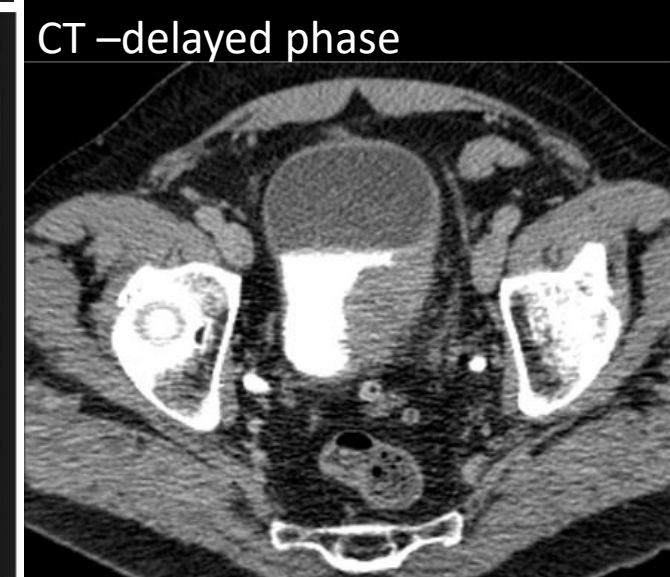




# Bladder cancer

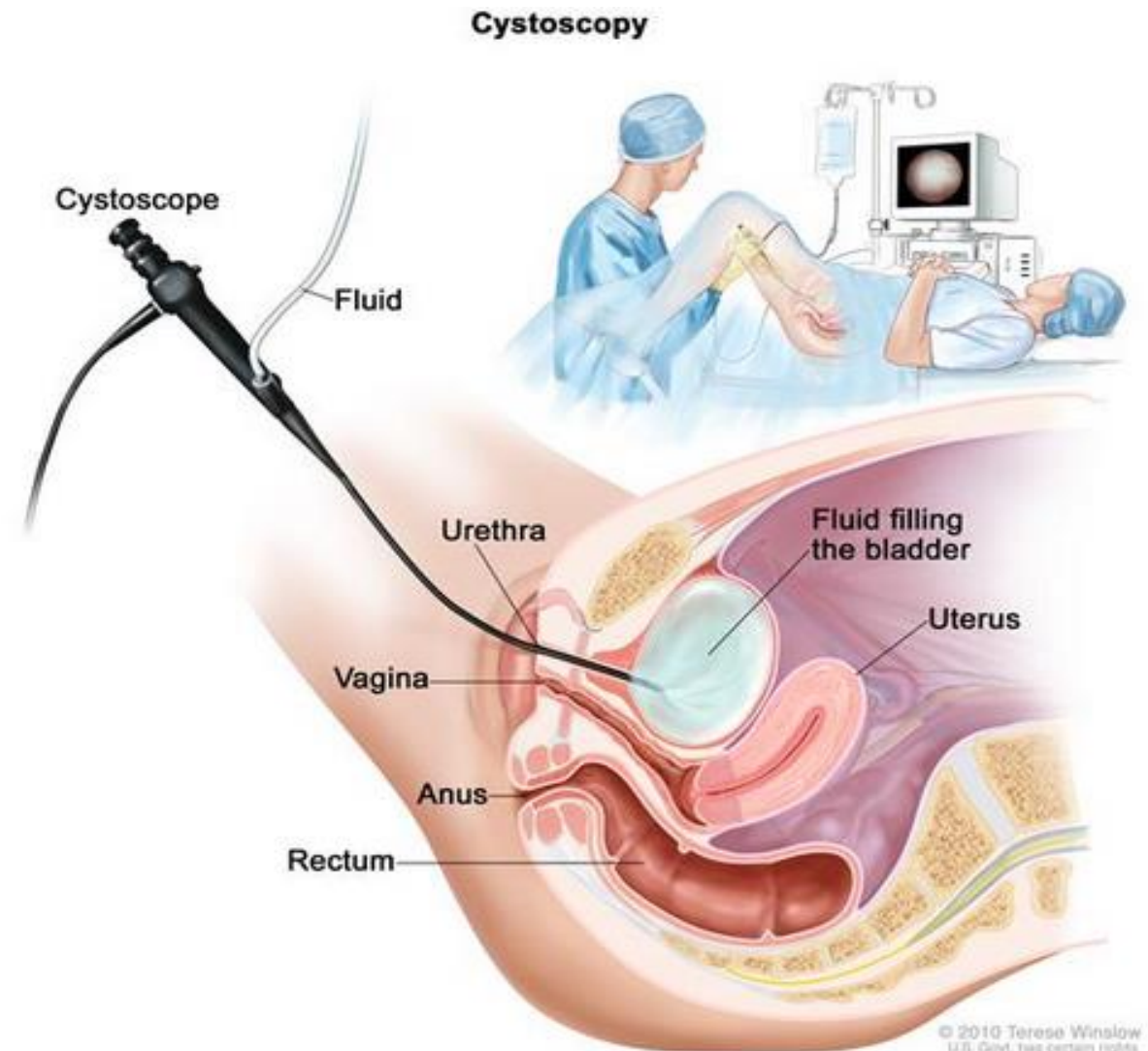
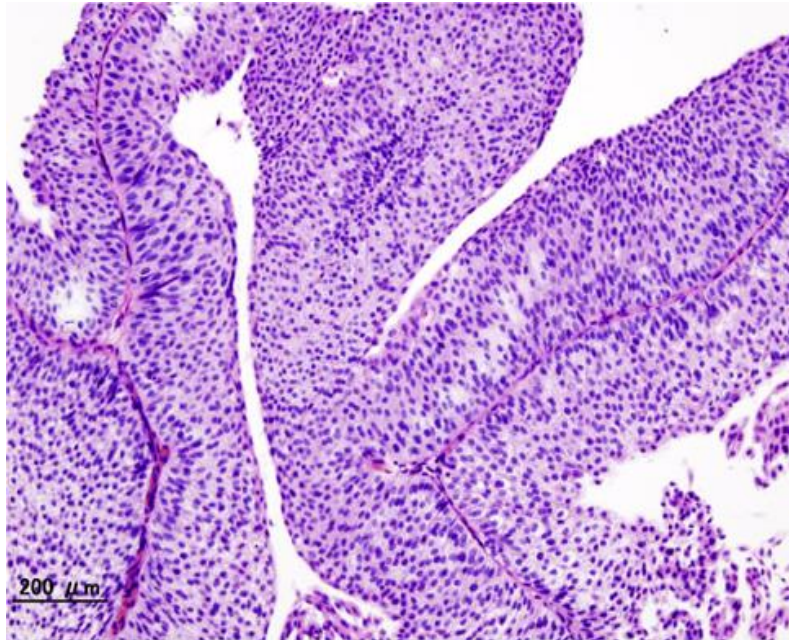
## – non-invasive workup

- CT
  - local and metastatic staging
- MRI
  - Marginally better than CT in local staging
- USG
  - Full bladder required
  - Unreliable but available (low sensitivity)
- Urinalysis
  - Haematuria, leukocyturia
  - Unreliable but available (low specificity)
- Urine cytology
  - Unreliable (low sensitivity, high specificity)



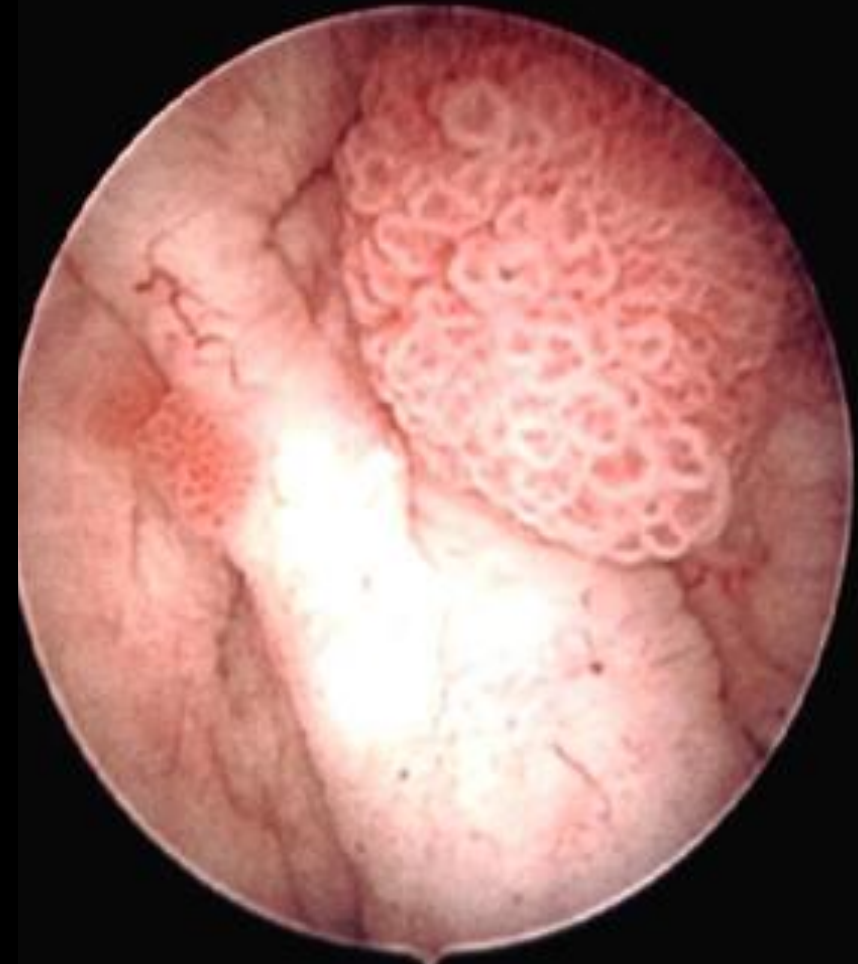
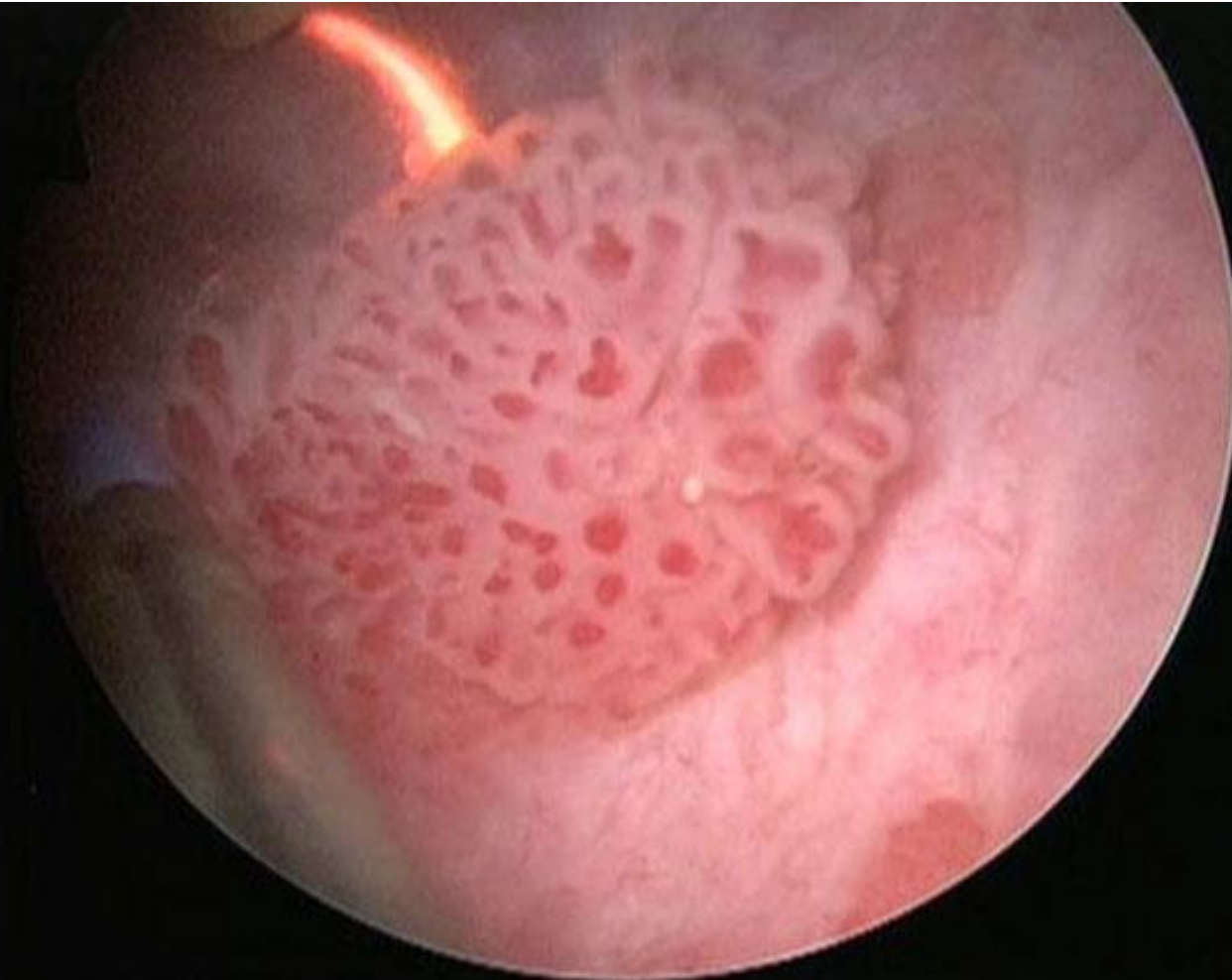
# Bladder cancer - workup

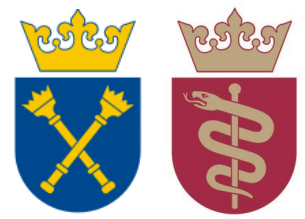
- Cystoscopy
  - Plain or fluorescent contrast enhanced
  - with TURBT or biopsy
- TURBT = trans urethral resection of bladder tumor



# Bladder cancer - workup

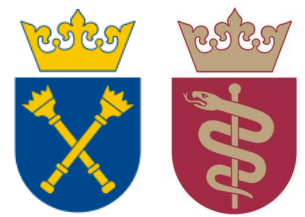
- Bladder cancers and papillomas as seen in cystoscopy





# Bladder cancer – pathology

- Urothelial Cancer > 90%
  - (>90% are in bladder, 8% in renal pelvis, 2% in ureter or urethra)
- Squamous Cancer – 3%
- Adenocarcinoma – 1 – 2%
- Small Cell – 1%
- Other (lymphomas, sarcomas, neuroendocrine etc.) <1%



# Bladder cancer – staging

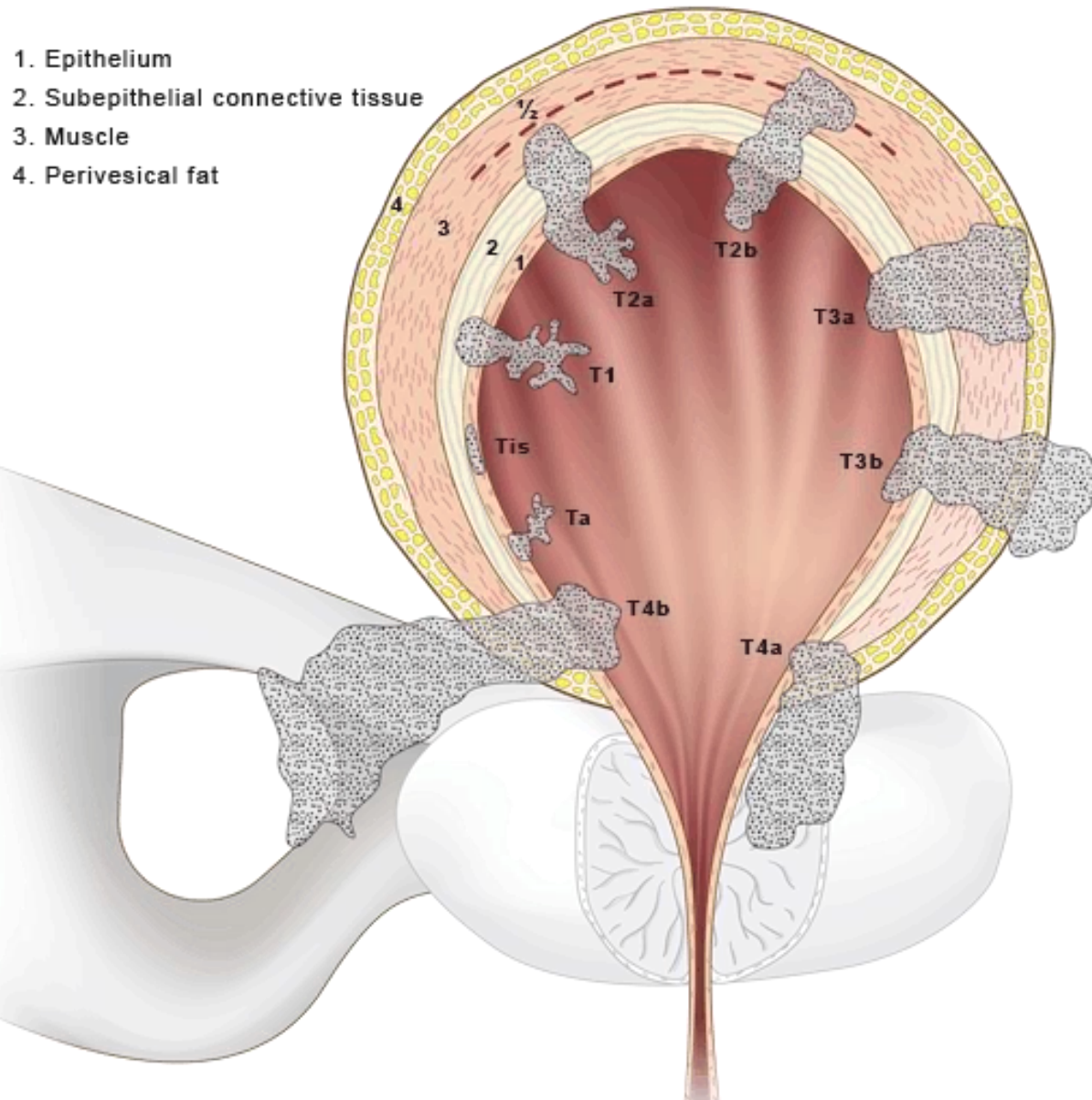
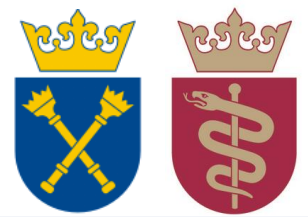
## Locoregional assessment (TN)

- CT
  - Relation to adjacent organs
  - Depth of invasion
- MRI
  - Relation to adjacent organs
  - Depth of invasion
- TURBT
  - Depth of invasion

## Metastasis assessment (M)

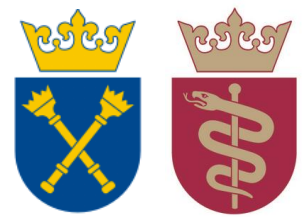
- CT
- MRI (if CT contraindicated)
- PET
  - Limited evidence
  - Limited utility of FDG
  - Choline-based radiotracers

# Bladder cancer – staging



Primary tumor (T)	
<b>TX</b>	Primary tumor cannot be assessed
<b>T0</b>	No evidence of primary tumor
<b>Ta</b>	Noninvasive papillary carcinoma
<b>Tis</b>	Carcinoma in situ: “flat tumor”
<b>T1</b>	Tumor invades lamina propria (subepithelial connective tissue)
<b>T2</b>	Tumor invades muscularis propria
<b>pT2a</b>	Tumor invades superficial muscularis propria (inner half)
<b>pT2b</b>	Tumor invades deep muscularis propria (outer half)
<b>T3</b>	Tumor invades perivesical tissue
<b>pT3a</b>	Microscopically
<b>pT3b</b>	Macroscopically (extravesical mass)
<b>T4</b>	Tumor invades any of the following: prostatic stroma, seminal vesicles, uterus, vagina, pelvic wall, abdominal wall
<b>T4a</b>	Tumor invades prostatic stroma, uterus, vagina
<b>T4b</b>	Tumor invades pelvic wall, abdominal wall

# Bladder cancer – staging



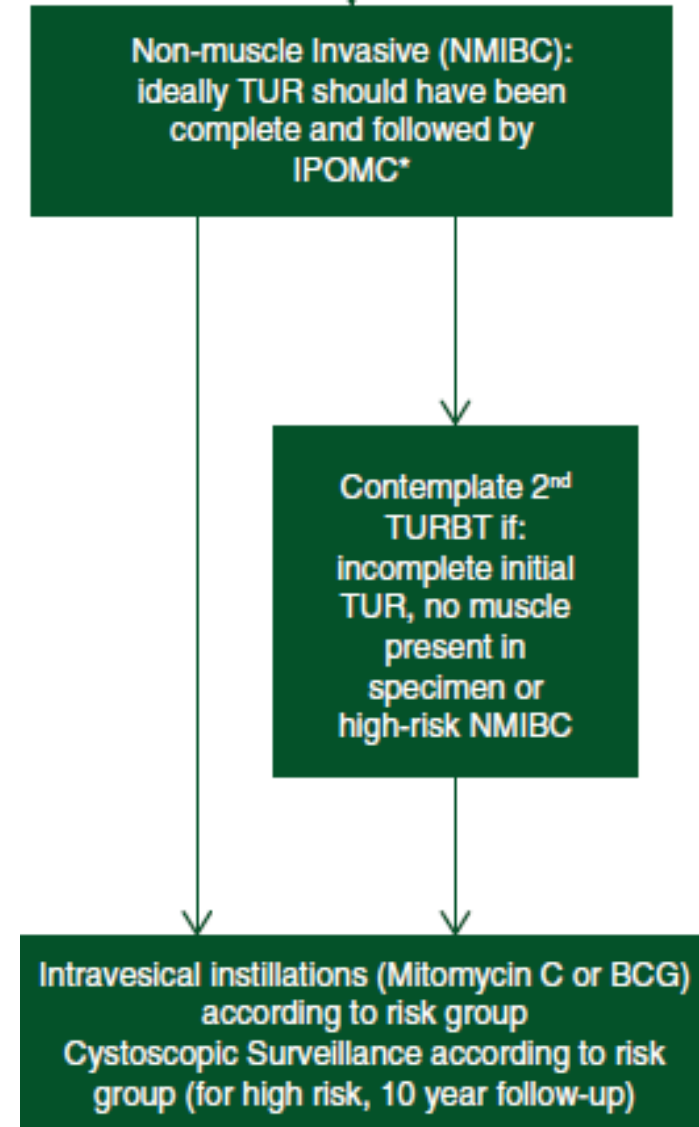
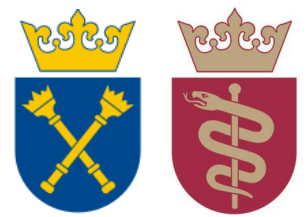
Regional lymph nodes (N)	
Regional lymph nodes include both primary and secondary drainage regions. All other nodes above the aortic bifurcation are considered distant lymph nodes.	
<b>NX</b>	Lymph nodes cannot be assessed
<b>N0</b>	No lymph node metastasis
<b>N1</b>	Single regional lymph node metastasis in the true pelvis (perivesical, obturator, internal and external iliac, or sacral lymph node)
<b>N2</b>	Multiple regional lymph node metastasis in the true pelvis (perivesical, obturator, internal and external iliac, or sacral lymph node metastasis)
<b>N3</b>	Lymph node metastasis to the common iliac lymph nodes
Distant metastasis (M)	
<b>M0</b>	No distant metastasis
<b>M1</b>	Distant metastasis
<b>M1a</b>	Distant metastasis limited to lymph nodes beyond the common iliacs
<b>M1b</b>	Non–lymph node distant metastases

Stage	T	N	M
<b>Stage 0a</b>	Ta	N0	M0
<b>Stage 0is</b>	Tis	N0	M0
<b>Stage I</b>	T1	N0	M0
<b>Stage II</b>	T2a	N0	M0
	T2b	N0	M0
<b>Stage IIIA</b>	T3a	N0	M0
	T3b	N0	M0
	T4a	N0	M0
	T1-T4a	N1	M0
<b>Stage IIIB</b>	T1-T4a	N2,N3	M0
<b>Stage IVA</b>	T4b	Any N	M0
	Any T	Any N	M1a
<b>Stage IVB</b>	Any T	Any N	M1b

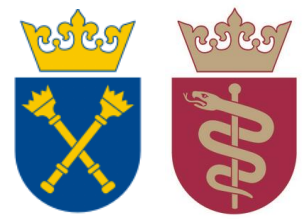
# Bladder cancer

## Treatment for non-muscle invasive disease

- TURBT of all visible lesions
- H-P assessment
  - margins
  - muscular layer invasion
- adjuvant intracystic therapy (directly after resection)
  - cytotoxic (doxorubicin, mitomycin C, bleomycin)
  - immunomodulatory – BCG (preferred in Tis tumours)
  - depending of risk factors as much as 7 doses in 36 months
- Follow-up cystoscopy
  - 1-4 weeks after TURBT)
  - assessment of pos-resection site with biopsy.
- Repeat for recurrent lesions

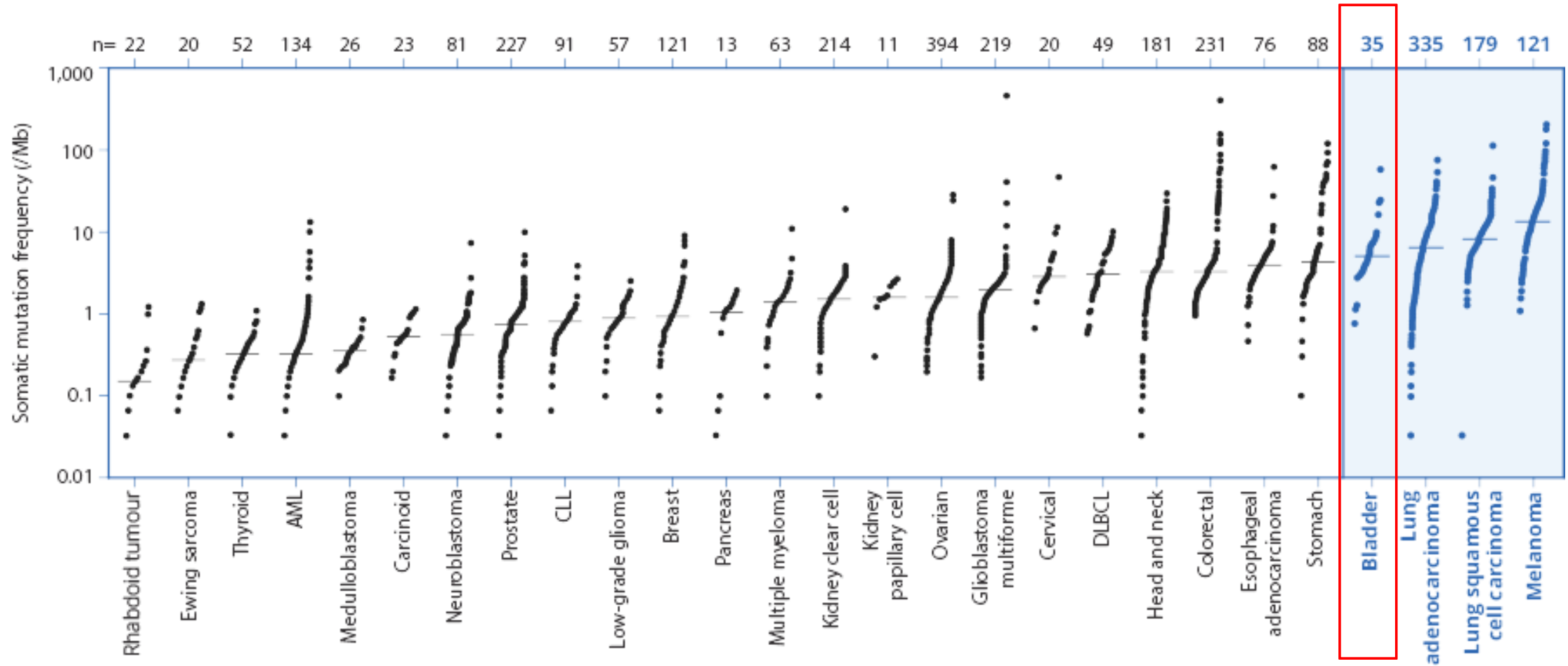


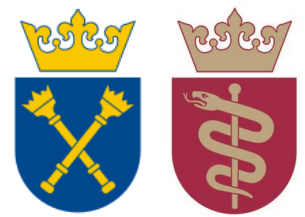




# Bladder cancer - immunotherapy

More mutations  
Fewer mutations

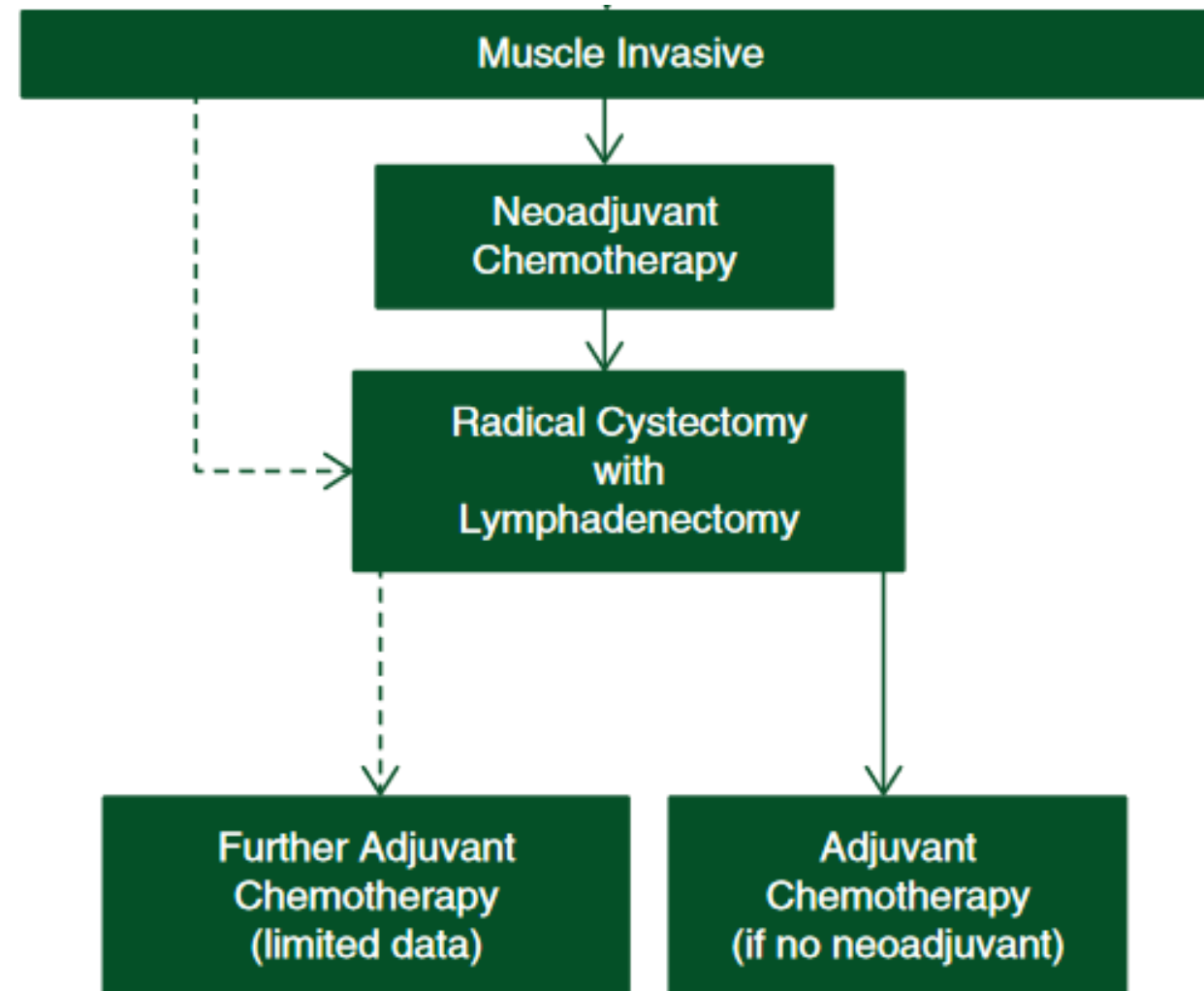




# Bladder cancer

## Treatment for muscle invasive disease

- Neoadjuvant chemo better than adjuvant chemo
- Radical cystectomy + extensive lymphadenectomy
  - long-standing standard (but QoL suboptimal)
  - Salvage radiation possible if R1
  - newer options are available
- Urinary diversion
  - Non-Continent Urinary Diversion
    - Generation of stoma (most common diversion)
    - Patient wears urostomy appliance to collect urine
  - Continent Urinary Diversion
    - Orthotopic ileal neobladder - void per urethra
    - Generation of pouch from intestine to store urine
      - Continence mechanism from “pouch” to skin
      - Patient catheterizes “pouch” throughout the day to empty urine

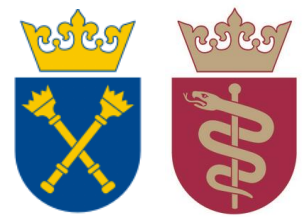




# Bladder cancer

## Treatment for muscle invasive disease

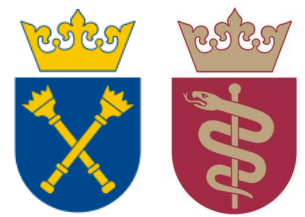
- Bladder sparing treatment protocols
  - Radical radiation alone
    - Long-term outcomes  $\approx$  surgery alone
    - Not all tumors sensitive, not all patients able to complete treatment
    - Salvage surgery impractical (no immediate outcome measure)
  - Radical radio-chemotherapy
    - Long-term outcomes  $\approx$  neoadjuvant chemo + surgery
    - Less immediate failures compared to RT alone but more toxic
    - Salvage surgery impractical (no immediate outcome measure)



# Bladder cancer

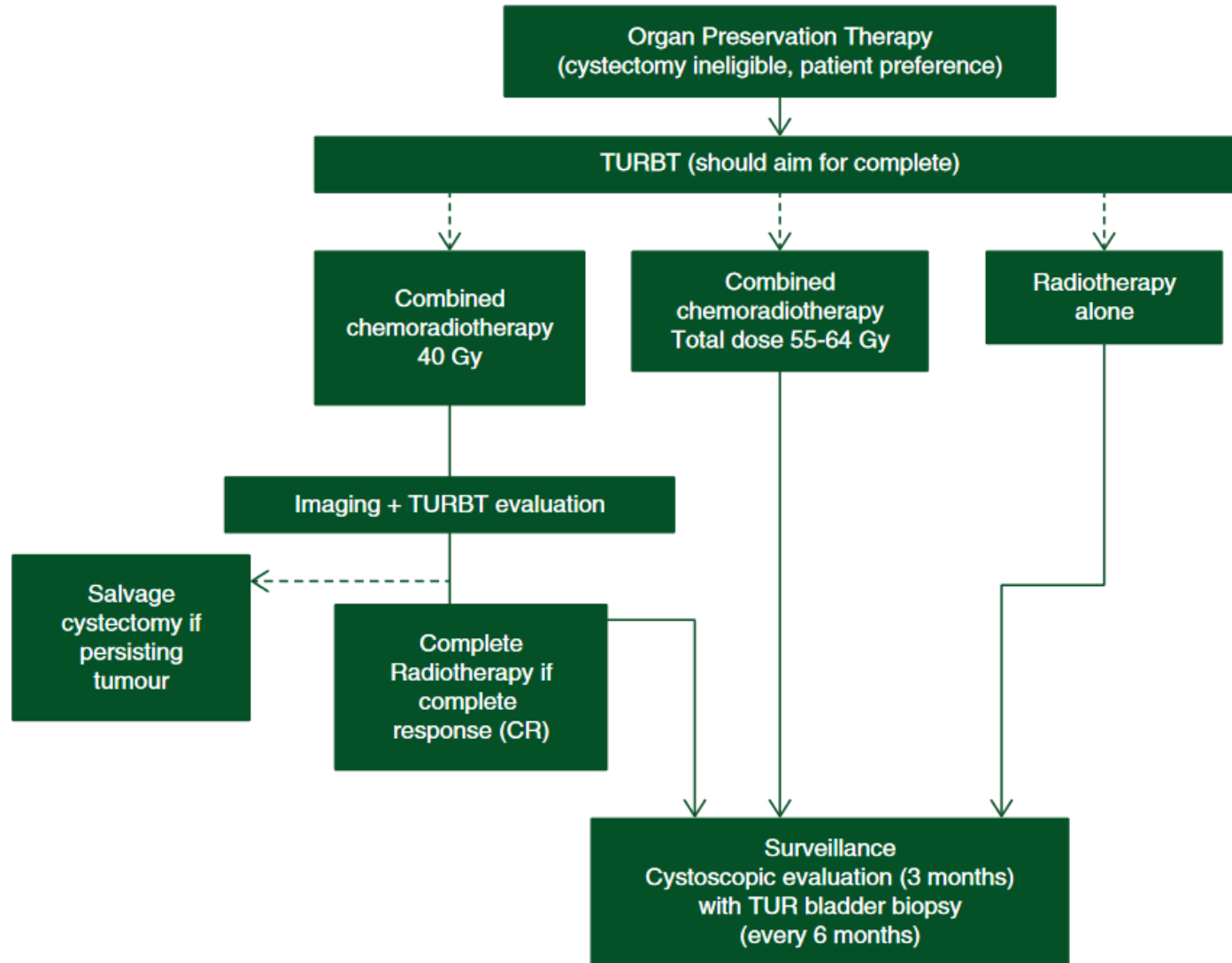
## Treatment for muscle invasive disease

- Bladder sparing treatment protocols
  - Trimodality therapy:
    - Radical TURBT, then
    - Chemoradiotherapy with cisplatin (either concomitant or sequential) to total dose of ~ 66 Gy.
    - early (4 weeks into RT – after 40Gy) response assessment imaging and cystoscopy with biopsy
      - If complete response – continue radiochemotherapy
      - if not complete response – stop radiotherapy and perform cystectomy



# Bladder cancer

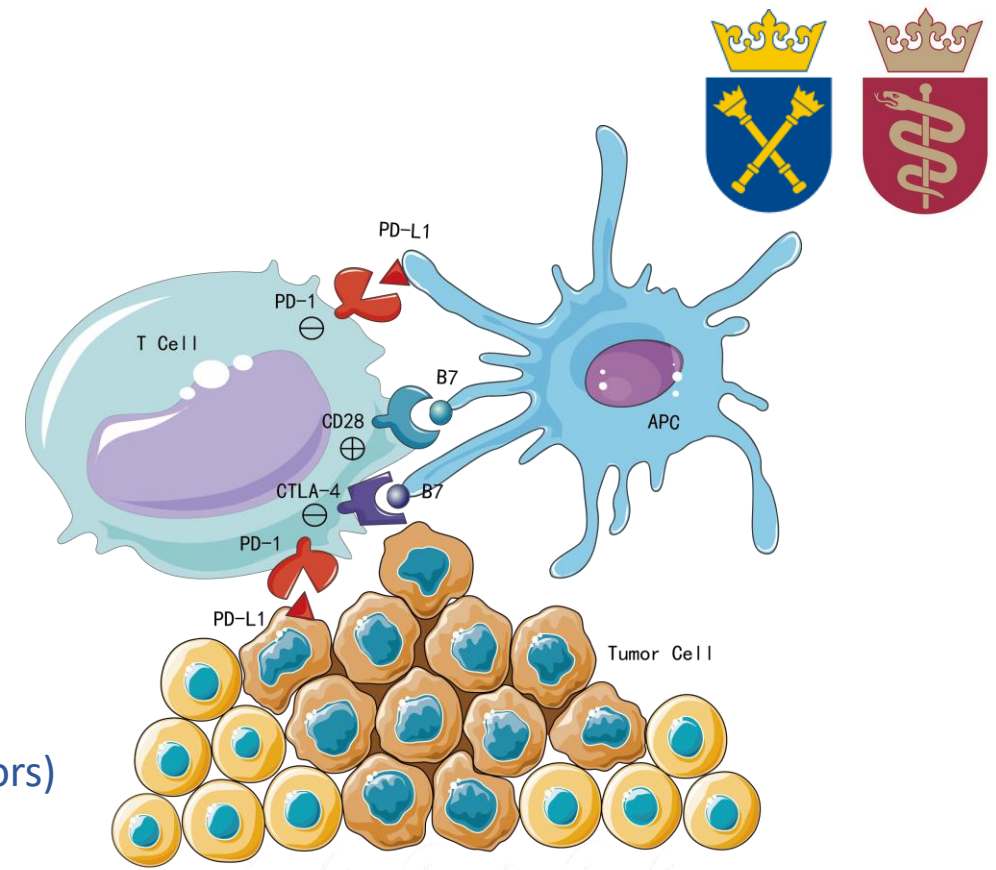
## Treatment for muscle invasive disease



# Bladder cancer

## Metastatic disease

- Re-staging
- Assess feasibility of localized treatment modalities
  - ie. radiotherapy or surgery in isolated nodal recurrence
- Choose systemic treatment
  - Clinical trial
  - Assess predictive biomarkers for immunotherapy (checkpoint inhibitors)
  - assess feasibility of palliative chemotherapy
    - platinum based (most active cytotoxic class)
    - poly vs monotherapy
- remember about supportive care
  - Bisphosphonates
  - Tromboprophylaxis
  - pain management)
- Monitor the response

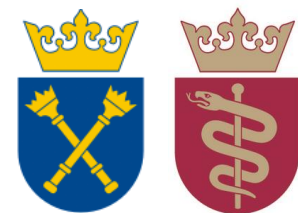


Patients characteristics	Regimen irrespective of PD-L1 status	PD-L1-positive
Creatinine clearance >60 ml/min	Cisplatin-based therapy	
Creatinine clearance <60 ml/min or PS 2 or comorbidity	Gemcitabine/ carboplatin	Atezolizumab Pembrolizumab



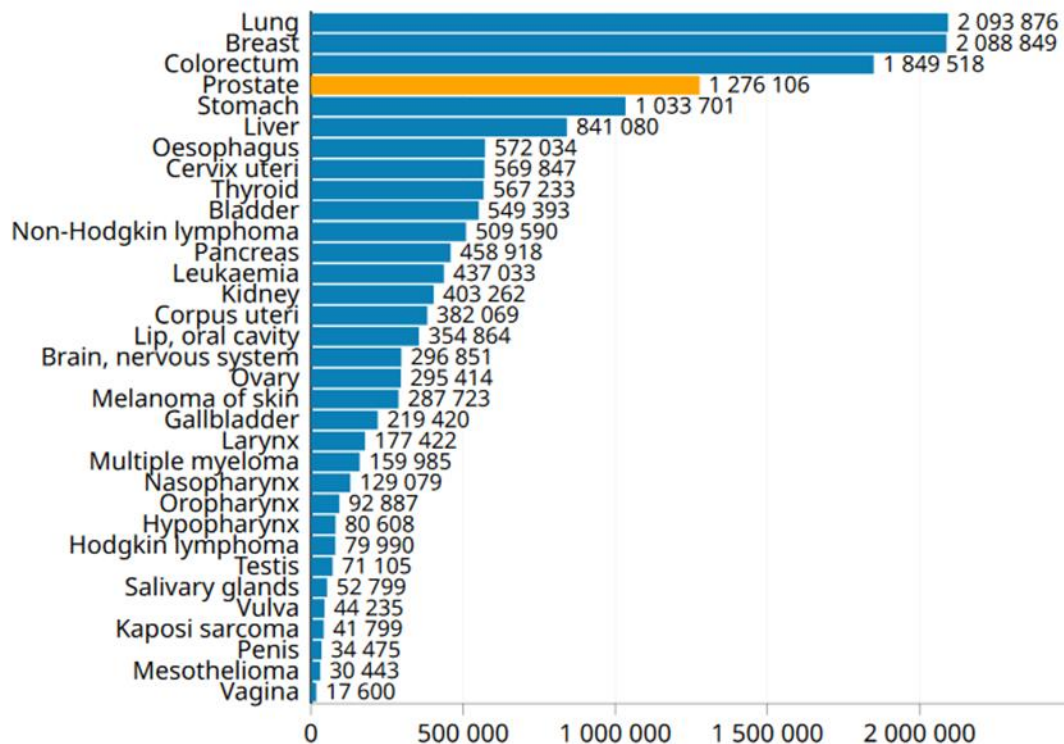
# Prostate cancer



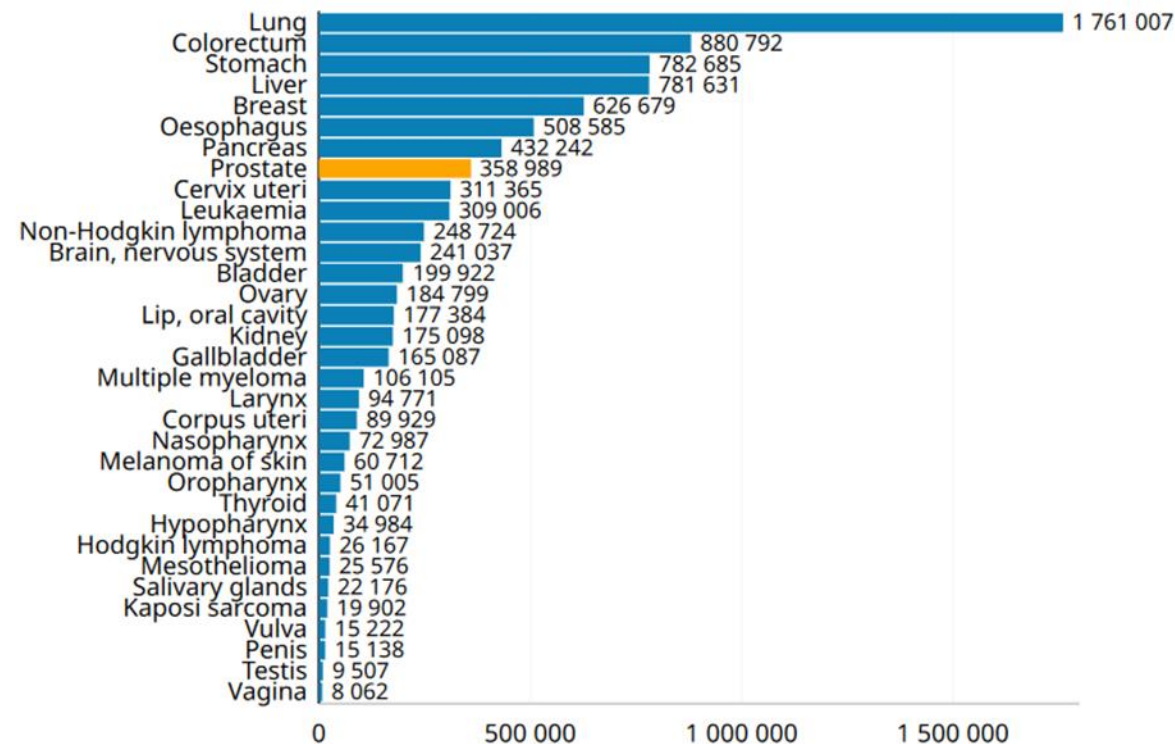


# Prostate cancer - epidemiology

Number of new cases in 2018, both sexes, all ages



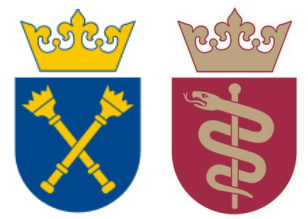
Number of deaths in 2018, both sexes, all ages



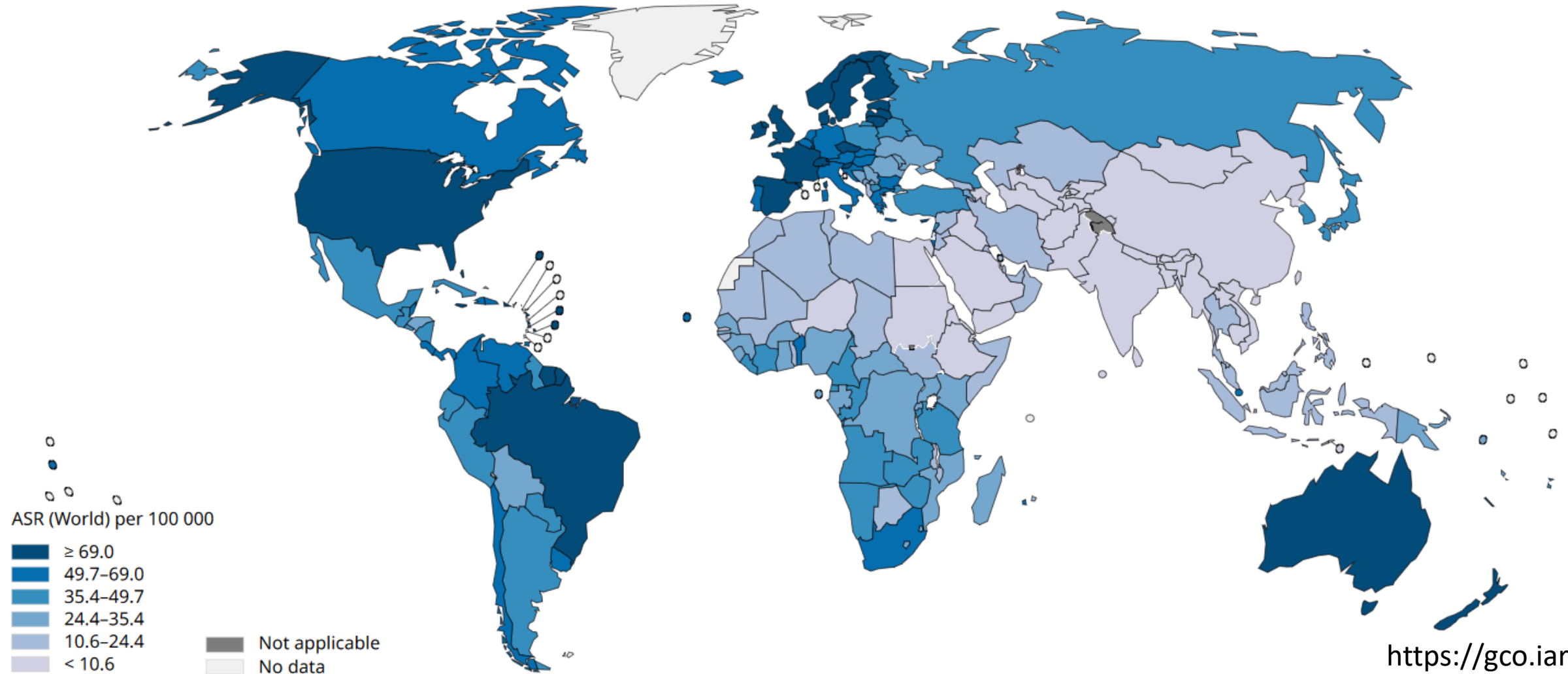


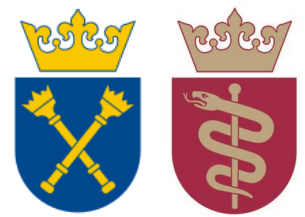
# Prostate cancer

## – incidence rates worldwide



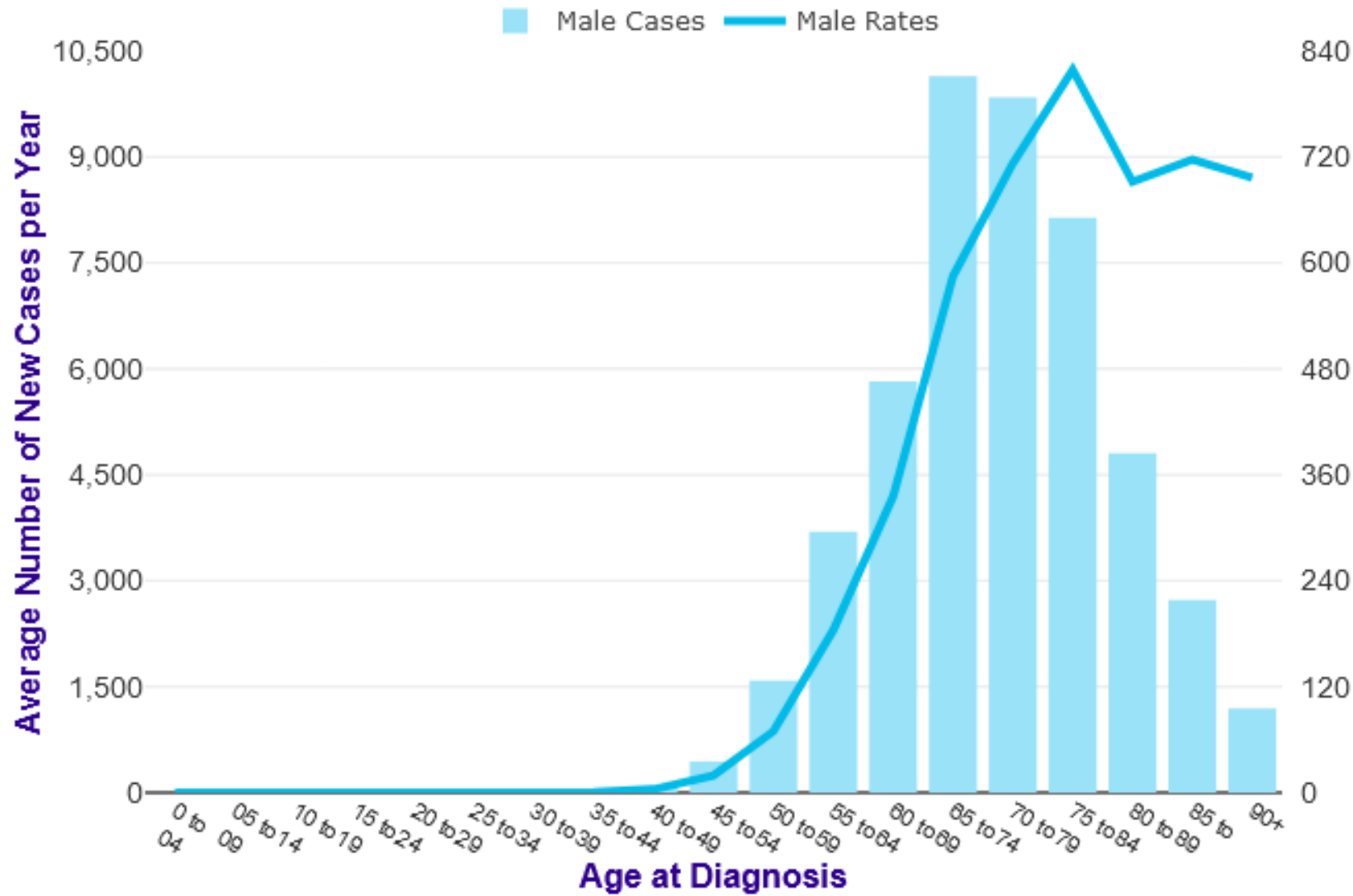
Age standardized (World) incidence rates, prostate, all ages





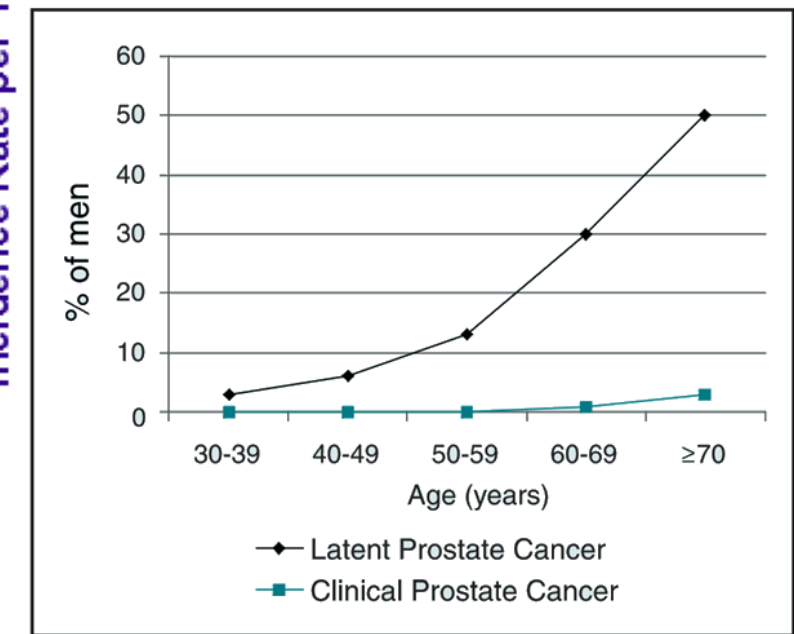
# Prostate cancer

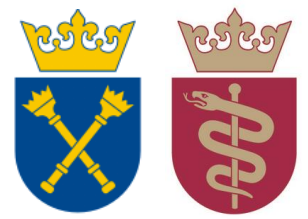
## – incidence by age and gender



age (years)	occult prostate cancer prevalence (%)
20-30	2-8%
31-40	9-31%
41-50	3-43%
51-60	5-46%
61-70	14-70%
71-80	31-83%
81-90	40-73%

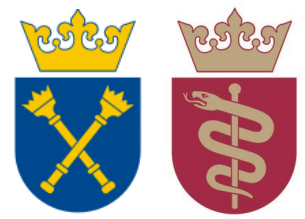
Incidence Rate per 100,000





# Prostate cancer – risk factors

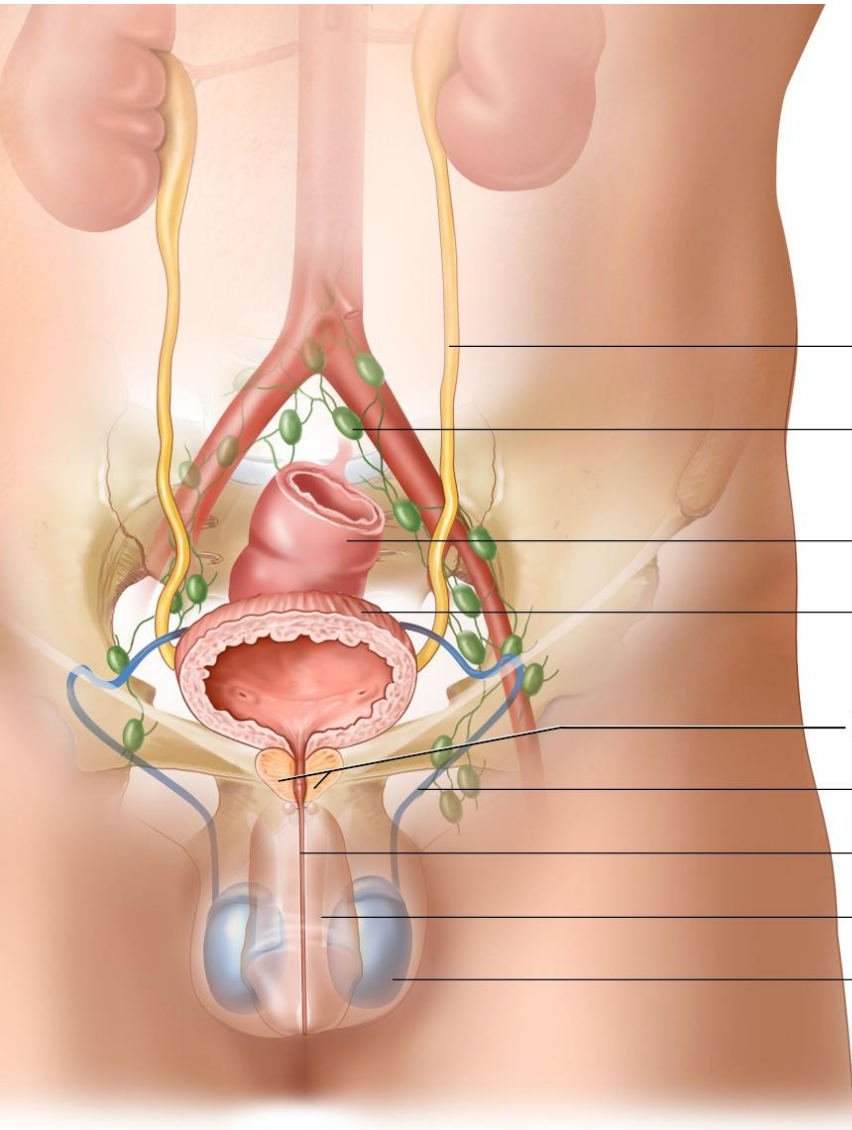
- Ethnicity
  - African – highest risk
  - Asian – lowest risk
- Genetic factors
  - dHRR – estimated
    - ~10% patients are HRR mutant (~2,5 x more common than breast cancer patients)
    - BRCA2 and ATM – most common mutations.
  - dMMR (Lynch Syndrome)
- Metabolic syndrome
  - Obesity
  - Waist/hip ratio
- Environmental carcinogenes
  - Tobacco
  - Zinc
  - SDTs



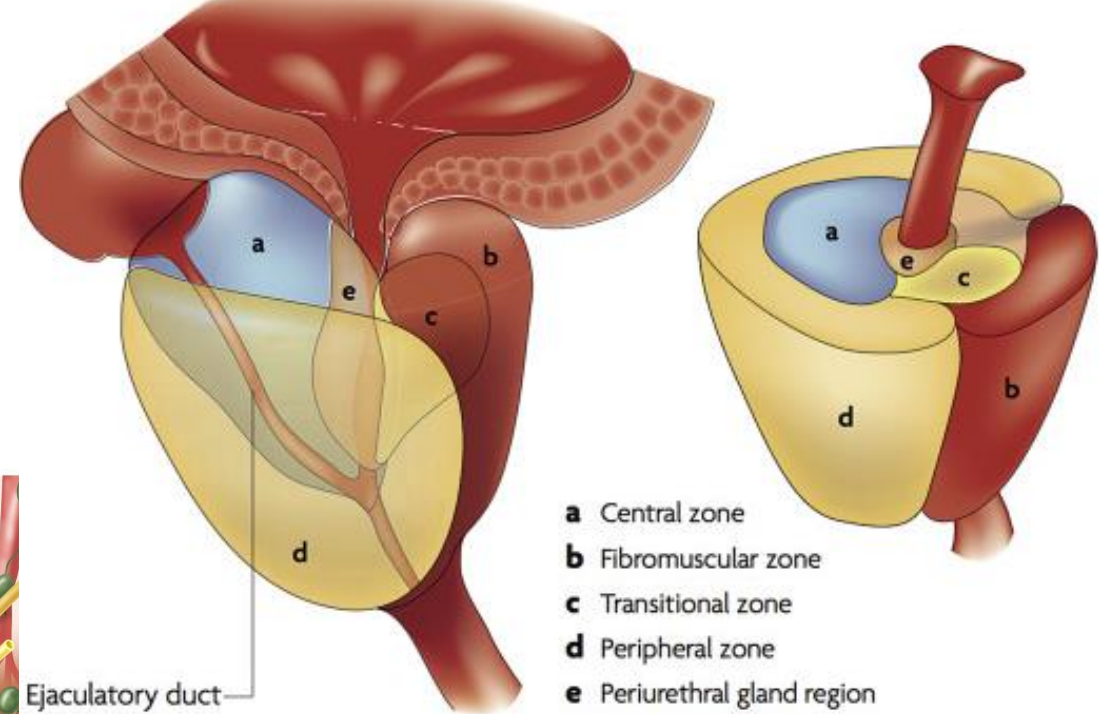
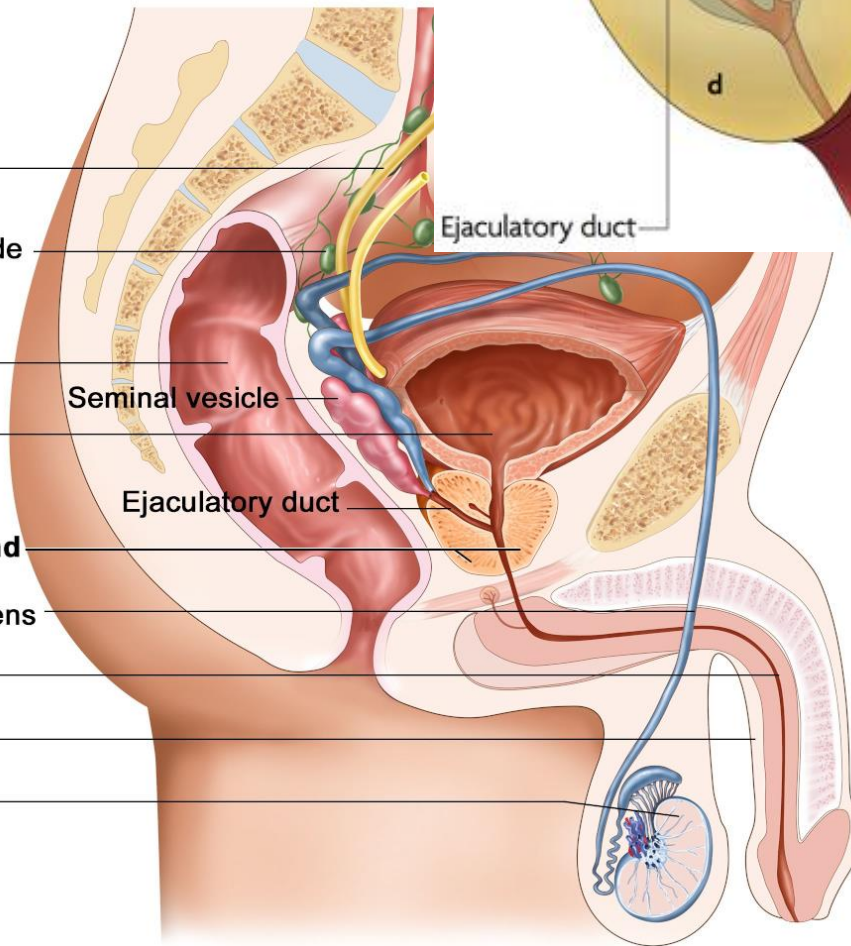
# Prostate cancer – protective factors

- Modest protective effects demonstrated for dietary factors:
  - Coffee
  - Soy
  - Tomatoes
  - Fish oil
- NSAIDs
- Ejaculation frequency
  - > 5x/week is protective
  - Effect especially strong in 20-30 year olds

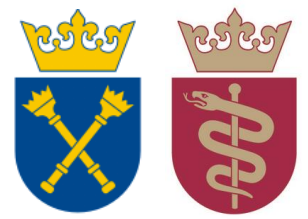
# Prostate cancer – anatomy



- Ureter
- Lymph node
- Rectum
- Bladder
- Prostate gland**
- Vas deferens
- Urethra
- Penis
- Testis



- a** Central zone
- b** Fibromuscular zone
- c** Transitional zone
- d** Peripheral zone
- e** Periurethral gland region



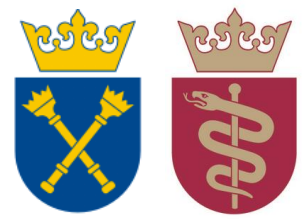
# Prostate cancer – presentation

- Symptoms non-specific, frequently asymptomatic
- Voiding symptoms:
  - Dysuria: urgency, frequency
  - Obstruction: straining, intermittent stream,
- Hematuria/hemospermia
- Pain
  - Perineum or lower abdomen from primary
  - various locations from metastases
- Recurrent urinary tract infections
  
- Screening controversial



# Prostate cancer – screening

- Conflicting results from trials assessing PSA-based screening on mortality
- Even positive trials reported high NNT
  - ~800 screened and ~16 of them treated to prevent one death
- Screening of unselected population controversial
- Screening of patients with dHRR probably more beneficial – trials underway
- Shared decision making is the recommended approach



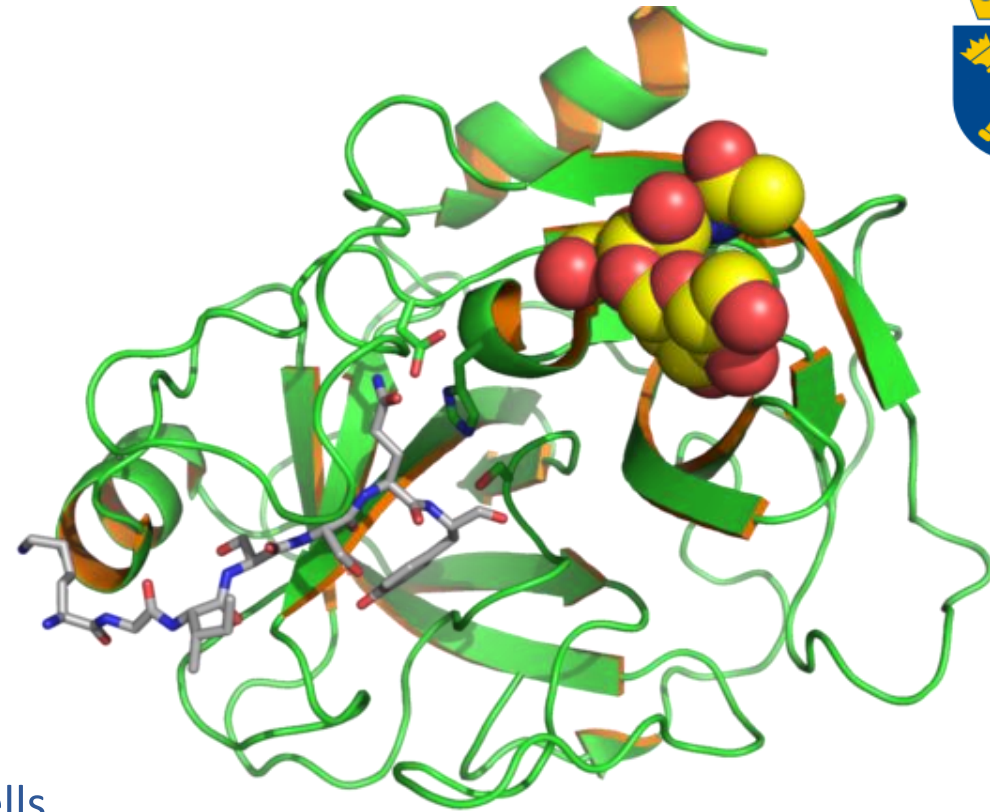
# Prostate cancer – workup

- DRE (digital rectal examination)
  - Explain first! (What? Why? How? Consent)
  - Prepare (gloves, wipes, lube, sink, privacy)
  - Position (on the side, knees close to the chest, asking the patient to bear down will relax the sphincter)
  - Examine
    - Pain
    - Apparent tumor
    - Size, firmness, symmetry
    - Affixation to adjacent structures (especially rectal mucosa)
  - Hygiene (wipe, clean-up, both wash hands)
  - Explain again (findings, significance)

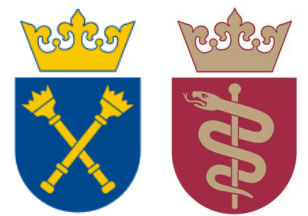


# PSA

- Glycoprotein
  - Member of kalikrein family
  - Gene on chromosome 19
- Produced :
  - Predominantly by prostate and prostate cancer cells  
(any damage to a priorly health prostate will cause PSA increase – main source of false positives)
  - Rarely produced in other tumors relying on androgen-dependent stimulation (ie. apocrine cancer)
  - Trace amounts produced in other tissues  
(ie. ileum, thyroid, salivary glands, lactating breasts)
- Half-life 2-3 days (free PSA ~2h).

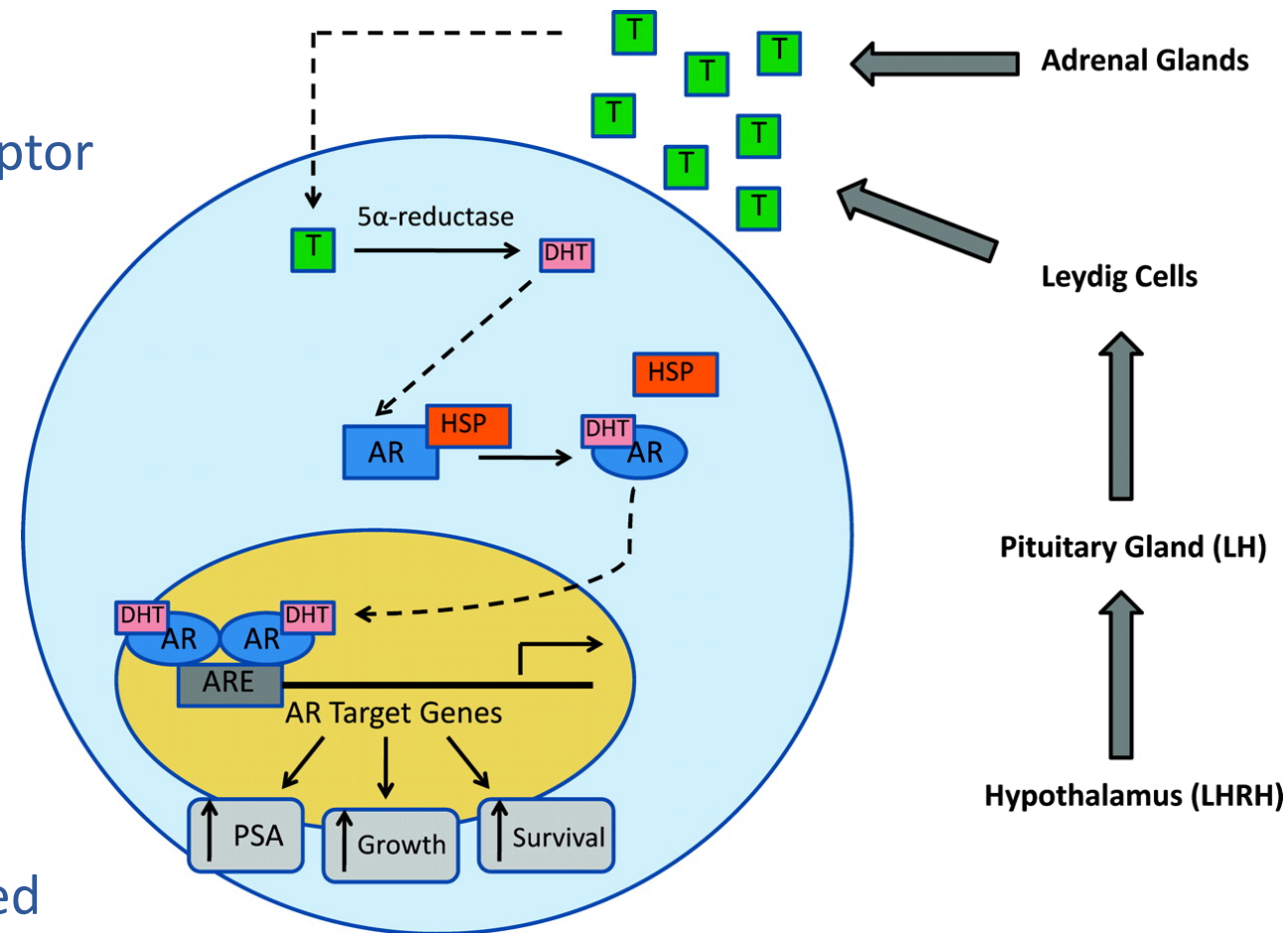


- Olsson, A. Y. *et al. Int. J. Cancer* 113, 290–297 (2005)
- Diamandis, E. P. *et al. Urol. Clin. North Am.* 24, 275–82 (1997)



# PSA

- Expression strongly linked to androgen receptor stimulation (puberty biomaker)
- PSA level depends on:
  - Quantity of producing cells
  - possible gene amplification
  - Androgen receptor stimulation level,
- PSA measuring test still not fully standardized (a good practice is keeping to one laboratory)

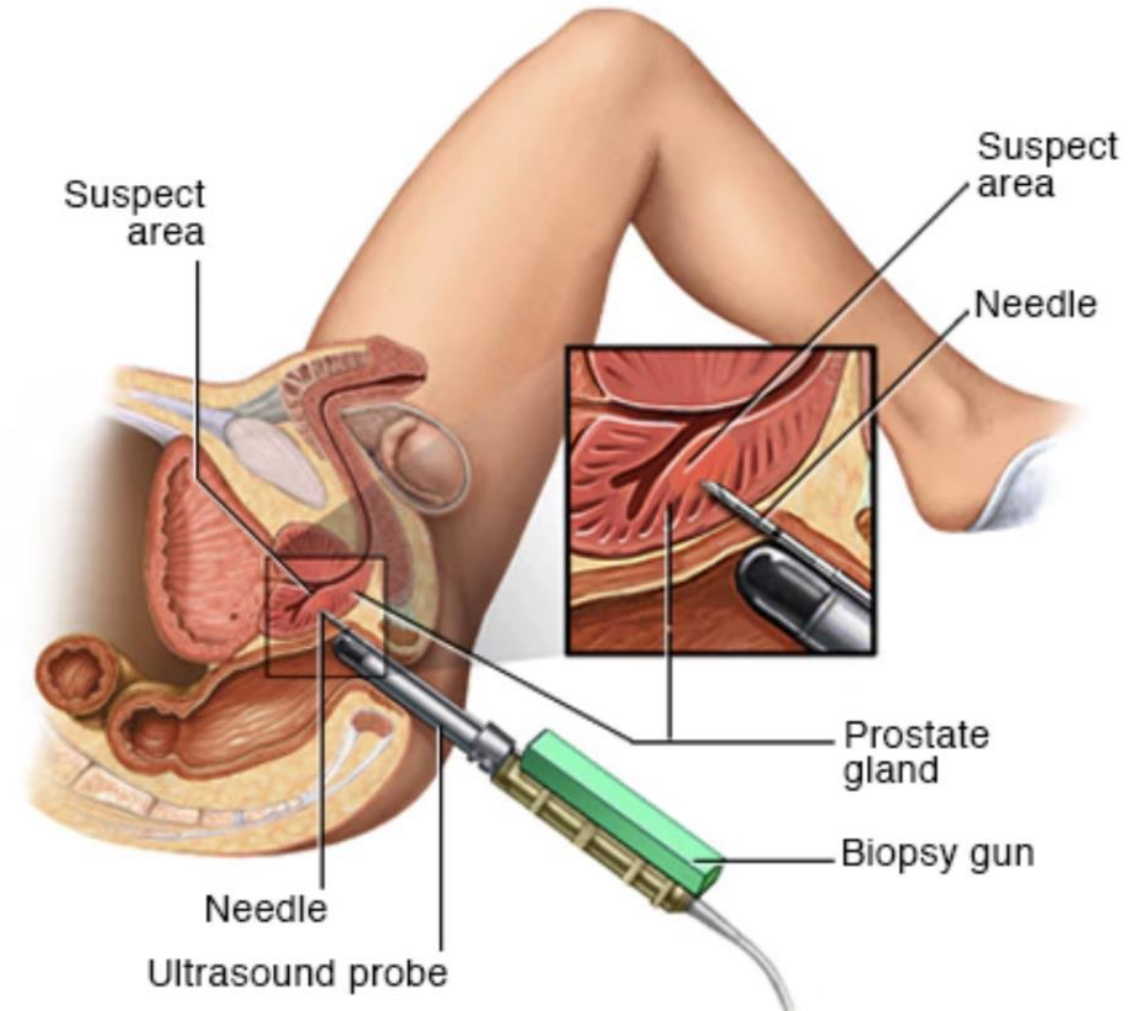


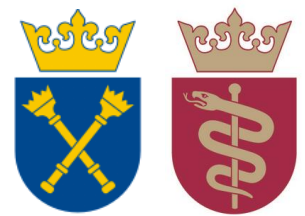
- Saraon, P. et al. *Clin. Chem.* 57, 1366–1375 (2011)
- Brzeziński A et al. *Raport COBJDL 2007*

# Prostate cancer – workup

## Histopathologic verification

- Mapping biopsy
  - At least 6 cores per lobe
  - Good representation of whole prostate
- Targeted biopsy (Fusion biopsy)
  - Several cores from the tumor (as seen on MRI but biopsy performer under ultrasound hence software image Fusion needed)
- Formal biopsy
  - Metastatic patient with significantly increased PSA – to confirm histology
- TURP - trans-urethral resection of prostate
  - Mainly to alleviate obstruction but can also provide histology





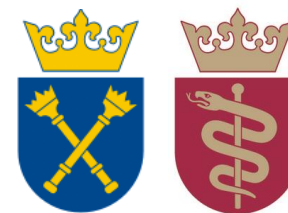
# Prostate cancer – staging

## Locoregional assessment (TN)

- MRI
  - Best way to localize the primary
  - Best way to assess resectability
  - Pinpointing the local recurrence
- CT
  - Relation to adjacent organs if MRI not available
- PET
  - PSMA – radiotracer as specific as PSA
  - Choline or acetate based tracers if PSMA not available
  - FDG is of limited use
  - PET especially useful for pinpointing the local recurrence

## Metastasis assessment (M)

- CT (chest, abdomen, pelvis)
- MRI
  - if CT contraindicated
  - or to assess the skeleton
- Bone scan (Tc)
- PET
  - PSMA
  - Choline or acetate based tracers if PSMA not available



# Prostate cancer – staging

T category T criteria		N category	N criteria	
TX	Primary tumor cannot be assessed	NX	Regional nodes were not assessed	
T0	No evidence of primary tumor	N0	No positive regional nodes	
T1	Clinically inapparent tumor that is not palpable	N1	Metastases in regional node(s)	
T1a	Tumor incidental histologic finding in 5% or less of tissue resected	<b>M category M criteria</b>		
T1b	Tumor incidental histologic finding in more than 5% of tissue resected	M0	No distant metastasis	
T1c	Tumor identified by needle biopsy found in one or both sides, but not palpable	M1	Distant metastasis	
T2	Tumor is palpable and confined within prostate	M1a	Nonregional lymph node(s)	
T2a	Tumor involves one-half of one side or less	M1b	Bone(s)	
T2b	Tumor involves more than one-half of one side but not both sides	M1c	Other site(s) with or without bone disease	
T2c	Tumor involves both sides	NOTE: When more than one site of metastasis is present, the most advanced category is used. M1c is most advanced.		
T3	Extraprostatic tumor that is not fixed or does not invade adjacent structures	<b>Grade Group</b>	<b>Gleason score</b>	<b>Gleason pattern</b>
T3a	Extraprostatic extension (unilateral or bilateral)	1	≤6	≤3+3
T3b	Tumor invades seminal vesicle(s)	2	7	3+4
T4	Tumor is fixed or invades adjacent structures other than seminal vesicles such as external sphincter, rectum, bladder, levator muscles, and/or pelvic wall	3	7	4+3
		4	8	4+4, 3+5, or 5+3
		5	9 or 10	4+5, 5+4, or 5+5



# Prostate cancer – staging

Prostate cancer TNM prognostic stage groups AJCC UICC 8th edition

When T is...	And N is...	And M is...	And PSA is...	And Grade Group is...	Then the stage group is...	
cT1a-c, cT2a	N0	M0	<10	1	I Low risk	
pT2	N0	M0	<10	1		
cT1a-c, cT2a, pT2	N0	M0	≥10 <20	1	IIA Interm. risk	
cT2b-c	N0	M0	<20	1		
T1-2	N0	M0	<20	2		
T1-2	N0	M0	<20	3		
T1-2	N0	M0	<20	4	IIC	
T1-2	N0	M0	≥20	1-4	IIIA	IIIB High risk
T3-4	N0	M0	Any	1-4	IIIB	
Any T	N0	M0	Any	5	IIIC	
Any T	N1	M0	Any	Any	IVA	IVB
Any T	Any N	M1	Any	Any	IVB	



# Prostate cancer

## Treatment for localized disease

### ■ Low risk options

- Watchful waiting
  - only PSA testing
  - decision on androgen deprivation (ADT) on significant progression
- Active surveillance
  - PSA and imaging, possibly re-biopsy
  - definite therapy on risk increase)
- Radical prostatectomy
- Radical radiation (tele or brachy)

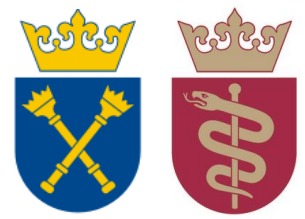
### ■ Intermediate risk options:

### ■ Intermediate risk options

- Active surveillance
  - PSA and imaging, possibly re-biopsy
  - definite therapy on risk increase)
- Radical prostatectomy ± adjuvant radiation
- Radical radiation ± neoadjuvant ADT

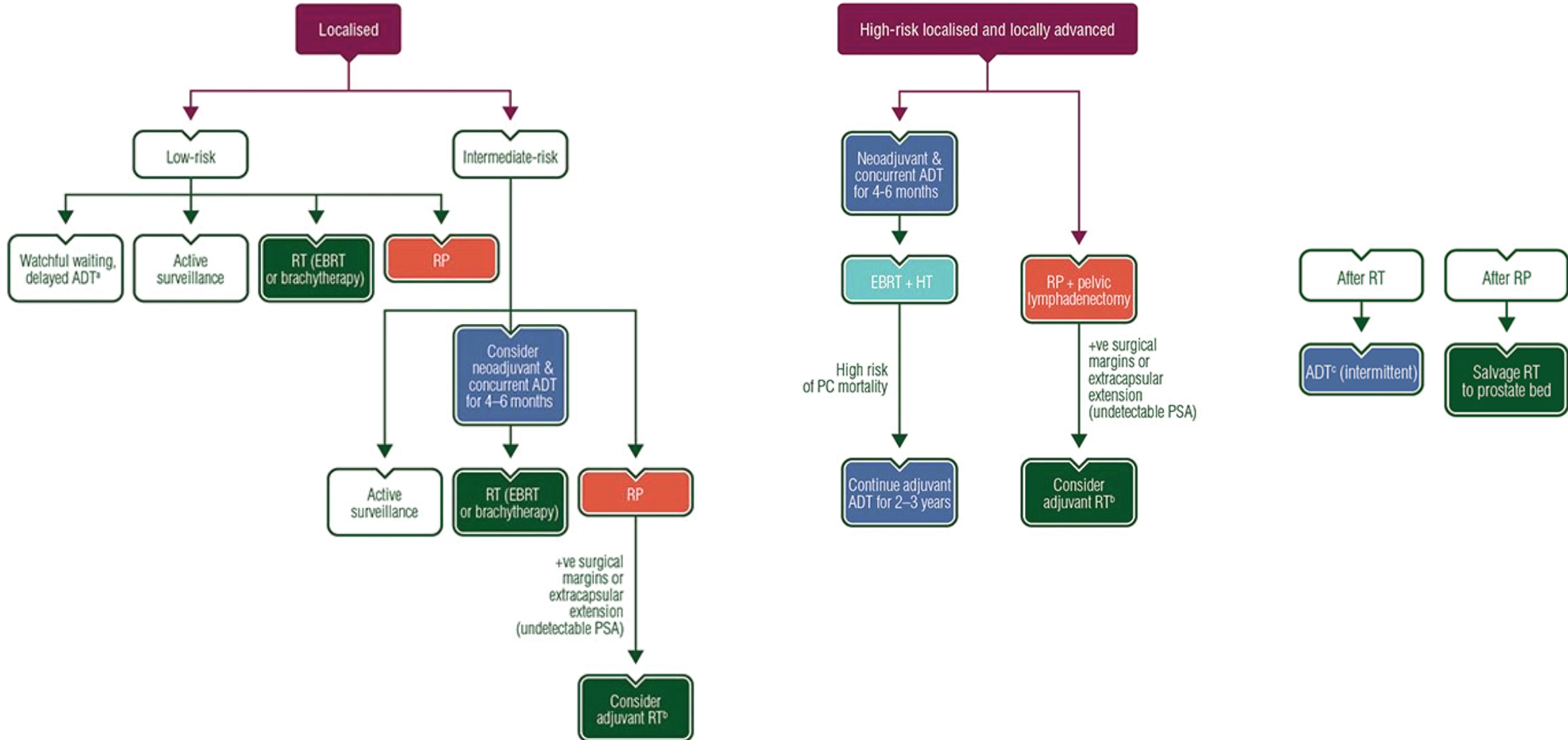
### ■ High risk options

- Radical prostatectomy with lymphadenectomy ± adjuvant radiation
- Neoadjuvant ADT -> radical radiation -> ADT



# Prostate cancer

## Treatment for localized disease





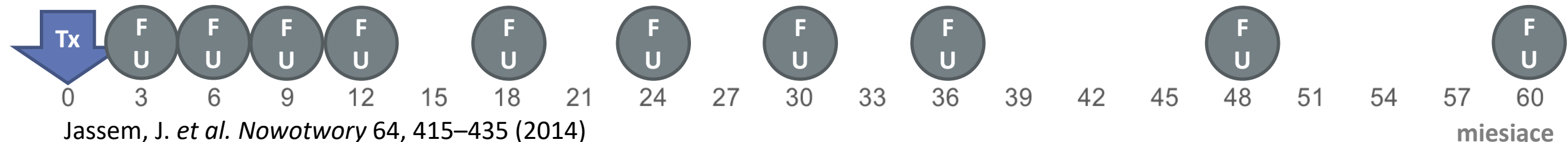


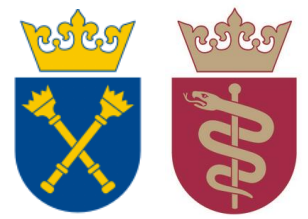
# Prostate cancer

## Surveillance post radical treatment

- Routine assessments
  - PSA
  - Anamnesis + physical
  - (DRE) – not necessarily required if no PSA increase
- Surveillance length controversial (forever?)
  
- Polish surveillance protocol

Period	Frequency
Pierwszy rok obserwacji	Co 3 miesiące
Kolejne 2 lata obserwacji	Co 6 miesięcy
Kolejne lata obserwacji	Co 12 miesięcy





# Prostate cancer

## Treatment for recurrent disease

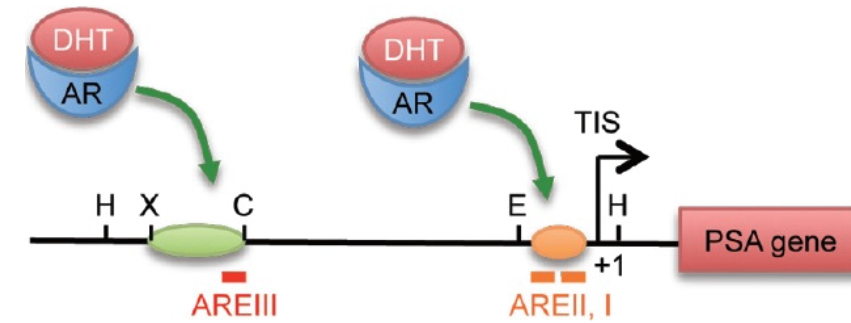
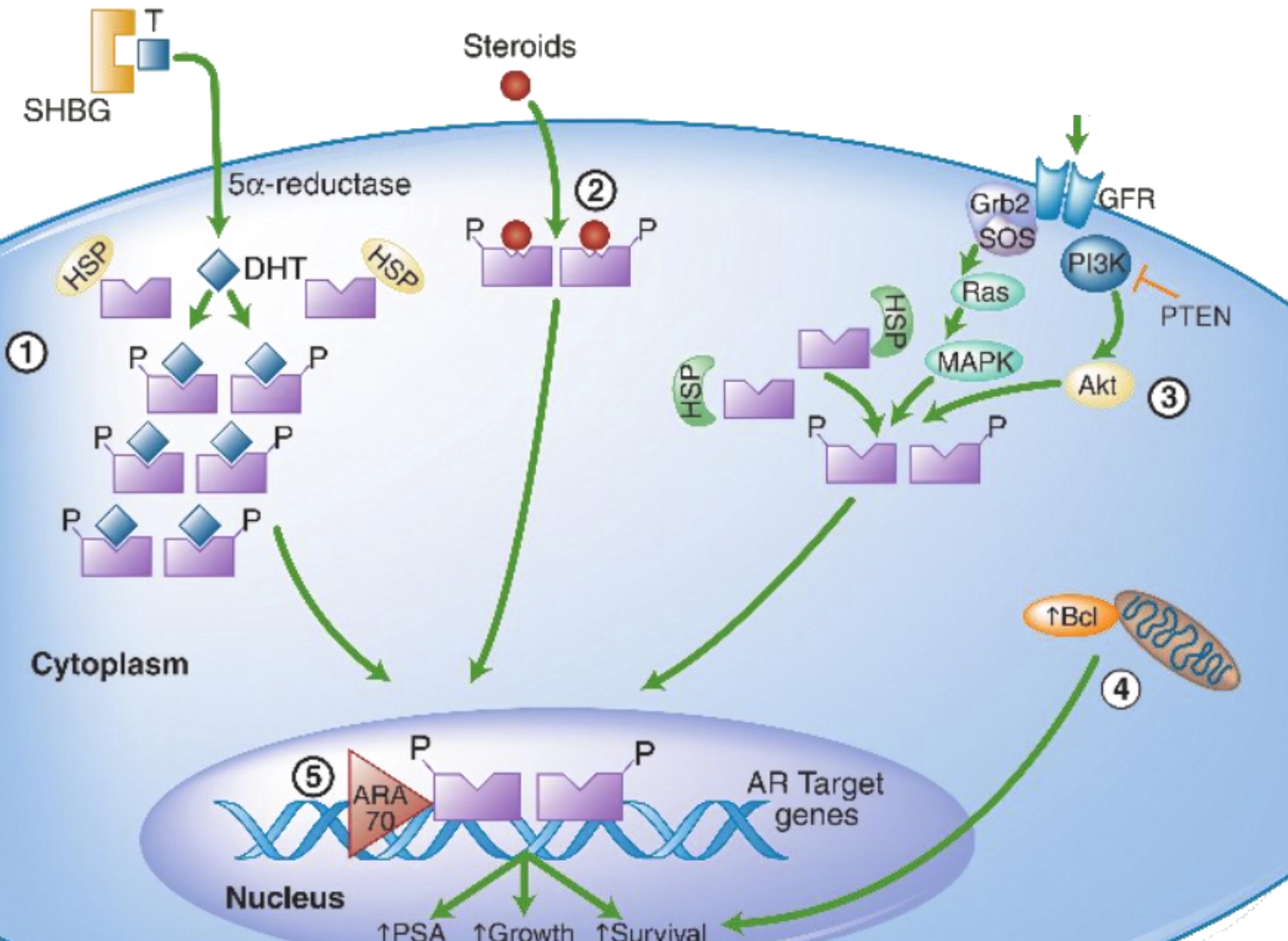
### ■ Assess the feasibility of definite treatment

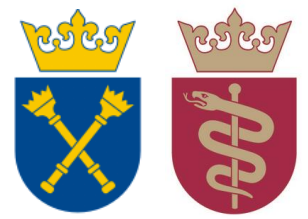
- Localized recurrence
  - RT if prostatectomy before and vice versa
  - HIFU, brachy, needle ablations
- Oligomeastatic disease
  - Localized treatment associated with improved survival
  - Resection for isolated nodal recurrence
  - SBRT for isolated bone lesion

### ■ Choose systemic treatment if definite not possible

- ADT – androgen deprivation therapy
- Chemotherapy
  - Docetaxel
  - Cabazitaxel
- New generation antiandrogens
  - Androgen synthesis inhibitors – abiraterone
  - Pleiotropic receptor inhibitors – enzalutamide, apalutamide, darolutamide.
- Radiopharmaceuticals
  - Radium-223.
- PARP inhibitors
  - Olaparib, rucaparib

# Prostate cancer is androgen-dependent





# Prostate cancer

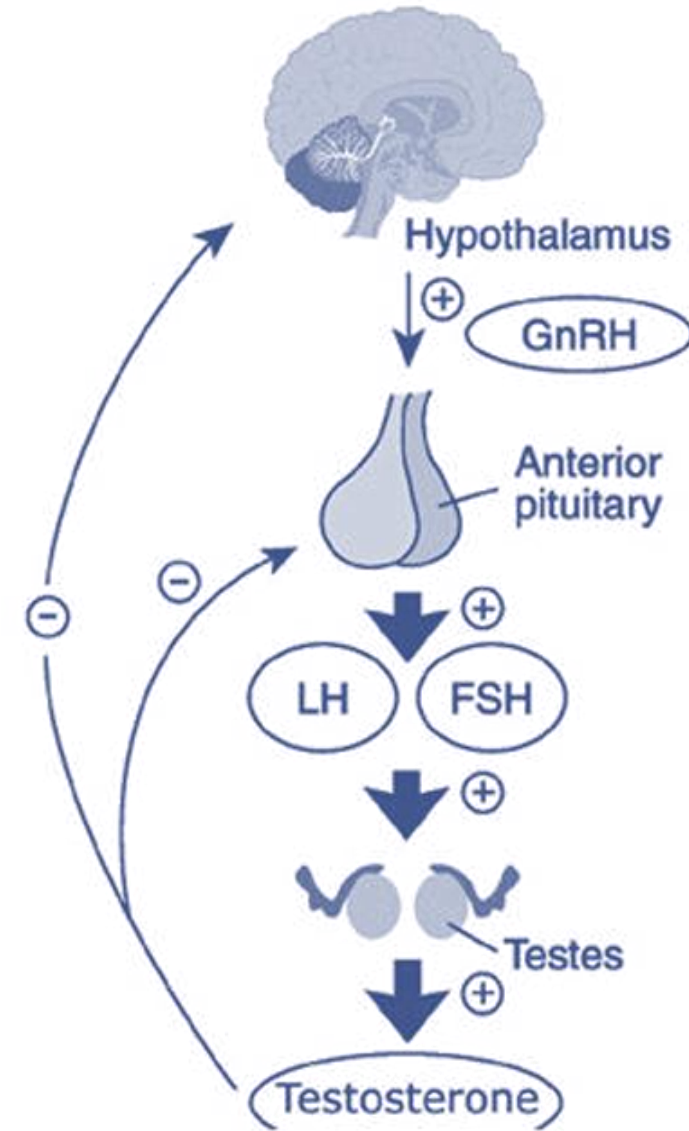
## Androgen deprivation therapy

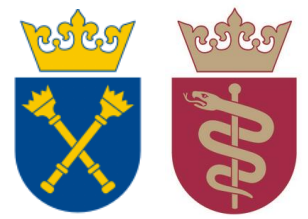
### ▪ Choice of ADT method:

- GnRH agonists (goserelin, triptorelin, leuprorelin)
- GnRH antagonists (degarelix)
- orchiectomy

### ▪ All options similarly active but:

- Orchiectomy or agonist preferred when:
  - Complete or imminent malignant spinal cord compression
  - Possibly (low quality data) for patients with „shallow” castration (testosterone level 20-50ng/ml)
- Orchiectomy most cost efficient but rarely utilized (psychological reasons)





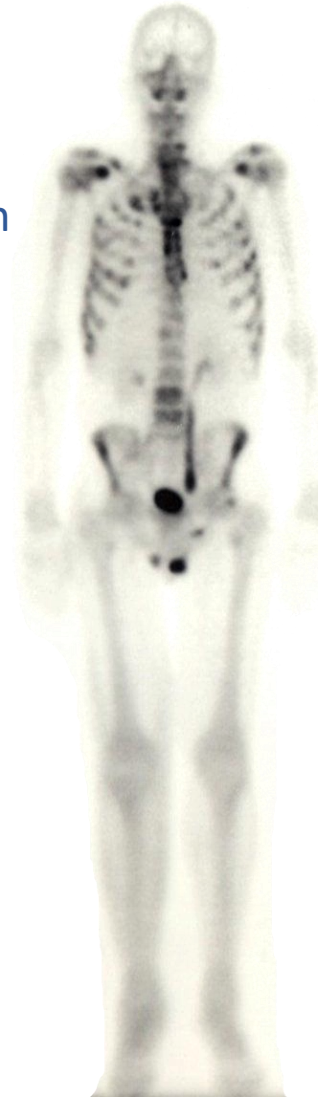
# Prostate cancer castration sensitive vs castration resistant

## ■ Castration sensitive

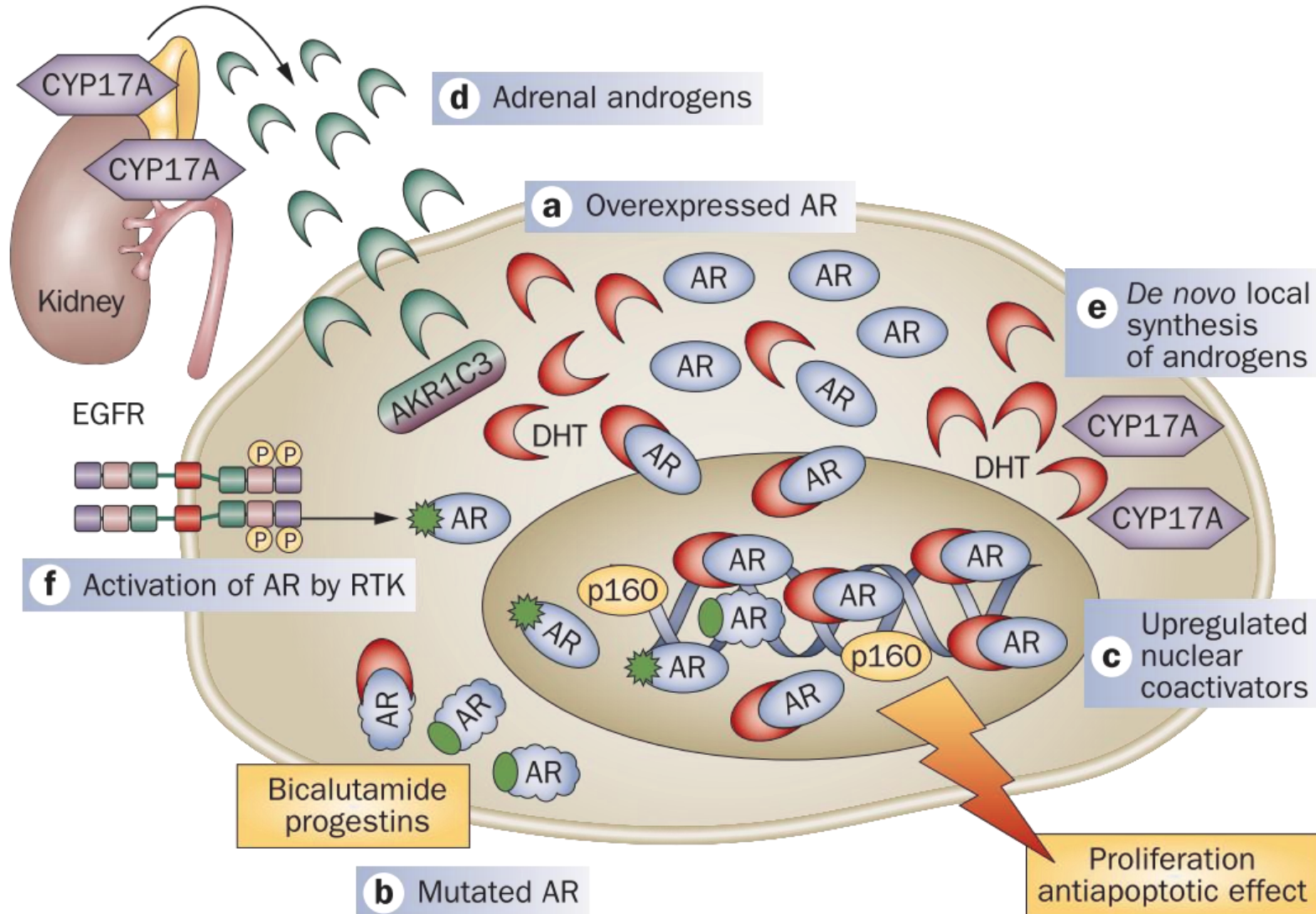
- Recurrence or progression,
- while the patient is NOT subjected to androgen deprivation therapy
- Testosterone level > 50ng/ml (1,7 nmol/l)
- Earlier adjuvant or neoadjuvant ADT permitted if subsequent castration reversal documented

## ■ Castration sensitive

- Recurrence or progression
- While the patient IS subjected to androgen deprivation therapy
- Testosterone level < 50ng/ml (1,7 nmol/l)
- Criteria for significant progression have to be met



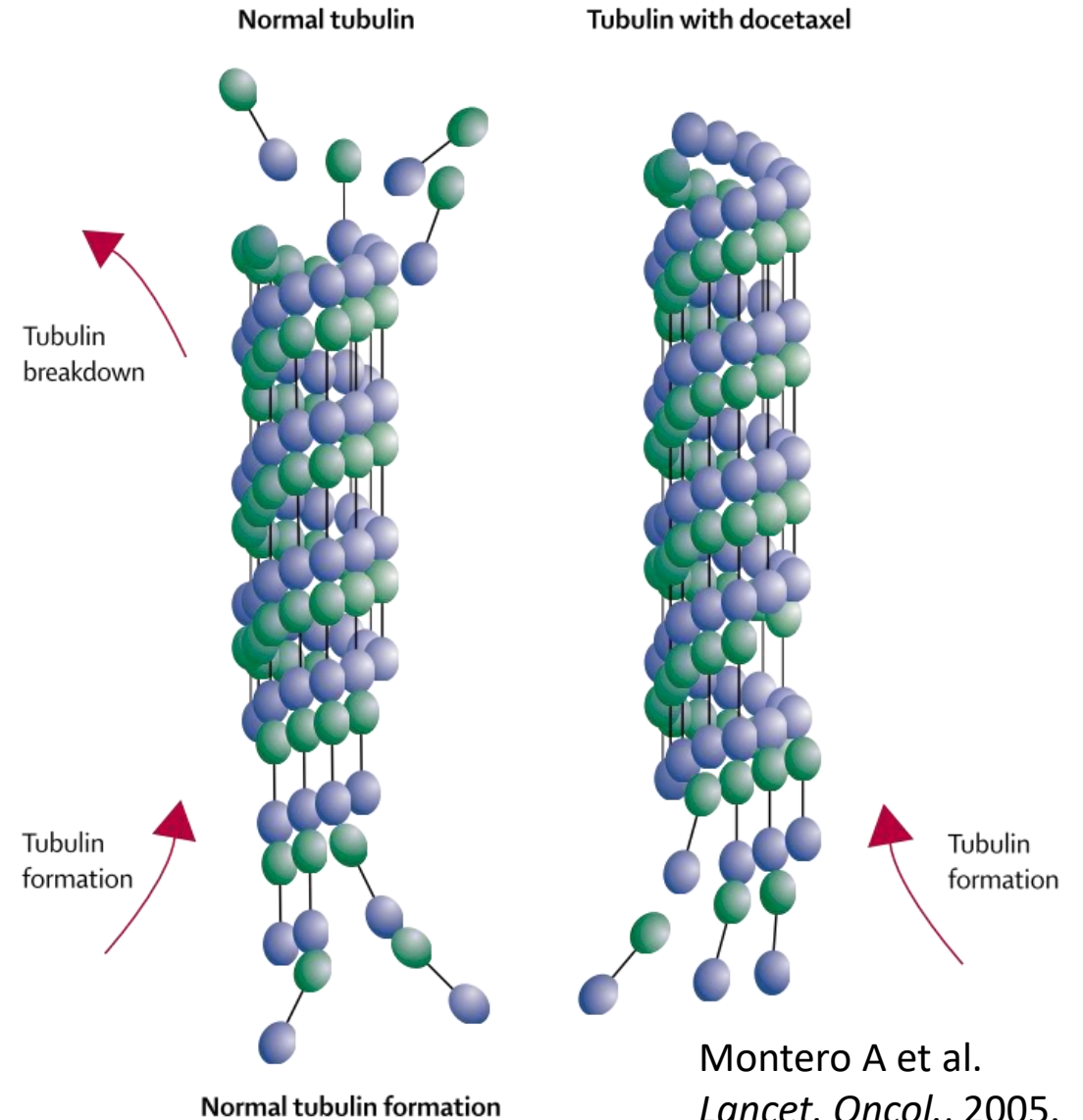
# Prostate cancer castration-resistance mechanisms



# Prostate cancer

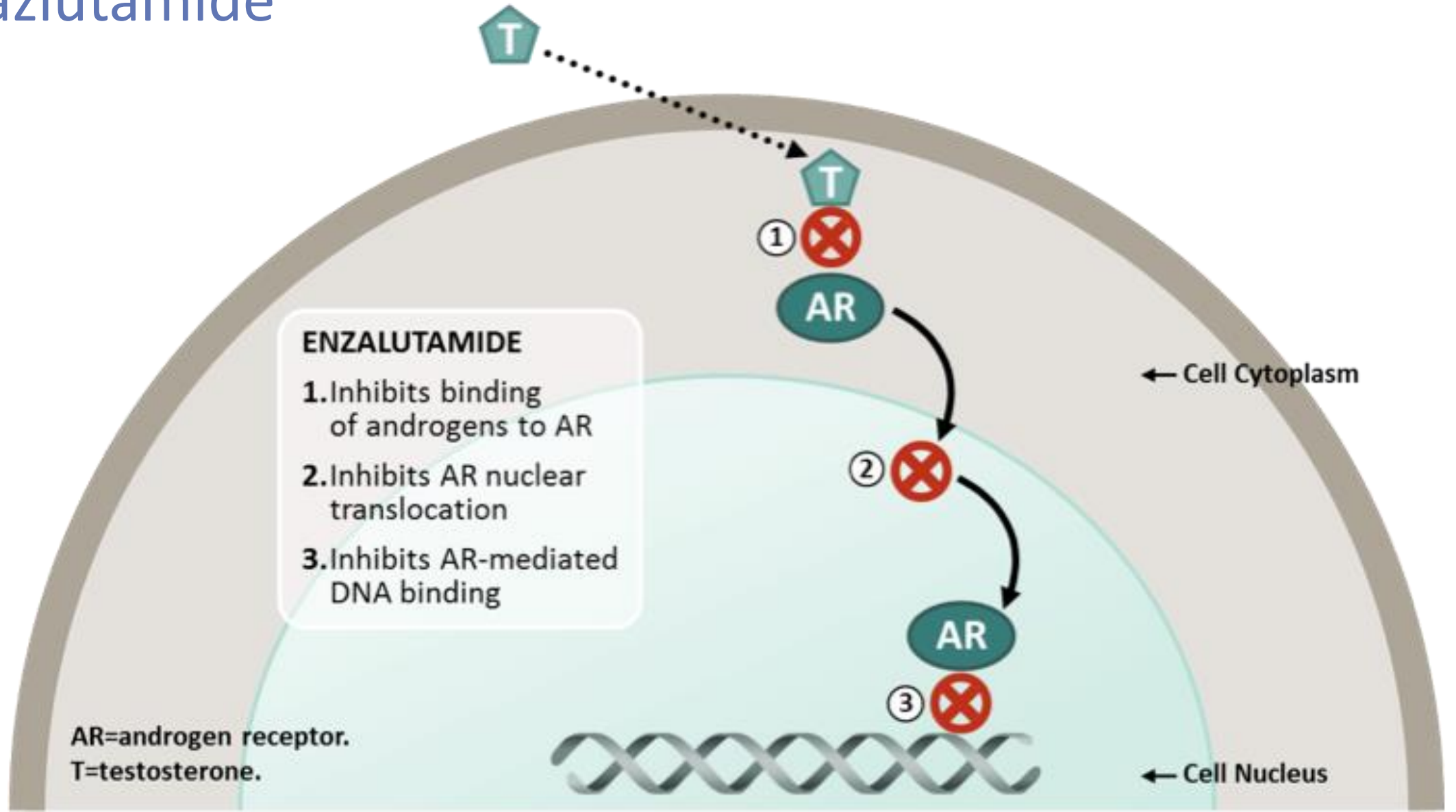
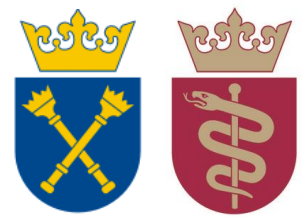
## Docetaxel

- Disorganises microtubules
- G2/M arrest (mitotic spindle damage)
- Cytoskeleton damage
  - Endothelial toxicity
  - Intracellular transport disorganisation
  - Inhibition of androgen receptor translocation



# Prostate cancer

## Enzalutamide

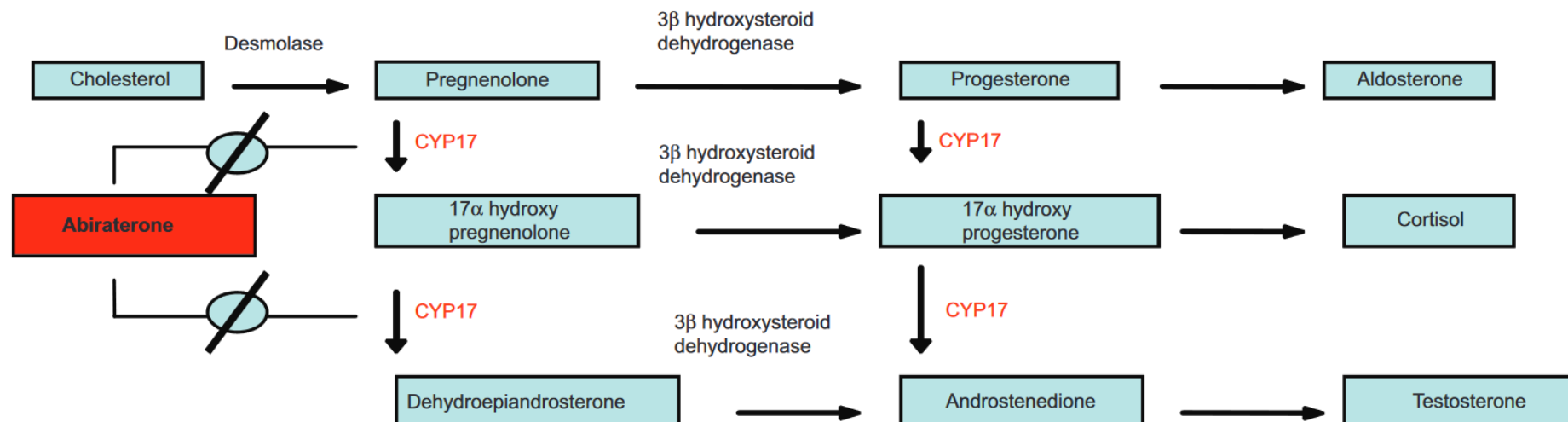
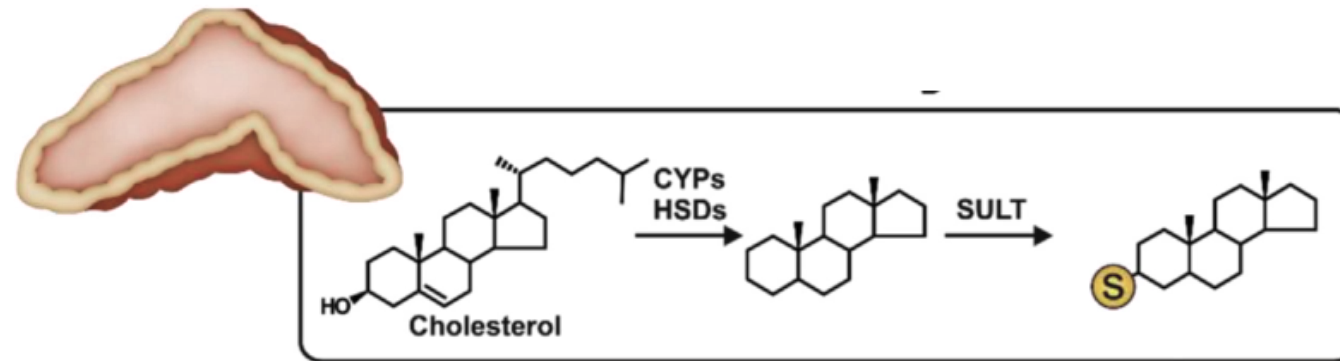




# Prostate cancer

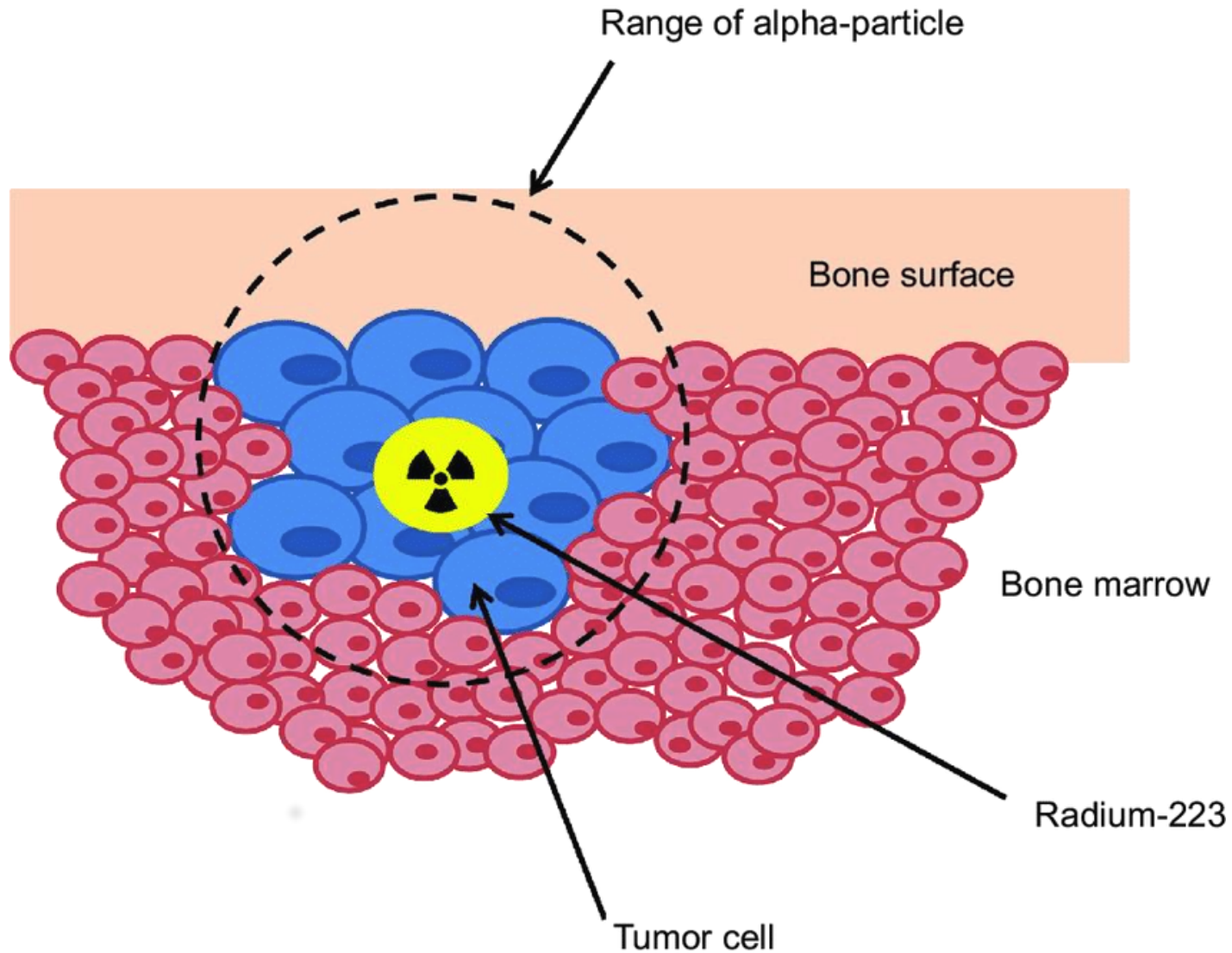
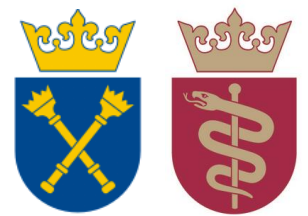
## Enzalutamide

Androgen biosynthesis – mainly in Leydig cells, but also in peripheral tissues (adrenals, cancer and adjacent cells)



# Prostate cancer

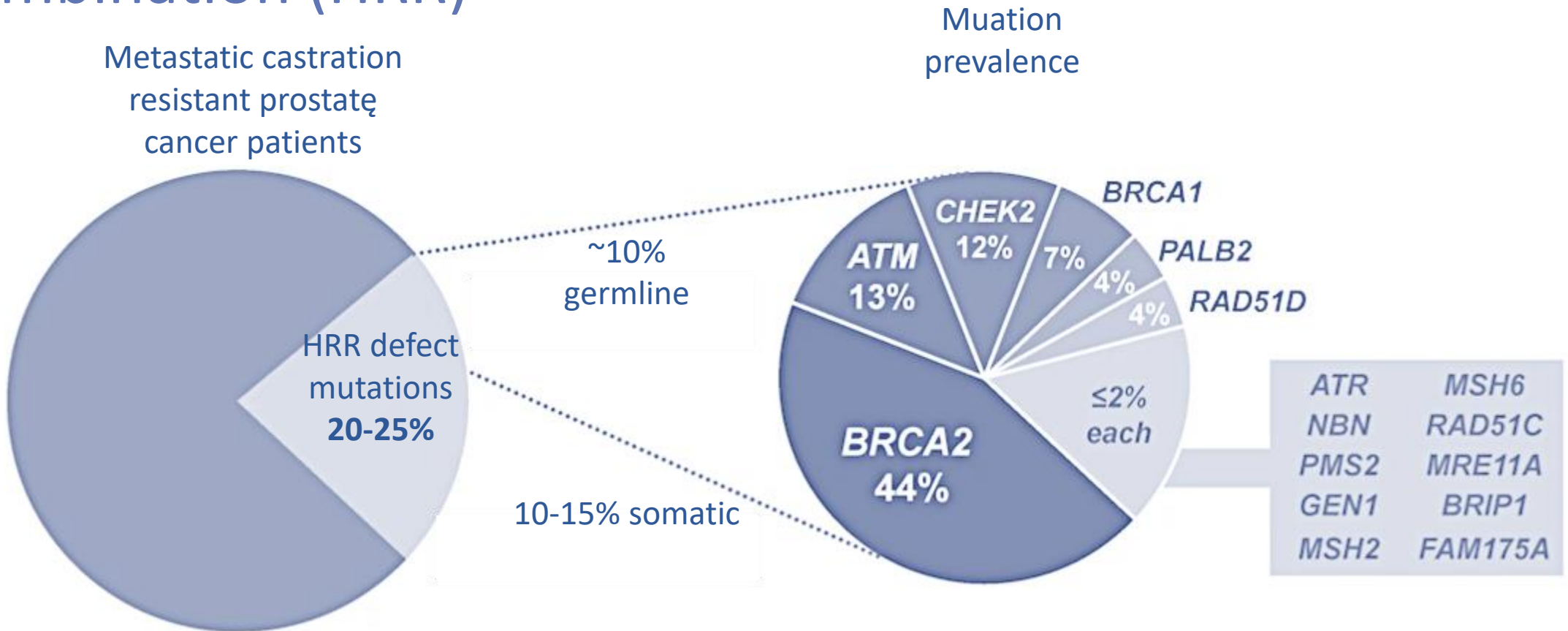
## Radium 223



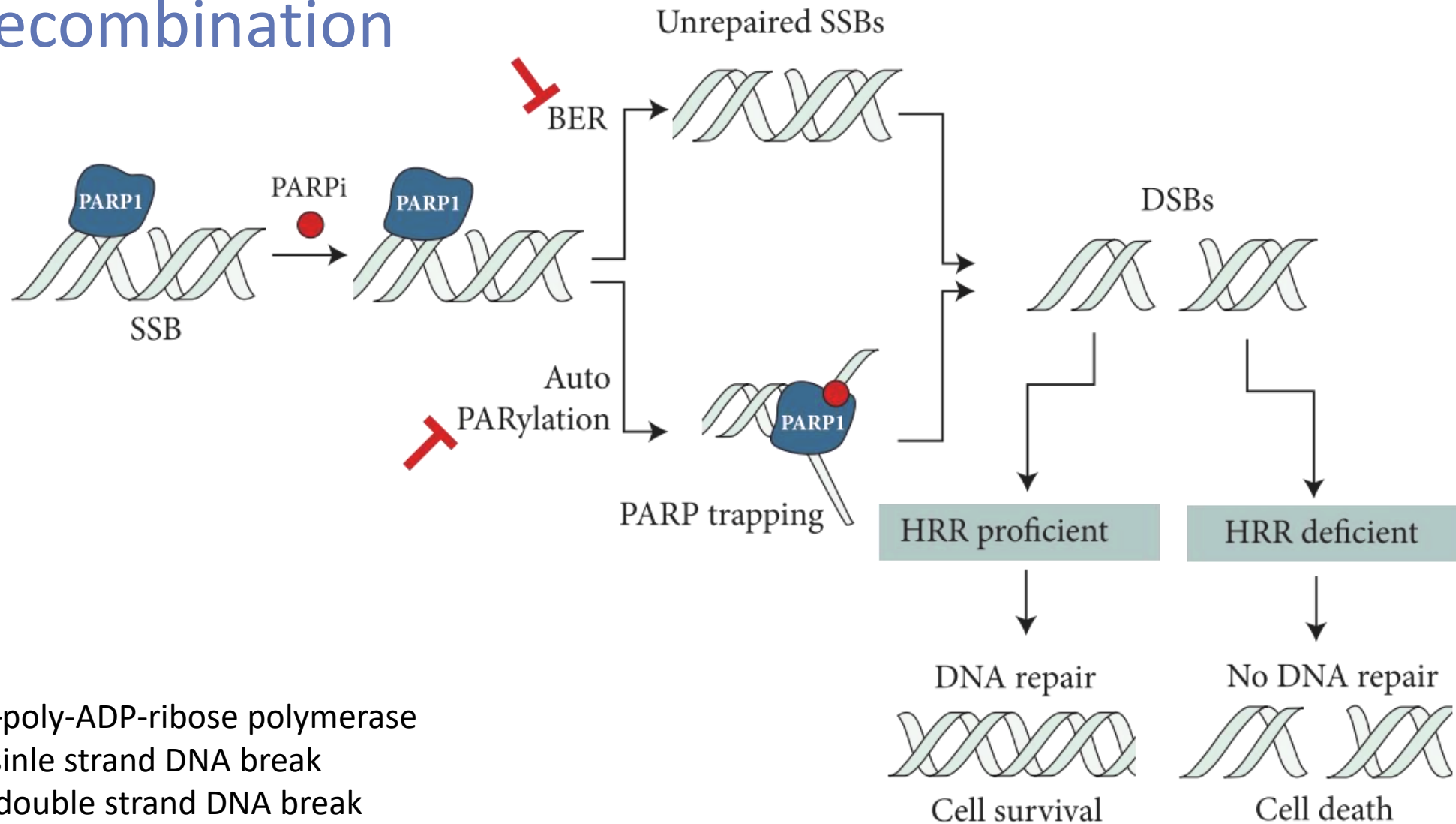
1 <b>H</b> Hydrogen Nonmetal					
3 <b>Li</b> Lithium Alkali Metal	4 <b>Be</b> Beryllium Alkaline Earth Metal				
11 <b>Na</b> Sodium Alkali Metal	12 <b>Mg</b> Magnesium Alkaline Earth Metal				
19 <b>K</b> Potassium Alkali Metal	20 <b>Ca</b> Calcium Alkaline Earth Metal	21 <b>Sc</b> Scandium transition Metal	22 <b>Ti</b> Titanium Transition Metal	23 <b>V</b> Vanadium Transition Metal	24 <b>Cr</b> Chromium Transition Metal
37 <b>Rb</b> Rubidium Alkali Metal	38 <b>Sr</b> Strontium Alkaline Earth Metal	39 <b>Y</b> Yttrium Transition Metal	40 <b>Zr</b> Zirconium Transition Metal	41 <b>Nb</b> Niobium Transition Metal	42 <b>Mo</b> Molybdenum Transition Metal
55 <b>Cs</b> Cesium Alkali Metal	56 <b>Ba</b> Barium Alkaline Earth Metal	*	72 <b>Hf</b> Hafnium Transition Metal	73 <b>Ta</b> Tantalum Transition Metal	74 <b>W</b> Tungsten Transition Metal
87 <b>Fr</b> Francium Alkali Metal	88 <b>Ra</b> Radium Alkaline Earth Metal	**	104 <b>Rf</b> Rutherfordium Transition Metal	105 <b>Db</b> Dubnium Transition Metal	106 <b>Sg</b> Seaborgium Transition Metal



# Prostate cancer and homologous recombination (HRR)



# Prostate cancer and homologous recombination



PARP – poly-ADP-ribose polymerase

SSB – single strand DNA break

DSB – double strand DNA break

BER – base excision repair

HRR – homologous recombination repair



# Multidisciplinary approach to genitourinary cancers



UNIWERSYTET JAGIELLOŃSKI  
COLLEGIUM MEDICUM



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W KRAKOWIE



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Thank you

