GERIATRIC PHARMACIST

BOOT CAMP

Genitourinary & Renal Disorders in the Older Adult

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Supported in part by an educational grant from the ASCP Foundation.

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Meet the Speaker

- Education & Training:
  - PharmD, University of Rhode Island
  - MEd, Northeastern University
  - PGY-1 Pharmacy Practice Residency, Hospital of Saint Raphael, New Haven, CT
- Associate Clinical Professor, Assistant Dean for Academic Affairs and Assessment, PharmD Program Director, Northeastern University, Boston, MA
- Board Certified Geriatric Pharmacist (2011) and Board Certified Pharmacotherapy Specialist (2013)
- ASCP Fellow (2020)
- Research areas: Geriatrics, internal medicine, scholarship of teaching and learning

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Picture: Cathedral Park and St. Johns Bridge, Portland, OR 2018 © Stephanie Sibicky

Disclosures

Stephanie Sibicky does not have relevant financial relationships with ineligible companies.

None of the planners for this activity have relevant financial relationships to disclose with ineligible companies.

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Learning Objectives

1. Determine genitourinary and kidney clinical findings and incorporate functional status into therapeutic decision-making.
2. Determine the therapeutic goals for older adults with kidney disease or urinary incontinence.
3. Solve and/or prevent genitourinary and renal associated medication-related problems.
4. Given a patient case, develop patient-centered genitourinary and kidney related therapy recommendations.

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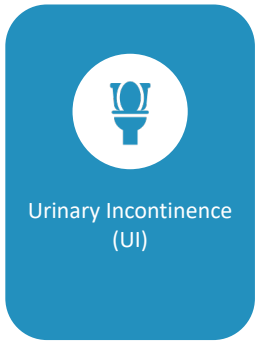
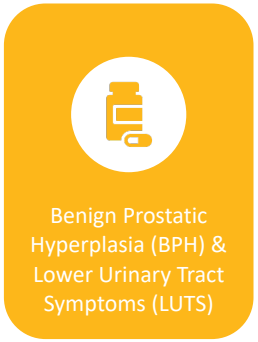
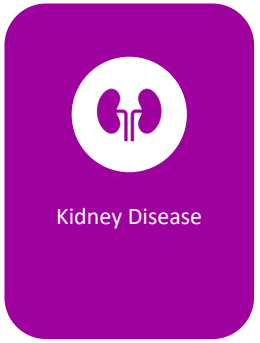
Outline

Please refer to Reference Sheet for additional information about medications mentioned!







Women = anatomy associated with female assignment at birth (e.g., vagina, uterus)
Men = anatomy associated with male assignment at birth (e.g, penis, prostate)

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Review

AGE-RELATED CHANGES IN KIDNEY FUNCTION	AGE-RELATED CHANGES TO THE LOWER URINARY TRACT

• Decreased creatinine production and renal blood flow
• Decreased nephrons and renal mass
• Impaired tubular secretion
• Less ability to concentrate urine
• Lower glomerular filtration rate (about 0.75 mL/min/year)
	• Increased:
	  • Detrusor muscle hyperactivity
	  • Post-void residuals
	  • Incidence of BPH and prostate cancer
	  • Nighttime urine production
	• Decreased:
	  • Bladder capacity
	  • Sensation of bladder fullness
	  • Contractile function
	  • Urethral closing pressure and estrogen production (♀)

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Johnson TM. Handb Clin Neurol. 2019;167:495-509.

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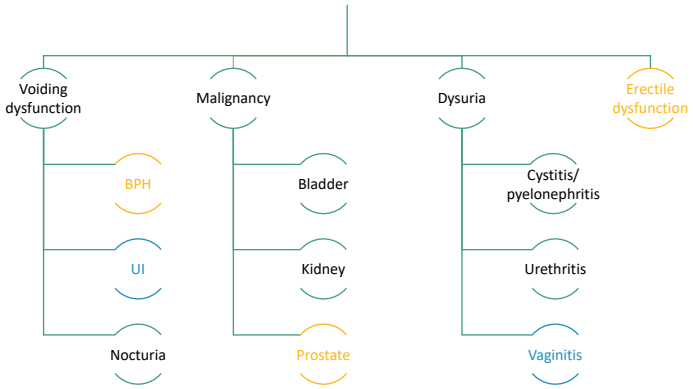
Urologic Conditions in Older Adults



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Outline

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- Urinary Incontinence (UI)
- Benign Prostatic Hyperplasia (BPH) & Lower Urinary Tract Symptoms (LUTS)
- Kidney Disease

Women = anatomy associated with female assignment at birth (e.g., vagina, uterus)
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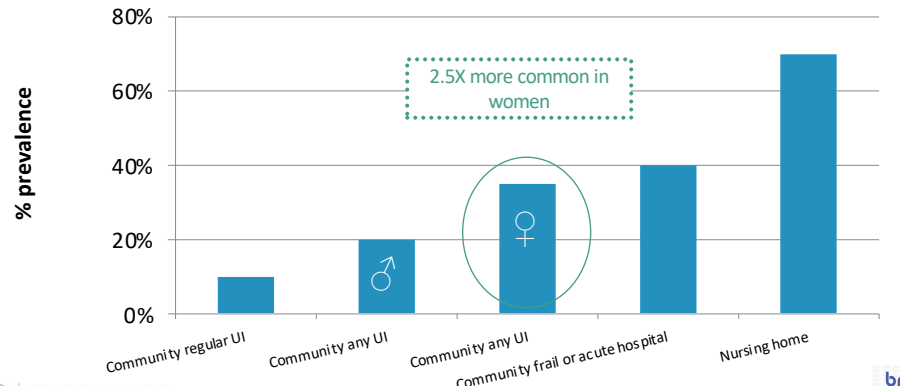
Urinary Incontinence



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Guzzo TJ, et al. Med Clin North Am. 2011 Jan;95(1):253-64.

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Consequences of Incontinence

Economic
Cost of supplies, medications, home health aide/care at home, nursing facility

Medical
Risk of cystitis, urosepsis, pressure sores, perineal rashes, sleep disturbances, dehydration, falls

Psychosocial
Embarrassment, isolation, depression, predisposition to institutionalization

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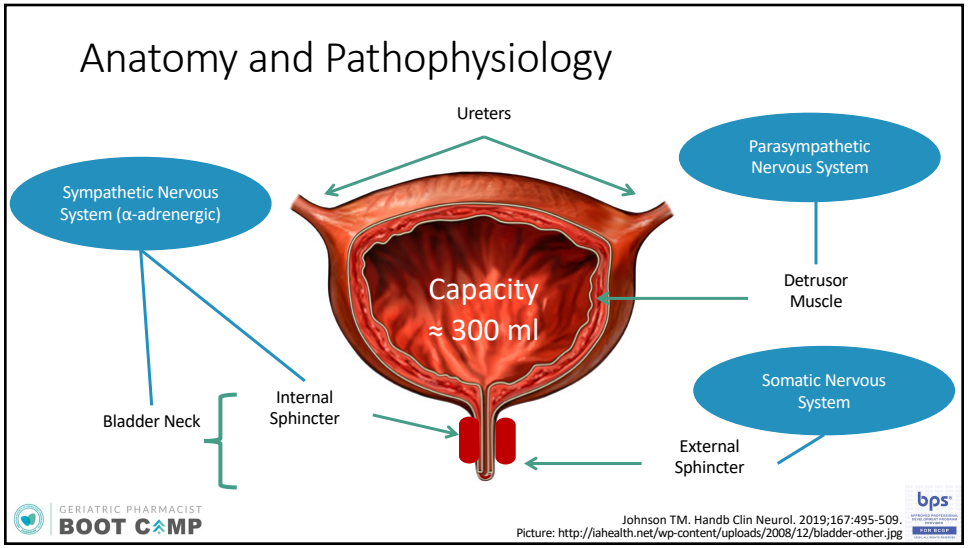
Anatomy and Pathophysiology
Ureters
Parasympathetic Nervous System
Sympathetic Nervous System (α-adrenergic)
Capacity ≈ 300 ml
Detrusor Muscle
Somatic Nervous System
Internal Sphincter
Bladder Neck
External Sphincter
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Johnson TM. Handb Clin Neurol. 2019;167:495-509.
Picture: http://iahealth.net/wp-content/uploads/2008/12/bladder-other.jpg

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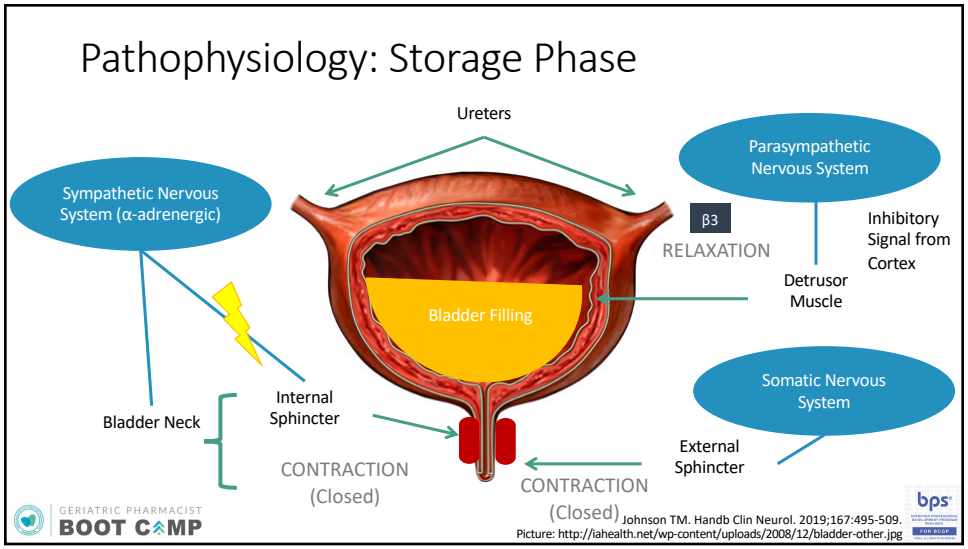
Pathophysiology: Storage Phase
Ureters
Parasympathetic Nervous System
Sympathetic Nervous System (α-adrenergic)
β3
RELAXATION
Inhibitory Signal from Cortex
Detrusor Muscle
Bladder Filling
Somatic Nervous System
Internal Sphincter
Bladder Neck
External Sphincter
CONTRACTION (Closed)
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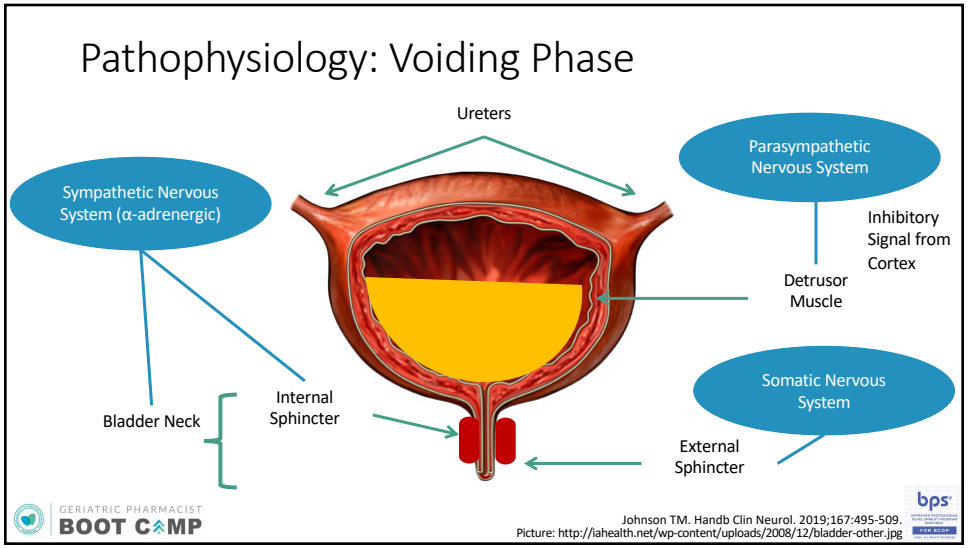
Pathophysiology: Voiding Phase
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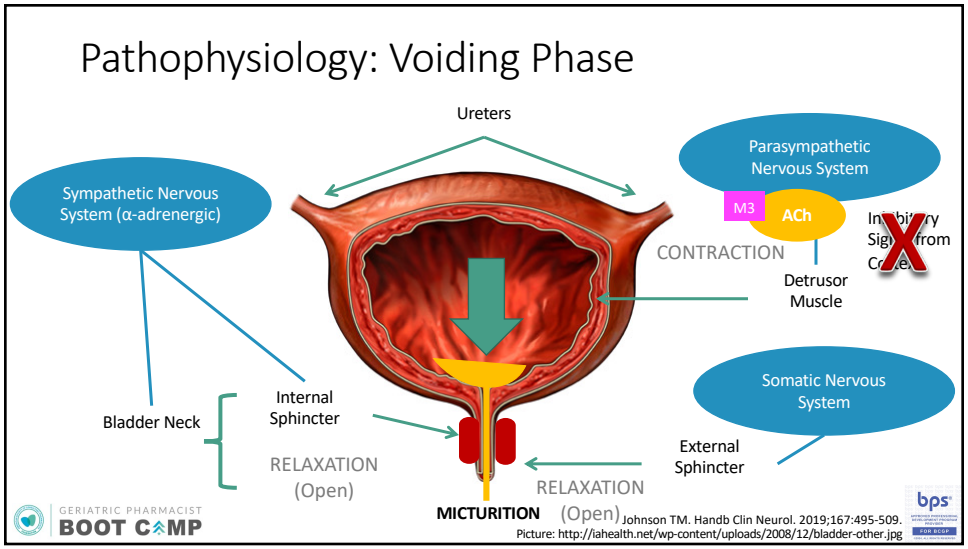
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Picture: http://iahealth.net/wp-content/uploads/2008/12/bladder-other.jpg
bps

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Evaluation & Diagnosis

HISTORY

- Symptoms (onset, type, frequency, timing)
- Bladder record or voiding diary
- Comorbidities (e.g., cognitive impairment, Parkinson's disease)
- Lifestyle
- Environment
- Patient perception of incontinence
- Medications

PHYSICAL

- Mobility issues and frailty
- Gynecological and urological evaluation
- Tests
  - Urinalysis and urine cultures
  - Blood chemistries (e.g., glucose, vitamin D, B12)
  - Renal function
  - Catheterization or bladder ultrasound (residual volumes)
  - Cystoscopy and flow studies
  - Urinary stress test

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Guzzo TJ, et al. Med Clin North Am. 2011 Jan;95(1):253-64.
Lukacz ES, et al. JAMA. 2017 Oct 24;318(16):1592-1604.

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Goals of Therapy

Minimize signs and symptoms most bothersome to the patient
- Non-pharmacologic techniques
- Medications
- Surgical intervention

Set realistic expectations
- Total elimination of symptoms may not be feasible
- Communicate most common side effects
- Balance patient goals, expectations, and risks

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Lukacz ES, et al. JAMA. 2017 Oct 24;318(16):1592-1604.

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Patient Case – Jamie

Jamie is a 78-year-old patient who is complaining of urinary frequency that has gotten worse over the last three months. She states that she often has to run to the restroom to urinate during normal daily activities such as walking in her rose garden, attending small council meetings, and shopping. Even though she has to rush, she has not had any "accidents".

She has two adult children and two grandchildren. She walks with a cane and was a homemaker.

Vital signs include BP 134/88, P 96, T 98.2F, Ht 5'7", Wt 212 lbs. Her annual lab work was unremarkable and her most recent Hgb A1c was 6.4%.

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Jamie's Medical History

- PMH:
  - Hypertension
  - Lower extremity edema
  - Hypothyroidism
  - Type 2 diabetes
  - Atrial fibrillation
  - Vitamin D deficiency
- No known drug allergies
- Medications:
  - Losartan 50 mg daily
  - Levothyroxine 75 mcg daily
  - Metformin 1000 mg twice daily
  - Furosemide 20 mg daily
  - Metoprolol XL 12.5 mg daily
  - Amiodarone 100 mg daily
  - Vitamin D 200 IU daily

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Self-Assessment Question #1

How would you classify Jamie's urinary incontinence?

A. Mixed with urge predominant
B. Stress
C. Urge
D. Functional

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Types of Incontinence

Acute/Transient UI

Reversible causes
Medication-induced

Chronic/Persistent UI

Urge
Stress
Mixed
Overflow
Functional

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Types of Incontinence

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Urge

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Classification: Acute/Transient

- Signs and symptoms with recent onset
- May be associated with an acute medical problem
  - Infection
  - Heart failure
  - Acute confusion or altered mental status
  - Constipation
  - Surgical procedures
- Can also alter/exacerbate chronic UI

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Johnson TM. Handb Clin Neurol. 2019;167:495-509.
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Reversible Causes & Management (DRIIPP)

Condition	Management
Delirium	Treat underlying cause
Restricted mobility, injury, restraint	Scheduled toileting, assistive devices, environment changes
Infection/**I**nflammation	
• Urinary tract infection	• Antibiotics (not asymptomatic bacteriuria)
• Atrophic vaginitis/urethritis	• Topical estrogen
• Prostatectomy	• Behavioral, no additional surgery within first year
Stool **I**mpaction	Anti-constipation medications, increase fluid intake, manual disimpaction
Polyuria	
• Metabolic (hyperglycemia, hypercalcemia)	• Control diabetes, treat underlying cause
• Excess intake	• Fluid restriction, reduce diuretic fluids (e.g., caffeine)
• Volume overload	• Diuretics
• Venous insufficiency/edema	• Compression stockings, leg elevation, sodium restriction, diuretics
Pharmaceuticals	Discontinue, change, decrease dose, timing, polypharmacy

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Johnson TM. Handb Clin Neurol. 2019;167:495-509.

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Medication-Induced Incontinence

Stress	• α-blockers	• Atypical antipsychotics
	• ACE inhibitors	• Sedative-hypnotics
Urge	• Antidepressants	• Hormone replacement
	• $5HT_4$ (serotonin)-agonists	• Sodium-glucose cotransporter-2 inhibitors
	• Direct or indirect parasympathomimetics (cholinesterase inhibitors)	
Overflow	• Anticholinergics	• α-agonists
	• Antiparkinson drugs	• Opioids
	• β-agonists	• Calcium channel blockers
Functional	• Histamine antagonists	• Opioids
	• Antipsychotics	• Alcohol
	• Benzodiazepines	• Antidepressants
Increase Urine Production	• Diuretics	• Thiazolidinediones
	• Lithium	• Muscle relaxants
	• NSAIDs	• Alcohol

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ACE – angiotensin-converting enzyme;
NSAIDs – non-steroidal antinflammatory drugs

Johnson TM. Handb Clin Neurol. 2019;167:495-509.

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Types of Incontinence

Acute/Transient UI

Reversible causes

Medication-induced

Chronic/Persistent UI

Urge

Stress

Mixed

Overflow

Functional

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Classification: Chronic/Persistent UI

	Urge	Stress	Overflow	Functional
Cause	Detrusor muscle overactivity	Weakened pelvic floor muscles (e.g., pregnancy, parity)	Bladder distension due to obstruction (BPH, fecal impaction)	Underlying physical or mental impairment impacting ability to toilet
Common Symptoms	Urgency with or without incontinence, frequency, nocturia or enuresis	Incontinence with coughing, sneezing, laughing, exercise, activities that increase abdominal pressure, frequency	Incomplete voiding, frequency, hesitancy, abdominal fullness, straining	Incontinence – looks like urge

Mixed = usually combination of urge and stress incontinence

Guzzo TJ, et al. Med Clin North Am. 2011 Jan;95(1):253-64.

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Patient Case – Jamie

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Jamie's Medical History

- PMH:
  - Hypertension
  - Lower extremity edema
  - Hypothyroidism
  - Type 2 diabetes
  - Atrial fibrillation
  - Vitamin D deficiency
- No known drug allergies
- Medications:
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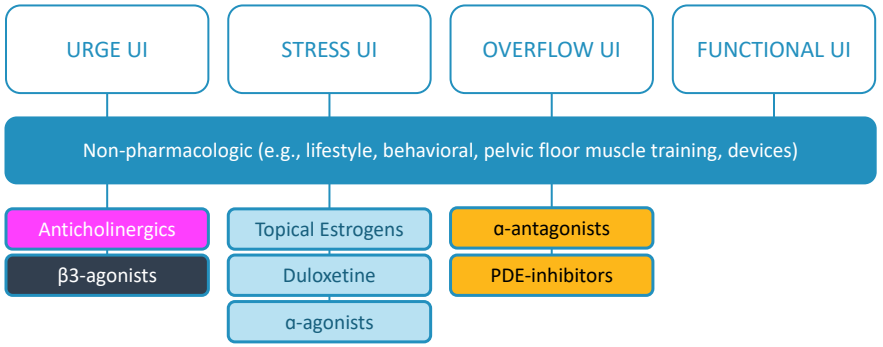
Management of UI



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Non-pharmacologic Options

- Diet (monitoring fluid, caffeine, bladder irritants)
- Exercise and weight loss
- Smoking cessation
- Scheduling regimens:
  - Timed voiding
  - Bladder training and scheduling
- External urine collection
  - Condom catheters (men only)
  - PureWick™
- Urinary prothesis (Inflow, women only)
- Indwelling catheters
- Muscle rehabilitation:
  - Biofeedback, electrical stimulation
  - Acupuncture
  - Pelvic floor muscle exercises (e.g., Kegel exercises)
    - Most effective = 30 contractions/day; 3 sets of 10, hold for at least 10 seconds
    - Vaginal weights
    - Pessaries
    - Exercise videos or trainers
- Commodes, urinals, elevated toilet seats
- Physical and/or occupational therapy
- Assistive devices
- Surgery (e.g., midurethral sling)

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Subak LL, et al. NEJM. 2009;360(5):481-90.
Dallosso HM, et al. BJU Int. 2003;92(1):69-77.
Dumoulin C, et al. Cochrane Database Syst Rev. 2014; May 14;(5):CD005654.

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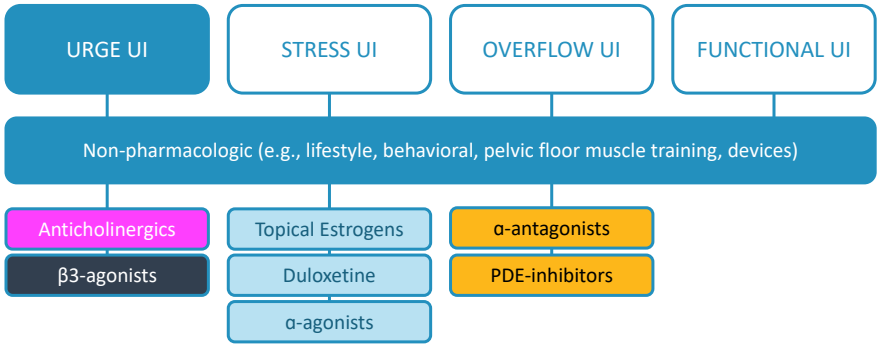
Management of UI



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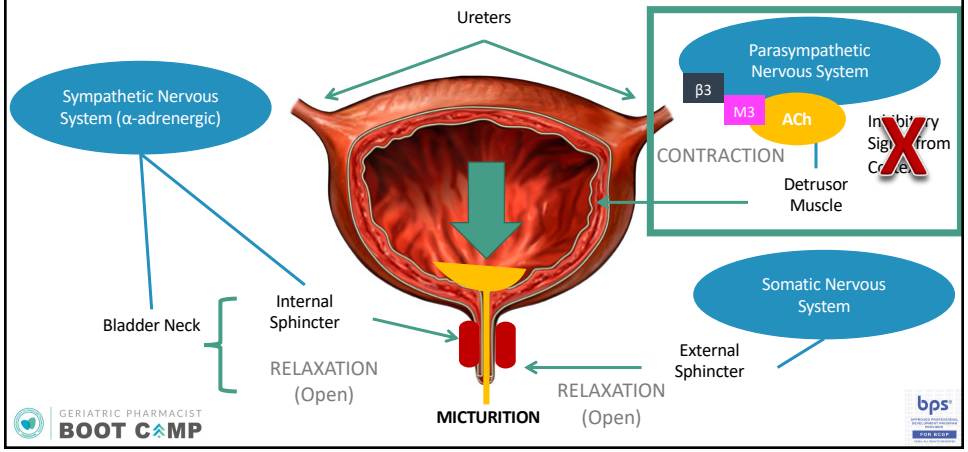
Urge UI: Treatment Targets



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Urge UI Treatment: Anticholinergics

- Reduce cholinergic transmission to bladder, inhibit involuntary detrusor contraction, increase bladder capacity, decrease frequency of urination
- Side effects: dry mouth, visual disturbances, constipation, dry skin
- Precautions: arrhythmias (QT-prolongation with solifenacin, tolterodine), cardiovascular disease, gastrointestinal motility issues, dementia, and elderly
- Contraindications: gastrointestinal obstruction, closed and narrow angle glaucoma

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Lukacz ES, et al. JAMA. 2017 Oct 24;318(16):1592-1604.

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Urge UI Treatment Targets: Non-selective

Receptor	Anatomical Location	Result of Antagonism
M1	Brain	Cognitive impairment
	GI tract	Constipation, dry mouth
M2	Brain	Cognitive impairment
	Heart	Tachycardia
	Urinary tract	Bladder relaxation, sphincter closing
M3	Urinary tract	Bladder relaxation, sphincter closing
	GI tract	Constipation, dry mouth
	Ophthalmologic	Mydriasis
M4	Brain	Balance impairment

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GI - gastrointestinal

Adapted from Zimmerman K. 2015.

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Urge UI Treatment Targets: Non-selective

Receptor	Anatomical Location	Result of Antagonism
M1	Brain	Cognitive impairment
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	Urinary tract	Bladder relaxation, sphincter closing
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	GI tract	Constipation, dry mouth
	Ophthalmologic	Mydriasis
M4	Brain	Balance impairment

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Adapted from Zimmerman K. 2015.

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Non-selective Anticholinergics

Medication	Formulations	Adverse Effects	Additional Comments
Oxybutynin	IR tablets (Ditropan®)	MOST	Reference standard Gradual dose escalation
	ER tablets (Ditropan XL®)		Better tolerated than IR
	Patch (Oxytrol®)		OTC for women only Bypasses 1st pass
	Gel (Gelnique®)		Bypasses 1st pass
Tolterodine	IR tablets (Detrol®)		CYP2D6 > CYP3A4 metabolism Renal dose adjustments
	ER capsules (Detrol® LA)		Better tolerated than IR
Fesoterodine	ER tablets (Toviaz®)		Adjustments for renal impairment and 3A4 inhibitors
Trospium	IR tablets (Sanctura®)		Dose adjustment for CrCl < 30 ml/min
	ER tablets (Sanctura XR®)	LEAST	Better tolerated than IR Avoid in renal impairment

IR – immediate release; ER – extended release; OTC – over-the-counter; CrCl – creatinine clearance

Lukacz ES, et al. JAMA. 2017 Oct 24;318(16):1592-1604.

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Urge UI Treatment Targets: Selective

Receptor	Anatomical Location	Result of Antagonism
M1	Brain	Cognitive impairment
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M2	Brain	Cognitive impairment
	Heart	Tachycardia
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	Ophthalmologic	Mydriasis
M4	Brain	Balance impairment

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Adapted from Zimmerman K. 2015.

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Urge UI Treatment Targets: Selective

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	GI tract	Constipation, dry mouth
	Ophthalmologic	Mydriasis
M4	Brain	Balance impairment

GI - gastrointestinal

Adapted from Zimmerman K. 2015.

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Selective Anticholinergics

Solifenacin

- IR tablets (Vesicare®)
- M3 selectivity > M2
- Efficacy
  - Non-inferior to oxybutynin IR
  - Superior to tolterodine IR
- Side effects
  - Less than oxybutynin and tolterodine
  - More than darifenacin
- Maximum 5 mg/day
  - Renal impairment (CrCl < 30 ml/min)
  - Moderate and severe hepatic impairment

Darifenacin

- ER tablets (Enablex®)
- Truly selective for M3
- Efficacy
  - Non-inferior to oxybutynin IR
  - More effective than tolterodine IR at 12 weeks
- Side effects less than oxybutynin
- No renal dose adjustment
- Hepatic impairment
  - Moderate – max 7.5 mg/day
  - Not evaluated in severe

Lukacz ES, et al. JAMA. 2017 Oct 24;318(16):1592-1604.

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Urge UI Treatment: Efficacy

- Similar efficacy between agents although limited head-to-head trials
- Anticholinergics have a modest benefit over placebo
  - Reduction in 0.5-0.7 UI episodes/day
  - Reduction of UI episodes for drug therapy alone (58%) v. in combination with behavioral interventions (69%)
- Continuation rates
  - 50% of patients still unhappy or frustrated with symptoms after treatment
  - 60-70% of women discontinue within 6 months
  - 50% continue at 3 months, 25% at 12 months, 10% beyond 2 years
- Most agents need to be tried for 4-8 weeks to see effect before trial of another agent within class

Shamliyan T, et al. Ann Intern Med. 2012;156(12):861.
Woodford HJ. Drugs Aging. 2018 Sep;35(9):773-776.
Lukacz ES, et al. JAMA. 2017 Oct 24;318(16):1592-1604.
Madhuvrata P, et al. Cochrane Database Syst Rev. 2012 Jan 18;1:CD005429.
AHRQ 2012. Available at http://effectivehealthcare.ahrq.gov/ehc/products/169/1021/CER36_Urinary-Incontinence_execsumm.pdf

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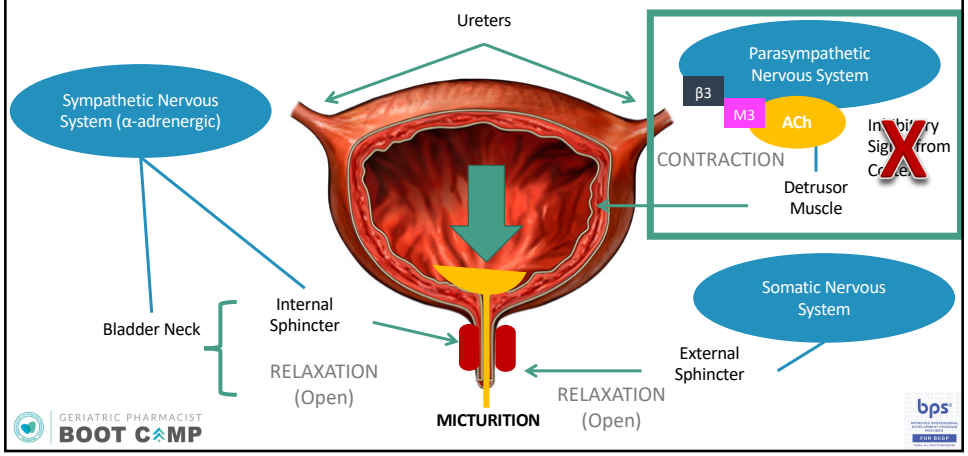
Urge UI: Treatment Targets



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β_3-agonist: Mirabegron

- ER tablet (Myrbetriq®)
- Reduces bladder contractions via relaxation of detrusor muscle through β_3-agonism
- Moderate inhibition of CYP2D6, substrate of 2D6, 3A4, p-glycoprotein
- Maximum 25 mg/day if eGFR 15-30 ml/min/1.73m^2; not studied in < 15 ml/min/1.73m^2
- Side effects: hypertension (avoid if severe, uncontrolled ≥ 180/110), nasopharyngitis, UTI, constipation, tachycardia, headache

Efficacy:

- Full in 4-8 weeks
- Reduction in 0.5 episodes/day at 50 mg dose
- Mirabegron + solifenacin v. solifenacin alone (71% v. 54% reduction, p=0.03)
- Mirabegron + solifenacin v. mirabegron alone (71% v. 61% reduction, NSS)

UTI – urinary tract infection; NSS – not statistically significant

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Dallosso HM, et al. BJU Int. 2017 Oct;120(4):562-575.
Lukacz ES, et al. JAMA. 2017 Oct 24;318(16):1592-1604.
Mirabegron [package insert]. Northbrook, IL: Astellas Pharma US, Inc.; 2018.

43

β_3-agonist: Vibegron

- Crushable, 75 mg tablet (Gemtesa®) available starting April 2021
- Use not recommended if eGFR < 15 mL/min/1.73 m^2
- No CYP2D6 interactions
- No blood-brain barrier penetration in animal studies
- Side effects: headache, nasopharyngitis, diarrhea, nausea

Efficacy (at 12 weeks):

- Mean CFB of 0.5 micturitions/day (-1.8 vs. -1.3 placebo, p < 0.001)
- Mean CFB of -0.6 incontinent episodes/day (-2 vs. -1.4 placebo, p < 0.0001)
- Statistically significant reduction in secondary outcomes including reduction in urgency episodes, volume per micturition, proportion of incontinent patients with a ≥ 75% reduction in urge UI episodes
- No increase in hypertensive episodes

eGFR – estimated glomerular filtration rate; CFB – change from baseline

GERIATRIC PHARMACIST BOOT CAMP

Staskin D, et al. J Urol. 2020 Aug;204(2):316-324.
Rechberger T, et al. Expert Opin Pharmacother. 2021 Jan;22(1):9-17.
Vibegron [package insert]. Irvine, CA: Urovant Services, Inc; 2020.

44

Other Pharmacologic Treatment

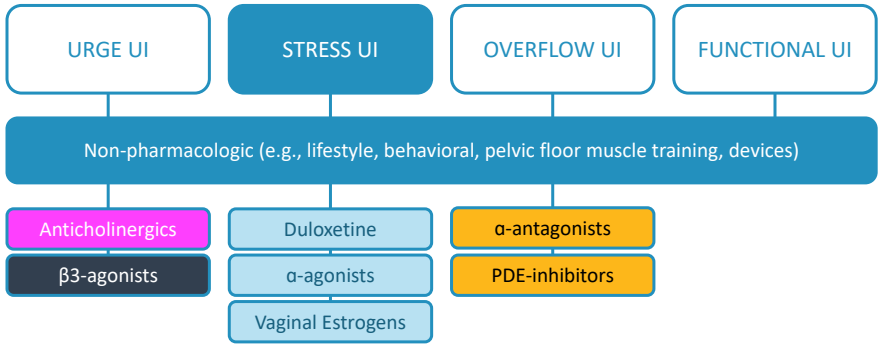
- Tricyclic Antidepressants (e.g., imipramine)
  - Increases bladder capacity and outlet resistance, anticholinergic properties
  - Side effects: weakness, fatigue, postural hypotension, hip fractures
- OnabotulinumtoxinA (Botox®)
  - Muscle paralytic when injected into detrusor muscle
  - Injected into 20 sites via urethra every 6-12 weeks
  - Decreases 1.6-1.9 episodes/day
  - Risks include urinary retention, infection, bleeding, spread of toxin effect

GERIATRIC PHARMACIST BOOT CAMP

Lukacz ES, et al. JAMA. 2017 Oct 24;318(16):1592-1604.

45

Management of UI



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Pharmacologic Treatment for Stress UI

No agent is FDA-approved for the treatment of Stress UI in the United States

Duloxetine (Cymbalta®)	α-Adrenergic agonists

• Serotonin and norepinephrine reuptake inhibitor
  • Involved in control of urethral smooth muscle in cats and rats
  • Facilitates pathway between bladder and sympathetic nervous system
  • Increases sphincter tone during storage phase
• Off-label in US due to to suicidal ideation, indicated in United Kingdom
• Side effects (diminish with time): nausea, dry mouth
• Older adults underrepresented in studies
• Avoid use if CrCl < 30 mL/min
	• Maintains urethral tone
	• Pseudoephedrine, phenylephrine
	• Caution in elderly due to side effects and comorbidity considerations (e.g., heart disease, seizures, thyroid disease, diabetes)
	• Contraindicated in hypertension or urinary obstruction

GERIATRIC PHARMACIST BOOT CAMP

Cardozo L et al. Curr Med Res Opin. 2010;26(2):253-61.

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Menopause & Urge/Stress UI

- Also known as vulvovaginal atrophy, atrophic vaginitis, vaginal atrophy
- Low estrogen can contribute to increased urinary urgency, frequency, decreased tissue, lower sensory threshold, sphincter dysfunction
- Overall considerations:
  - Topical estrogen therapy can improve symptoms of urge and stress UI
  - Systemic therapy is NOT recommended due to cancer risk
  - If on systemic therapy, can lead to worsening of UI symptoms
  - Evidence lacking for treatment durations, optimal dosage, long-term effects, or cost-effectiveness

GERIATRIC PHARMACIST BOOT CAMP

Bodner-Adler B, et al. Int Urogynecol J 2020;31:1577-82.

48

Topical Vaginal Estrogen Products

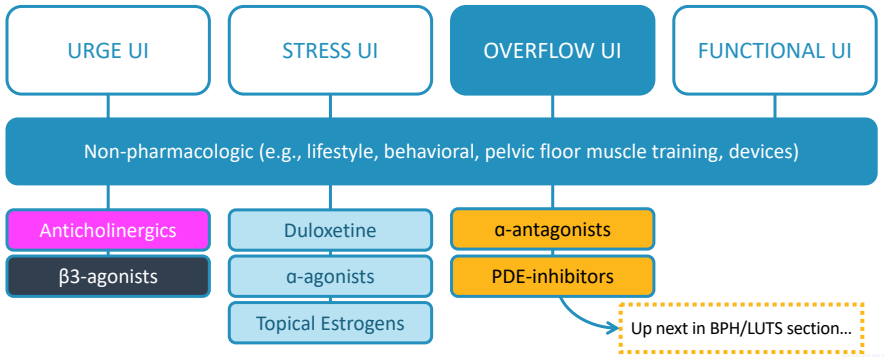
Product	Regimen (for vulvar/vaginal atrophy)
17β estradiol, vaginal tablet/insert; 10 mcg tablet (Vagifem®, Yuvafem®) 4 mcg, 10 mcg insert (Imvexxy®)	1 tablet/insert intravaginally once daily for 2 weeks, then 1 tablet/insert twice weekly thereafter
Conjugated equine estrogen vaginal cream; 0.625 mg/g (Premarin®)	0.325-1.25 mg (0.5-2 g cream) vaginally once daily (3 weeks of daily use, then 1 week off)
Estradiol vaginal cream; 0.1 mg/g (Estrace®)	2-4 g vaginally daily for 1-2 weeks, then reduce to ½ initial dose for 1-2 weeks; maintenance 1 g 1-3 times weekly
17β estradiol vaginal ring; 2 mg (Estring®)	1 ring intravaginally every 3 months (delivers 7.5 mcg daily)
Estradiol acetate vaginal ring; 12.4 or 24.8 mg (Femring®)	1 ring intravaginally every 3 months (delivers 0.05 or 1 mg/day)

GERIATRIC PHARMACIST BOOT CAMP

Malallah MA et al. Int Urogynecol J. 2015;26(4):477-85.
Cody JD et al. Cochrane Database Syst Rev. 2012 Oct 17;10:CD001405.

49

Management of UI



GERIATRIC PHARMACIST BOOT CAMP

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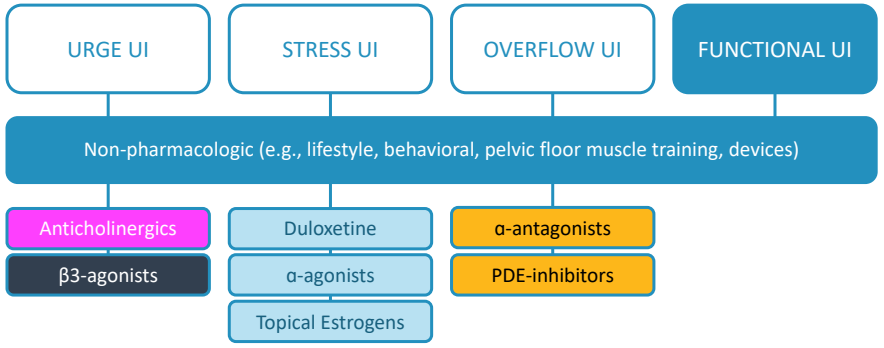
Management of UI



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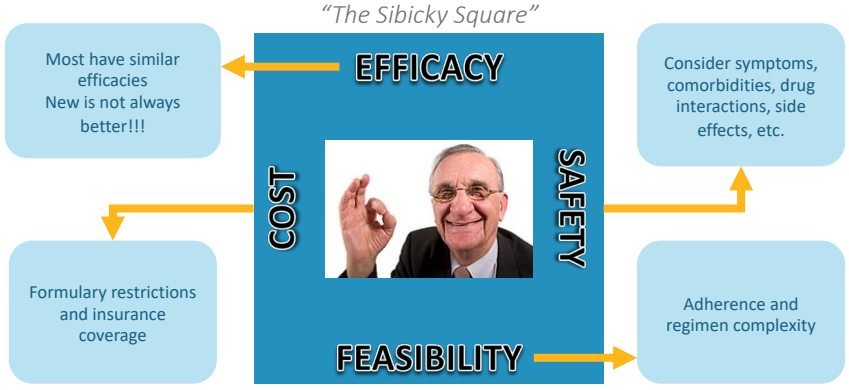
Choosing Pharmacologic Therapy

"The Sibicky Square"



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Treatment Approach in Elderly

INITIATING

- Determine if there is another underlying cause
- Start low and go slow
  - Dose adjust for renal and hepatic impairment
  - Titration based on side effects and tolerability
- Trial of one agent for up to 2 months
- Consider switch to another agent if no improvement and treatment is still necessary

DEPRESCRIBING

- Assess necessity of medication
- Wean with non-pharmacologic strategies
  - 25-50% of dose every 1-4 weeks
  - Faster if serious adverse effects
- Check response
  - No withdrawal? Continue wean then stop
  - Worsening confusion? Stop
  - Slow weaning (12.5%) when final lowest dose, continue for 2 weeks
  - Consider every-other-day dosing depending on dosage form

GERIATRIC PHARMACIST BOOT CAMP

Deprescribing Guide For Anticholinergic Drugs for Urinary Incontinence (Antimuscarinics). NSW Government, 2019.

bps

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Patient Case – Jamie

Jamie is a 78-year-old patient who is complaining of urinary frequency that has gotten worse over the last three months. She states that she often has to run to the restroom to urinate during normal daily activities such as walking in her rose garden, attending small council meetings, and shopping. Even though she has to rush, she has not had any "accidents".

She has two adult children and two grandchildren. She walks with a cane and was a homemaker.

Vital signs include BP 134/88, P 96, T 98.2F, Ht 5'7", Wt 212 lbs. Her annual lab work was unremarkable and her most recent Hgb A1c was 6.4%.

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Jamie's Medical History

- PMH:
  - Hypertension
  - Lower extremity edema
  - Hypothyroidism
  - Type 2 diabetes
  - Atrial fibrillation
  - Vitamin D deficiency
- No known drug allergies
- Medications:
  - Losartan 50 mg daily
  - Levothyroxine 75 mcg daily
  - Metformin 1000 mg twice daily
  - Furosemide 20 mg daily
  - Metoprolol XL 12.5 mg daily
  - Amiodarone 100 mg daily
  - Vitamin D 200 IU daily

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Self-Assessment Question #2

Jamie's primary care physician asks for your help in creating a plan for their incontinence. Which of the following would be the BEST treatment for Jamie?

A. Start darifenacin, monitor for anticholinergic side effects, continue for at least two months before switching to another therapy
B. Start mirabegron and solifenacin, monitor for hepatic impairment, continue for at least one month before switching to another therapy
C. Start duloxetine and bladder training/scheduling, monitor for depression-related adverse effects, continue for at least two months before switching therapy
D. Start fesoterodine, adjust for changes in renal impairment, continue for at least two weeks before switching to another therapy

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Outline

Please refer to Reference Sheet for additional information about medications mentioned!

- Urinary Incontinence (UI)
- Benign Prostatic Hyperplasia (BPH) & Lower Urinary Tract Symptoms (LUTS)
- Kidney Disease

Women = anatomy associated with female assignment at birth (e.g., vagina, uterus)
Men = anatomy associated with male assignment at birth (e.g, penis, prostate)

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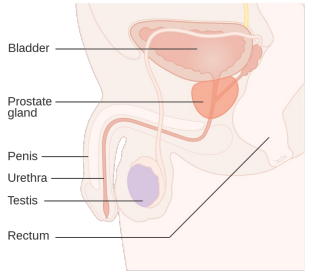
BPH and LUTS

- Most common neoplasm of aging men, up to 90% in their 80s
- Change in prostate size and the symptoms it causes (LUTS)
- Prostate gland:
  - Almond-shaped gland at junction of urinary bladder and urethra in men
  - Normal volume 20-30 grams
  - Three zones
    - Transition zone (closest to urethra)
    - Central zone (common duct from prostate and vesicles)
    - Large, peripheral zone
- Symptoms can be static (obstruction) and/or dynamic (receptor-mediated)



Picture: Cancer Research UK, CC BY-SA 4.0
https://creativecommons.org/licenses/by-sa/4.0
Via Wikimedia Commons, no changes made

Langan RC. Prim Care Clin Office Pract. 2019;46:223-32.

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American Urological Association Symptom Index (AUASI)

In the past month, how often have you experienced the following symptoms?	
1. Sensation of not completely emptying your bladder	Obstructive
2. Need to urinate less than two hours after urinating	Irritative
3. Stopped and started again while urinating	Obstructive
4. Found it difficult to postpone urination	Irritative
5. Had a weak urinary stream	Obstructive
6. Had to push or strain to begin urinating	Obstructive
7. How many times do you get up at night to urinate?	Irritative
Scored: 0 – not at all to 5 – all of the time; Question 7: each time is 1 point up to max 5 Total score 0-35; Mild LUTS 0-7; Moderate to Severe LUTS ≥ 8	

GERIATRIC PHARMACIST BOOT CAMP

Lerner LB, et al. J Urol 2021;206: 806.

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BPH & LUTS Evaluation

RISK FACTORS
- Age
- African-American race
- Type 2 diabetes
- Alcohol intake
- Physical inactivity
- Living in a larger body

MEDICATION CAUSES
- Alcohol
- Caffeine
- Diuretics
- Anticholinergics
- α-agonists
- β-blockers
- Calcium channel blockers

PHYSICAL EXAM

Digital rectal exam (DRE) for sphincter tone, size, nodules/ masses

LABS & PROCEDURES
- Urinalysis
- PSA (if > 10-year life expectancy, discussion of risk vs. benefit)
- Renal function
- Bladder ultrasound with residual volume

PSA – prostate specific antigen

GERIATRIC PHARMACIST BOOT CAMP

Langan RC. Prim Care Clin Office Pract. 2019;46:223-32.

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AUA 2023 Guideline Amend-ment

If **mild** LUTS, (AUASI 0-7), start with non-pharmacologic

If **moderate-severe** LUTS (AUASI ≥ 8)…

Non-Pharmacologic
Avoid alcohol, caffeine, limit salt, timed voiding, limit fluids 1-2 hours before sleep

α-blocker OR **PDE5** if patient has ED

If urgency/OAB symptoms, consider + **ACh/β3** agonist

Lack of or incomplete response?

Consider trial of **PDE5**

If prostate > 30 cc, consider adding **5ARI**

Lack of and/or incomplete response?

Consider Surgical Management
(e.g., TURP, laser, water vapor, microwave, stents)

PDE5 – phosphodiesterase-5 inhibitor
ED – erectile dysfunction
ACh – anticholinergic
5ARI – 5-alpha reductase inhibitor
TURP – transurethral resection of the prostate

GERIATRIC PHARMACIST BOOT CAMP

Sandhu JS et al. J Urol. 2024 Jan;211(1):11-19.
Lerner LB, et al. J Urol 2021;206: 818.

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Treatment Options for BPH/LUTS

	α-blockers	PDE5	5ARI
MOA	Sphincter relaxation, bladder neck and prostate	Smooth muscle relaxation through increase in cAMP and cGMP	Blocks enzyme preventing testosterone and DHT from stimulating prostatic tissue
EFFICACY	• No significant difference in efficacy between non-selective (NS) and selective • Lowers AUAIS by 4-6 points • Starts within 1 week, but may take up to 4 weeks	• Initially approved for ED • 12-week trial of tadalafil showed AUASI reduction of 3.8 points	• Similar efficacy between agents • Reduction of prostate size by 25%, Improves AUASI by 4-5 points • Works over 2-6 months • Not recommended to prevent prostate cancer
SIDE EFFECTS	Orthostatic hypotension, intraoperative floppy iris syndrome, caution in cardiovascular disease	Headache, indigestion, flushing, nasal congestion, orthostatic hypotension with α-blockers/ nitrates	Decreased libido, ED, gynecomastia
PRODUCTS	Doxazosin 1-8 mg daily (NS) Terazosin 1-20 mg daily (NS) Alfuzosin 10 mg daily Silodosin 8 mg daily (4 mg if CrCl 30-50) Tamsulosin 0.4-0.8 mg daily	Tadalafil 5 mg daily (2.5 mg daily if CrCl 50-80, initial 2.5 mg daily if CrCl 30-50)	Finasteride 5 mg daily Dutasteride 0.5 mg daily
		Combination product (Entadfi™) finasteride 5 mg/tadalafil 5 mg daily	

cAMP – cyclic adenosine monophosphate; cGMP - cyclic guanosine monophosphate; ED – erectile dysfunction

GERIATRIC PHARMACIST BOOT CAMP

Langan RC. Prim Care Clin Office Pract. 2019;46:223-32.
Fan Z, et al. Front Pharmacol. 2022 Mar 7;13:763184.

62

Self-Assessment Question #3

According to the 2023 AUA guidelines, which of the following would be considered first-line treatment for BPH/LUTS?

A. Doxazosin + tadalafil
B. Tamsulosin
C. Tadalafil + finasteride
D. Dutasteride

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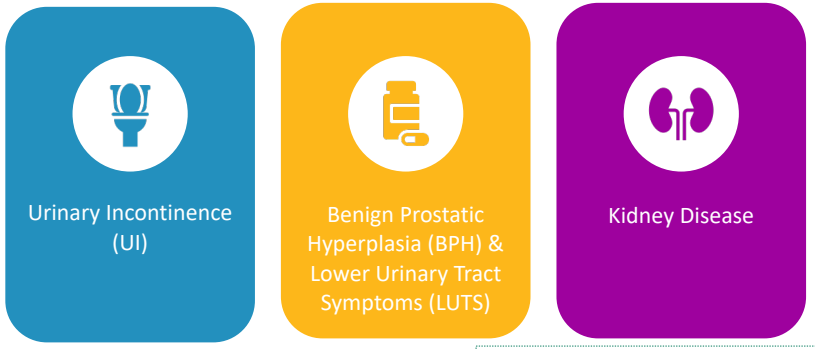
Outline

Please refer to Reference Sheet for additional information about medications mentioned!



Women = anatomy associated with female assignment at birth (e.g., vagina, uterus)
Men = anatomy associated with male assignment at birth (e.g, penis, prostate)

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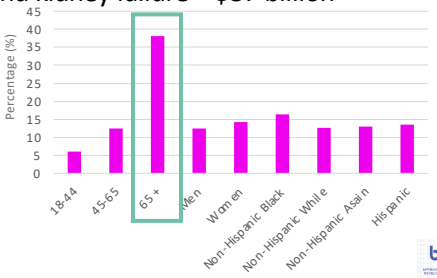
Kidney Disease

- Per CDC, more than 1 in 7 (15%) US adults have/estimated to have CKD (37 million)
- CKD costs Medicare > $87 billion and kidney failure > $37 billion
- Risk factors:
  - Diabetes (1 in 3 adults)
  - High blood pressure (1 in 5 adults)
  - Heart disease
  - Living in a larger body
  - Family history
  - Older age



CDC – Centers for Disease Control and Prevention; CKD – chronic kidney disease

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CDC. 2024. https://www.cdc.gov/kidneydisease/prevention-risk/CKD-common-serious-costly.html.

65

Nomenclature for Kidney Disease

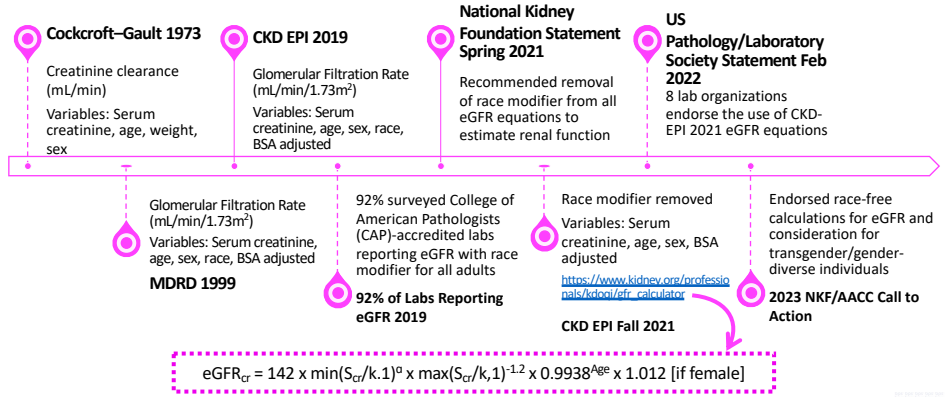
Preferred Term	Explanation	Terms to avoid
Kidney function and disease	Use "kidney" when describing kidney disease and function	Renal, "nephro-" (except in setting of specific diseases or syndromes)
Kidney disease	Reflects the entirety of acute kidney diseases and disorders and chronic kidney disease	Renal disease, nephropathy (except in setting of specific disease or syndromes)
Kidney failure (KF)	GFR < 15 ml/min per 1.73m^2 or treatment by dialysis	Renal failure (RF); end-stage renal disease (ESRD); end-stage kidney disease (ESKD), renal disease, renal/kidney impairment, insufficiency, dysfunction, azotemia
Kidney replacement therapy (KRT)	Includes dialysis and transplantations	Renal replacement therapy (RRT)
Acute kidney diseases and disorders (AKD)	Disease duration ≤ 3 months, KDIGO definition	Acute renal failure (ARF); acute renal insufficiency (ARI)
Acute kidney injury (AKI)	Subcategory of AKD, KDIGO Definition	ARF, ARI
Chronic kidney disease (CKD)	KDIGO definition	Chronic renal failure, ESRD, renal/kidney impairment, insufficiency, dysfunction

GFR – glomerular filtration rate; KDIGO – Kidney Disease Improving Global Outcomes

Levey AS, et al. Kidney Int. 2020 Jun;97(6):1117-1129.

66

Evolution of Calculating Kidney Function



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MDRD – Modified Diet in Renal Disease equation; CLD-EPI – Chronic Kidney Disease Epidemiology Collaboration; SCr – serum creatinine; NKF – National Kidney Foundation; AACC – American Association for Clinical Chemistry; Slide content modified from JBlack, CWhittaker

Delgado C et al. Adv Chronic Kidney Dis. 2022 Jan;29(1):5-16; Pierre CC et al. J Appl Lab Med. 2023 Jul 5;8(4):789-816.

67

When Estimating Kidney Function in Older Adults…

- Use **more than one** method (e.g., Cockcroft-Gault, MDRD, CKD-EPI)
- Many studies have found that CG *under*estimates and MDRD/CKD-EPI *over*estimates kidney function in older adults
- Using eGFR-cystatin C may improve risk assessment and accuracy
- Use actual SCr than round if SCr < 1.0 mg/dL (within reason…)
- Weigh **risk and benefits** of each medication with dose adjustments
  - Risk of sub/supra-therapeutic levels
  - Is there an alternative?

Not One Size Fits All!

Consider Comorbidities!

GERIATRIC PHARMACIST BOOT CAMP

Hart LA, et al. Clin Pharmacokinet. 2018 Aug;57(8):943-76.

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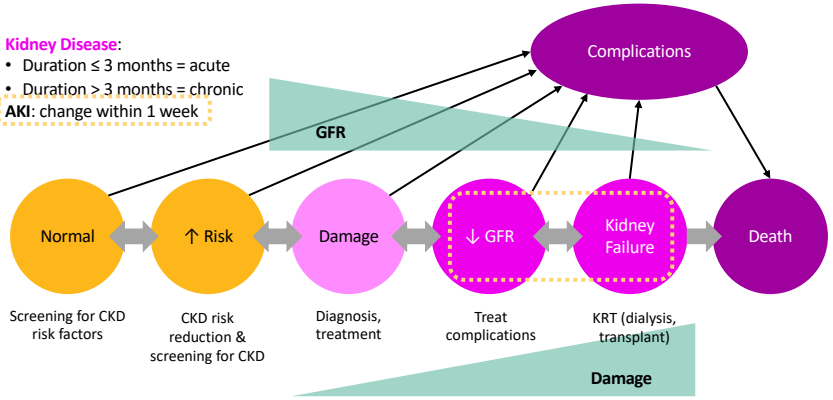
Conceptual Model of Kidney Disease

Kidney Disease:
- Duration ≤ 3 months = acute
- Duration > 3 months = chronic

AKI: change within 1 week



GERIATRIC PHARMACIST BOOT CAMP

AKI – acute kidney injury; GFR – glomerular filtration rate; CKD – chronic kidney disease; KRT – kidney replacement therapy
Recreated from Levey AS, et al. Kidney Int. 2020 Jun;97(6):1117-1129.

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Acute Kidney Injury

- An acute rise in serum creatinine with or without a decrease in urine output over a short period of time
- KDIGO guideline definition:
  - Increase in SCr by ≥ 0.3 mg/dL within 48 hours; or
  - Increase in SCr to ≥ 1.5 X baseline, which is known or presumed to have occurred within the prior 7 days; or
  - Urine volume < 0.5 mL/kg/hour for 6 hours
- Types:
  - Prerenal = decreased blood flow
  - Intrinsic/intrarenal = structural damage (acute tubular necrosis, acute interstitial nephritis, glomerulonephritis)
  - Postrenal = obstruction within urine collection system

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SCr – serum creatinine
Slide content modified with permission from MBartuca, LSylvia
Levey AS, et al. Kidney Int. 2020 Jun;97(6):1117-1129.

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Causes of AKI

Prerenal	Intrinsic	Postrenal

• Low VOLUME
  • Dehydration, diarrhea/vomiting
  • Diuretics
• Low FLOW
  • HF
  • Acute hypotension, sepsis
  • Diabetes with vascular changes
  • Cirrhosis
• **Medications**
  • **NSAIDs**
  • **ACE-inhibitors**
  • **ARBs**
	• Vascular disease
	• Glomerular disease
	  • Allergy, infection, immunologic reaction
	• Tubulointerstitial disease
	  • Ischemic damage (e.g., shock)
	  • **Toxins (e.g., medications)**
	  • **Contrast**
	  • **Penicillins**
	  • **Aminoglycosides**
	  • **Calcineurin inhibitors**
		• Kidney stones
		• Blood clots
		• BPH
		• Malignancy
		• **Crystals**
		  • **Acyclovir**
		  • **Indinavir**
		  • **Sulfadiazine**
		  • **Chemotherapeutics**

HF – heart failure, NSAID – non-steroidal anti-inflammatory drugs, ACE – angiotensin converting enzyme, ARB – angiotensin receptor blocker

GERIATRIC PHARMACIST BOOT CAMP

Slide content modified with permission from MBartuca, LSylvia

KDIGO. Kidney Inter. Suppl. 2012;2:1–138.

71

Treatment of AKI

Solid = appropriate at all stages
Shaded = increasing priority as intensity increases

High Risk	Stage 1	Stage 2	Stage 3
Discontinue all nephrotoxic agent when possible Ensure volume status and perfusion pressure Consider functional hemodynamic monitoring Monitor serum creatinine and urine output Avoid hyperglycemia Consider alternatives to radiocontrast procedures			
	Non invasive diagnostic workup		
	Consider invasive diagnostic workup		
		Check for changes in drug dosing	
		Consider KRT & ICU admission	
			Avoid subclavian catheters if possible

Stage	1	2	3
SCr	SCr 1.5-1.9 X baseline OR ≥ 0.3 mg/dL ↑	2.0-2.9 X baseline	3.0 X baseline OR ↑ to ≥ 4 mg/dL OR start KRT
UO	< 0.5 mL/kg/hr for 6-12 hrs	< 0.5 mL/kg/hr for ≥ 12 hrs	< 0.3 mL/kg/hr for ≥ 24 hrs OR anuria for ≥ 12 hrs

SCR – serum creatinine; UO – urine output;
KRT – kidney replacement therapy; ICU – intensive care unit

KDIGO. Kidney Inter. Suppl. 2012; 2: 1–138.

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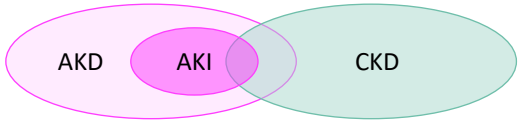
Kidney Disease Overlap



	AKI	AKD	CKD	No Kidney Disease
Duration	Within 7 days	≤ 3 months	> 3 months	
Functional Criteria	↑ SCr by ≥ 50% OR ↑ SCr by 0.3 mg/dL within 2 days OR oliguria ≥ 4 hours	AKI OR GFR < 60 OR ↓ GFR by ≥ 35% baseline OR ↑ SCr by ≥ 50% baseline	GFR < 50 mL/min/1.73m^2	GFR ≥ 50 mL/min/1.73m^2
Structural Criteria	Not defined	Marker of damage (albuminuria, hematuria, pyuria)	Marker of damage (albuminuria)	None

GERIATRIC PHARMACIST BOOT CAMP

AKD – acute kidney diseases and disorders; AKI – acute kidney injury; CKD – chronic kidney disease; SCr – serum creatinine; GFR – glomerular filtration rate

Recreated from Levey AS. Nephron. 2022;146(3):302-305.

73

CKD:

Defined as abnormalities of kidney structure/ function for > 3 months

Classified by **C**ause, **G**FR, and **A**lbuminuria categories

GERIATRIC PHARMACIST BOOT CAMP

Prognosis of CKD by GFR and albuminuria categories

Adapted from KDIGO Kidney Int. Suppl. 2024;105(4S) S117-314.

Green = low risk (if no other markers of kidney disease, no CKD); yellow = moderately increased risk; orange = high risk, red = very high risk;
Numbers indicate frequency of monitoring (per year)

GFR categories (mL/min per 1.73m^2) Description and range				Persistent albuminuria categories Description and range		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				< 30 mg/g < 3 mg/mmol	30-300 mg/g 3-30 mg/mmol	> 300 mg/g > 30 mg/mmol
	G1	Normal or high	≥ 90	1 if CKD	1	2
	G2	Mildly decreased	60-89	1 if CKD	1	2
	G3a	Mildly to moderately decreased	45-59	1	2	3
	G3b	Moderately to severely decreased	30-44	2	3	3
	G4	Severely decreased	15-29	3	3	4 +
	G5	Kidney failure	< 15	4 +	4 +	4 +

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Patient Case - Kris

Kris is a 70-year-old patient who you are seeing today in the nephrology clinic.

Their PMH includes CKD, type 2 diabetes, hypertension, and gout.

Their medication list and kidney function have been stable over the past year.

Vital signs: Weight 180 lbs.; blood pressure 134/86 mmHg; pulse 64 bpm

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Kris's Additional Data

- Labs:
  - SCr = 1.7 mg/dL
  - eGFR (CKD-EPI) = 43 mL/min/1.73m^2
  - BUN = 8 mg/dL
  - Bicarbonate = 24 mmol/L
  - Potassium = 4.8 mEq/L
  - Urinary albumin:SCr = 100 mg/g
- Medications:
  - Allopurinol 100 mg daily
  - Atenolol 50 mg daily
  - Atorvastatin 20 mg daily
  - Hydrochlorothiazide 50 mg daily
  - Losartan 100 mg daily
  - Metformin 1000 mg twice daily

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Self-Assessment Question #4

Based on the KDIGO guidelines, how should Kris's CKD be classified?

A. G2, A2
B. G2, A3
C. G3b, A2
D. G3b, A3

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CKD:

Defined as abnormalities of kidney structure/ function for > 3 months

Classified by **C**ause, **G**FR, and **A**lbuminuria categories

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Prognosis of CKD by GFR and albuminuria categories

KDIGO Kidney Int. Suppl. 2024;105(4S) S117-314.

Green = low risk (if no other markers of kidney disease, no CKD); yellow = moderately increased risk; orange = high risk, red = very high risk;
Numbers indicate frequency of monitoring (per year)

GFR categories (mL/min per 1.73m²) Description and range			Persistent albuminuria categories Description and range		
			A1	A2	A3
			Normal to mildly increased	Moderately increased	Severely increased
			< 30 mg/g < 3 mg/mmol	30-300 mg/g 3-30 mg/mmol	> 300 mg/g > 30 mg/mmol
G1	Normal or high	≥ 90	1 if CKD	1	2
G2	Mildly decreased	60-89	1 if CKD	1	2
G3a	Mildly to moderately decreased	45-59	1	2	3
G3b	Moderately to severely decreased	30-44	2	3	3
G4	Severely decreased	15-29	3	3	4 +
G5	Kidney failure	< 15	4 +	4 +	4 +

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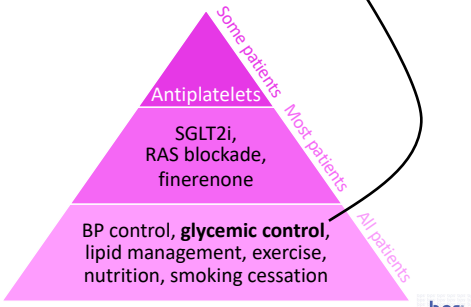
Management of CKD

Target HbA1c of 7%, unless hypoglycemia or limited life expectancy

LIFESTYLE & BLOOD PRESSURE

- Diet and Lifestyle:
  - Target sodium intake < 2 g/day
  - Protein 0.8 g/kg/day, G3-G5
  - Moderate-intensity exercise 150 minutes/week as tolerated
- BP:
  - Target SBP < 120 mmHg, when tolerated
  - Start ACE-inhibitor/ARB for those G1-G4, A2 or A3

DIABETES



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KDIGO Kidney Int. Suppl. 2024;105(4S) S117-314.
Evans M, et al. Adv Ther. 2022 Jan;39(1):33-43.

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Symptoms and Complications of CKD

Symptoms (≥ Stage 3)
Cold intolerance, edema, SOB, palpitations, depression, fatigue, sexual dysfunction, anorexia, malnutrition

Cardiovascular Disease
50% in CKD Stage 4-5
AF and ACS risk doubles
HF 3X more likely

Anemia

Mineral and Bone Disorders (≥ Stage 3)
Calcium
Vitamin D
Phosphate

Metabolic acidosis
Dialysis (**A**EIOU)
Oral bicarbonate

Hyperkalemia
May need to reduce or discontinue ACEi/ARB
Potassium-binding (e.g., patiromer)

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KDIGO Kidney Int. Suppl. 2024;105(4S) S117-314.
Evans M, et al. Adv Ther. 2022 Jan;39(1):33-43.

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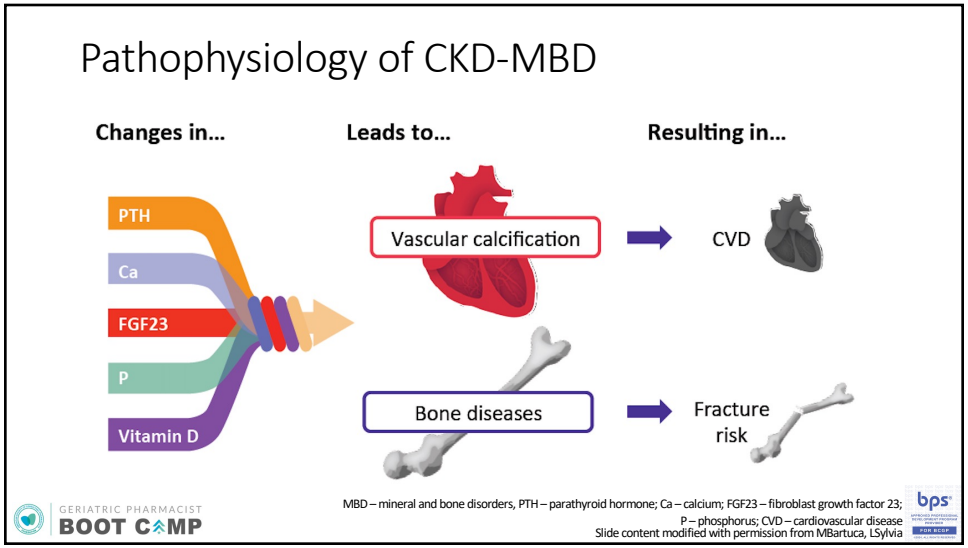
Pathophysiology of CKD-MBD
Changes in...
Leads to...
Resulting in...
PTH
Ca
FGF23
P
Vitamin D
Vascular calcification
CVD
Bone diseases
Fracture risk
GERIATRIC PHARMACIST BOOT CAMP
MBD – mineral and bone disorders, PTH – parathyroid hormone; Ca – calcium; FGF23 – fibroblast growth factor 23;
P – phosphorus; CVD – cardiovascular disease
Slide content modified with permission from MBartuca, LSylvia
bps

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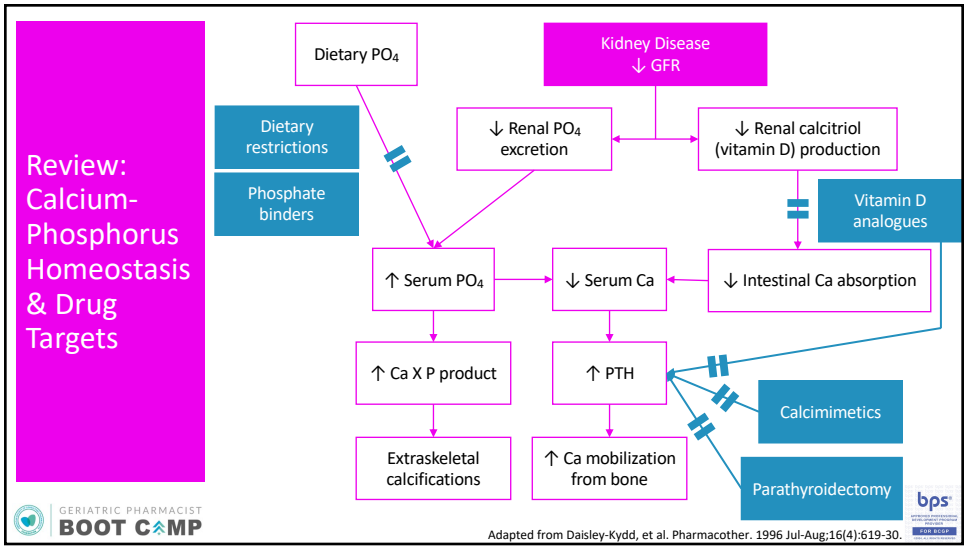
Review: Calcium-Phosphorus Homeostasis & Drug Targets
Dietary PO4
Kidney Disease
↓ GFR
Dietary restrictions
Phosphate binders
↓ Renal PO4 excretion
↓ Renal calcitriol (vitamin D) production
Vitamin D analogues
↑ Serum PO4
↓ Serum Ca
↓ Intestinal Ca absorption
↑ Ca X P product
↑ PTH
Calcimimetics
Extraskeletal calcifications
↑ Ca mobilization from bone
Parathyroidectomy
GERIATRIC PHARMACIST BOOT CAMP
Adapted from Daisley-Kydd, et al. Pharmacother. 1996 Jul-Aug;16(4):619-30.
bps

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2023 AGS Beers Criteria®

Table 6 includes list of medications to avoid or dose reduce for older adults

Medications	Rationale	Recommendation	Strength of Recommendation
Digoxin for first-line treatment of atrial fibrillation or heart failure	Decreased renal clearance of digoxin may lead to increased risk of toxic effects	Avoid dosages > 0.125 mg/day (may require further dose reduction CKD G4 and G5)	Strong (moderate quality evidence)
Trimethoprim-sulfamethoxazole	Increased risk of hyperkalemia when used concurrently with an ACEI or ARB in presence of decreased CrCl	Use with caution in patients on ACEI or ARB and decreased CrCl Reduce dose if CrCl 15-29, avoid if < 15 mL/min	Strong (low-moderate quality evidence)
Nitrofurantoin	Potential for pulmonary toxicity, hepatotoxicity, and peripheral neuropathy, especially with long-term use	Avoid in individuals with CrCl < 30 mL/min or for long-term suppression	Strong (low quality evidence)
NSAIDs	May increase risk of acute kidney injury and further decline of kidney function	Avoid in individuals with CrCl < 30 mL/min	Strong (moderate quality evidence)

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AGS Beers Criteria® Update Expert Panel. J Am Geriatr Soc. 2023 Jul;71(7):2052-81.

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Agents to Prescribe with Caution in Older Adults with Kidney Diseases

Medication Class	Agents	Renal Considerations
Antihypertensives/ cardiac medications	Beta blockers (e.g., atenolol)	Increase drug exposure, risk of toxic effect as renal function declines
	Digoxin	Adjust in the setting of acute/chronic decline, or change in health status
	Diuretics	Thiazide diuretics decreased efficacy eGFR < 30 mL/min/1.73m^2
Antihyperglycemics	Sulfonylureas Insulin	Increase risk of hypoglycemia as renal function declines, other hypoglycemics Adjust in the setting of acute/chronic decline, or change in health status
	Metformin	Increase risk of lactic acidosis in setting of AKI, eGFR < 30 mL/min/1.73m^2
Pain/analgesics	NSAIDs (generally avoid)	Hyperkalemia, increased risk of AKI, increase blood pressure
	Tramadol	Opioid–like adverse effects, short-term use, avoid extended release
	Gabapentin, pregabalin	Increased risk of toxic effects as function declines
Acid Suppressants	Proton pump inhibitors (PPI)	Chronic PPI use associated with AKI and CKD
	H2-receptor antagonists	Accumulation and increased risk of adverse effects with usual dosing in setting of acute/chronic decline
Other	Allopurinol	Allopurinol hypersensitivity syndrome: recent onset, diuretic therapy Start low (50 – 100 mg daily) then titrate to uric acid goal

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KDIGO Kidney Int. Suppl. 2024;105(4S) S117-314.; J Am Geriatr Soc. 2023 Jul;71(7):2052-81.
Nagge J, et al. Arch Intern Med. 2002;162(22):2605-2609; Dalbeth N, et al. Seminars in Dialysis.2007;20(5):391-395.
Moledina DG, et al. J Am Soc Nephrol. 2016;27(10):2926-2928; Manlucu J, et al. Nephrol Dial Transplant. 2005 Nov;20(11):2376–84.

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Patient Case - Kris

Kris goes to the emergency room after experiencing a fall at home. Their concerns include feeling faint, dizzy, and unsteady on their feet. They deny any changes to medications but report taking ibuprofen 2-3 times over the past week for a gout flare.

Vital signs:

Weight 180 lbs.

Blood pressure (seated) 136/88 mmHg; pulse 65 bpm

Blood pressure (standing) 128/76 mmHg; pulse 68 bpm

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Kris's Additional Data Upon Admission

- Labs (1 week ago):
  - SCr = 1.7 mg/dL
  - eGFR (CKD-EPI) = 43 mL/min/1.73m^2
  - BUN = 8 mg/dL
  - Bicarbonate = 24 mmol/L
  - Potassium = 4.8 mEq/L
  - Urinary albumin:SCr = 100 mg/g
- Labs (today):
  - SCr = 2.65 mg/dL
  - eGFR (CKD-EPI) = 25 mL/min/1.73m^2
  - BUN = 36 mg/dL
  - Bicarbonate = 20 mmol/L
  - Potassium = 5.2 mEq/L

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Self-Assessment Question #5

Based on this new laboratory data, what is your assessment of Kris' kidney function?

A. Acute kidney disease
B. Acute kidney injury
C. Chronic kidney disease
D. Kidney failure

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Self-Assessment Question #6

Which of the following medications could be contributing to Kris' kidney injury? (Select ALL that apply)

A. Allopurinol
B. Ibuprofen
C. Losartan
D. Metformin

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UI

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Genitourinary Disorders in the Older Adult

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Extra Reference Slides

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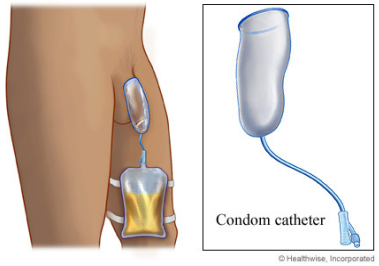
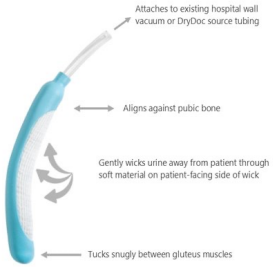
External Urine Collection

Condom Catheter (Men)



PureWick™ (Women)



https://youtu.be/xSOuvcShikw

Pictures: https://www.healthlinkbc.ca/sites/default/libraries/healthwise/media/medical/hw/h9991505_001.jpg; https://www.liberatormedical.com/purewick/img/purwick_works.jpg

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Urinary Prosthesis (Women Only)

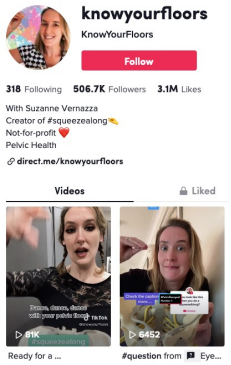
- Draws urine out of the bladder and blocks urine flow out
- Inserted by physician, then by patient or caregiver
- Replace every 29 days
- Use remote control to void
- Informational videos: http://vesiflo.com/videos/

Picture credit: http://www.thedailynarrative.com/wp-content/uploads/2014/10/20141014-FG30001014FDA-H.jpg?33fdec /

95

Non-Pharmacologic: Pelvic Floor Muscle Training

- Helpful for prevention of postpartum SUI
  - Most effective = 30 contractions per day, 3x10 sets, hold 10 seconds
  - Start early and then 3-6 months post-delivery
  - Benefit shown to sustain 1 year postpartum
- Treatment:
  - May be helpful for UUI and mixed UI
  - Recommended by almost all guidelines as effective first-line therapy



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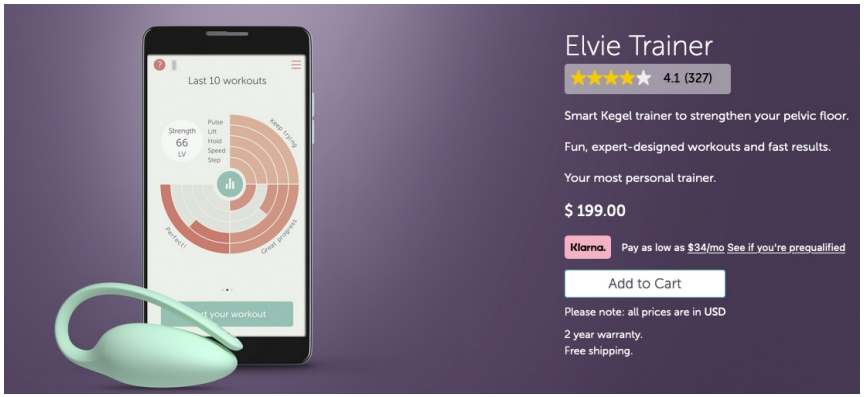
Pelvic Floor Muscle Training: Elvie



https://www.elvie.com/en-us/shop/elvie-trainer

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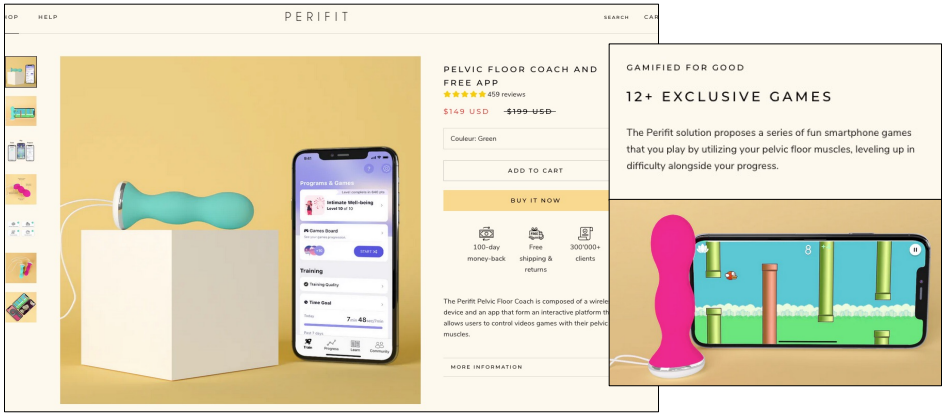
Pelvic Floor Muscle Training: Perifit



https://perifit.co/

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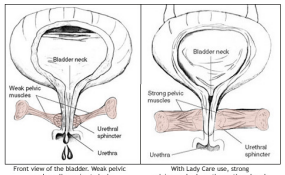
Non-Pharmacologic Treatment for SUI

Pelvic floor muscle training



Picture credit: http://1qghdw20tywd2qc5uw1w82ap-wpengine.netdna-ssl.com/wp-content/uploads/2016/09/vagina.jpg;
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http://www.seekwellness.com/mystore/products_pictures/stepfree%20weights.jpg
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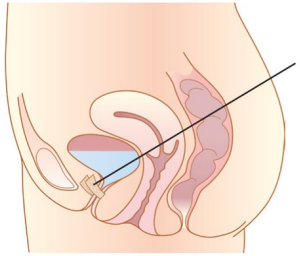
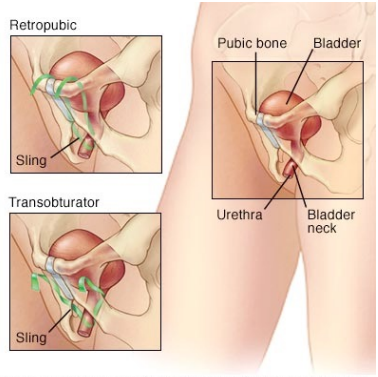
Surgical Intervention for SUI – Midurethral Sling



Placement of MiniArc sling supports the urethra and prevents urine leakage



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Compare:
RIFLE,
AKIN,
KDIGO

RIFLE Category	SCr and GFR Criteria	Urine Output Criteria
Risk	SCr increase to 1.5-fold or GFR decrease >25% from baseline	<0.5 mL/kg/hr for ≥6 hours
Injury	SCr increase to twofold or GFR decrease >50% from baseline	<0.5 mL/kg/hr for ≥12 hours
Failure	SCr increase to threefold or GFR decrease >75% from baseline, or SCr ≥4 mg/dL (354 µmol/L) with an acute increase of at least 0.5 mg/dL (44 µmol/L)	Anuria for ≥12 hours
Loss	Complete loss of function (RRT) for >4 weeks	
ESRD	RRT >3 months	
AKIN Criteria	**SCr Criteria**	**Urine Output Criteria**
Stage 1	SCr increase ≥0.3 mg/dL (27 µmol/L) or 1.5- to 2-fold from baseline	<0.5 mL/kg/hr for ≥6 hours
Stage 2	SCr increase >2- to 3-fold from baseline	<0.5 mL/kg/hr for ≥12 hours
Stage 3	SCr increase >3-fold from baseline, or S^{cr} ≥4 mg/dL (354 µmol/L) with an acute increase of at least 0.5 mg/dL (44 µmol/L), or need for RRT	<0.3 mL/kg/hr for ≥24 hours or anuria for ≥12 hours
KDIGO Criteria	**SCr Criteria**	**Urine Output Criteria**
Stage 1	SCr increase ≥0.3 mg/dL (27 µmol/L) or 1.5-1.9 times from baseline	<0.5 mL/kg/hr for 6-12 hours
Stage 2	SCr increase 2-2.9 times from baseline	<0.5 mL/kg/hr for ≥12 hours
Stage 3	SCr increase three times from baseline, or SCr ≥4 mg/dL (354 µmol/L), or need for RRT, or eGFRc <35 mL/min/1.73 m^2 (0.34 mL/s/m^2) in patients <18 years	Anuria for ≥12 hours

GERIATRIC PHARMACIST BOOT CAMP

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Differentiating Between Causes of AKI

LABORATORY TEST	PRERENAL	INTRARENAL	POSTRENAL
BUN/SCr	20:1 ratio SCr doubles BUN will rapidly increase (usually will go up faster than creatinine)	16:1 ratio SCr doubles BUN increases but not as fast or to the same extent as prerenal	~16:1 ratio
Urine output	Usually ↓ output because trying to conserve but not indicative of poor prognosis	Low/normal output; lower output is a poor prognostic sign	Low/normal output; lower output is a poor prognostic sign
Urine sediment	Normal/bland sediment with no evidence of cell death	ATN: Granular cell casts from PCT called "muddy brown casts" AIN: WBC-coated casts +/- eosinophilic casts Glomerulonephritis: RBC casts	Cellular debris (depends on back pressure and development of ATN)
Urinary RBC	None	2-4 + (in glomerulonephritis)	Variable
Urinary WBC	None	2-4 + (in AIN)	1 +
Urine Na	< 20 mEq/L	> 40 mEq/L	> 40 mEq/L
Urine protein	None	In all intrarenal AKIs; highest in glomerulonephritis	Variable
FeNA (%)	< 1% (conserving Na)	≥ 2% (wasting Na)	≥ 2% (wasting Na)

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