# Registrar Education Series

## AKI and CKD

*Continuing education for personal growth and quality improvement*

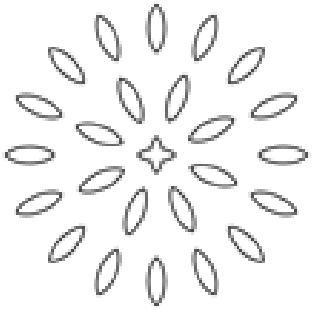
DynaMed

AFP

# How to…

- What is the differential based on the chief complaint?
- What additional information do you want?
- How does the history narrow down the differential?
- What labs/imaging would be most helpful?
- What is the diagnosis?
- What is the assessment?
- What is the treatment/plan?



# AKI and CKD CASES

challenging the status quo

# Seed Global Health

## Renal Case 1

Chief Concern | Histories | PE | Assessment | Plan

# Seed Global Health

## Chief Complaint

Blessing is a 62yoF with a PMH of HTN and an MI presenting for shortness of breath.

# Seed Global Health

## Histories

*HPI*: Blessing is a 62yoF with a PMH of HTN and an MI who presents to the hospital with a 3 day history of increasing SOB, cough, swelling and 15# weight gain.
Her discharge creatinine from an admission 6 months prior was 150 with a GFR of 52.
MEDS: lisinopril 20mg, hctz 25mg, simvastatin 40mg, asa 81mg

*PMH:* DM, HLD, obesity

*PSH:* c-section

*FH:* DM, HTN, HLD

*Social:* Originally Lusaka. Lives with her husband and 4 children. Eats a nshima and walks 3x a week.  Enjoys dancing and kitchen parties.

# Seed Global Health

## Physical Exam

VITALS: T: 36.9, HR 103, RR 23, BP 103/60

GEN: Obese female in mild distress

CV: S1, S2 soft, S3 present, tachycardic with a regular rhythm, no murmur or rub.
RESP: Air movement in all fields. Coarse bilateral crackles. No wheezing or ronchi.
ABD: soft, non-tender, non-distended, bowel sounds present
MSK: 3+ pitting edema in b/l lower extremity up to the knees

Labs

Imaging

# Seed Global Health

## Labs:

| FBC | |
|---|---|
| WBC | 7.5 |
| Hgb | 11.7 |
| Hct | 34 |
| Plt | 220 |

| RFTs/LFTs | |
|---|---|
| Na | 135 |
| K | 5.8 |
| Bicarb | 23 |
| Cl | 97 |
| BUN | 62 |
| Cr | 245 |
| Glucose | 5.8 |
| GFR | 27 |
| T bili | 7 |
| AST | 35 |
| ALT | 32 |
| Alk Phos | 125 |

| Urine | |
|---|---|
| LE | Negative |
| Blood | Negative |
| Nit | Negative |
| Protein | Positive |
| FENA | <1% |

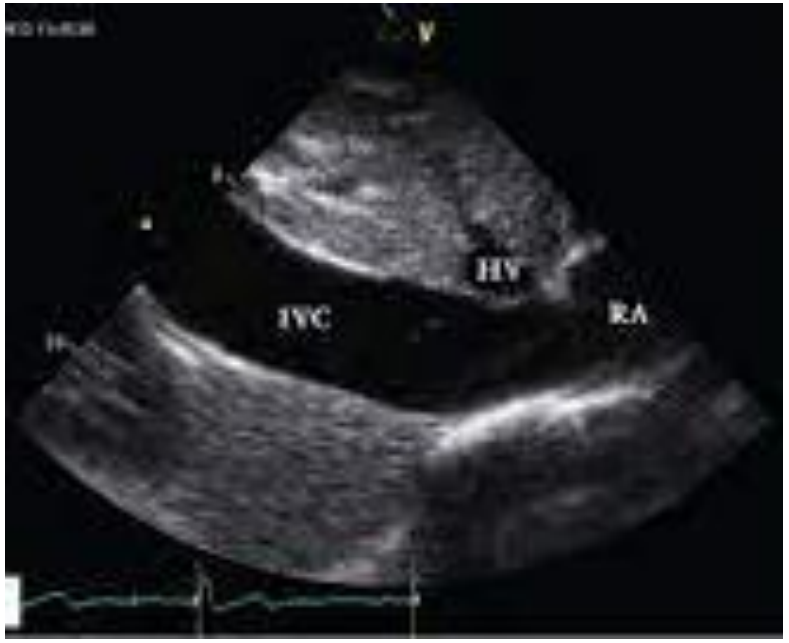
| Other | |
|---|---|
| A1c | 5.2 |
| Chol | 4.8 |
| LDL | 3.4 |
| HDL | 1.1 |
| Trigs | 2.1 |

Imaging

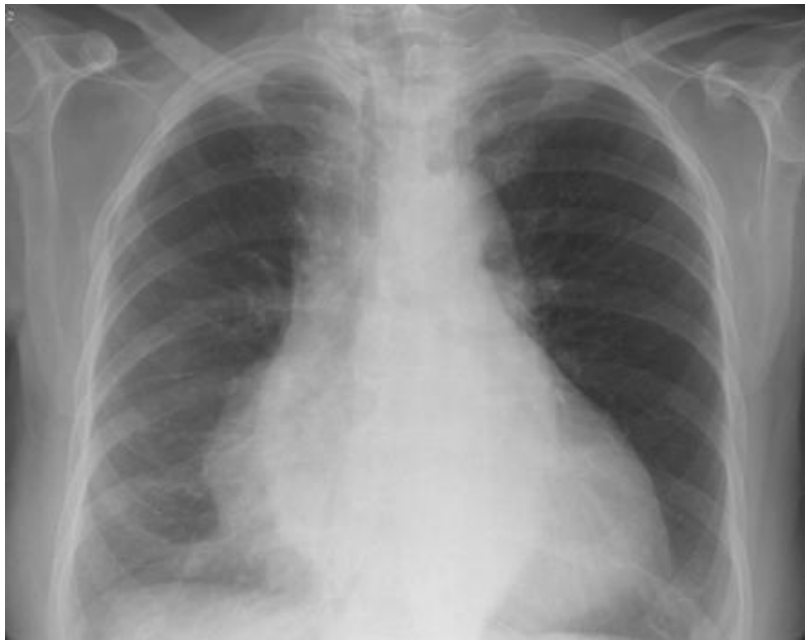
*indicates the test was likely not indicated with this clinical presentation

# Seed Global Health

## Imaging




U/S: non-collapsible IVC



CXR

Labs

*indicates the test was likely not indicated with this clinical presentation

# Seed Global Health

## Assessment

- Blessing is a 62yoF with a PMH of HTN and MI who presents with new onset CCF and pre-renal AKI due to intravascular depletion from third spacing due to her edematous state on top of existing CKD .

- Other causes of AKI:
  - Pre-renal from volume depletion and hypotension.
  - Renal: ATN, glomerulonephritis, nephritis.
  - Postrenal: stone, TB, BPH, stricture

# Seed Global Health

## Plan

- Need to correct the underlying problem which in this case is intravascular depletion and not systemic hypovolemia otherwise would be giving fluids in order to perfuse the kidneys.
- Treat the CCF exacerbation with furosemide and renal function should improve as the patient is diuresed.
- Hold the ACE-I while she is in AKI and resume once renal function has resolved.
- Avoid other nephrotoxic medications: NSAIDs, ARBs, aminoglycosides, contrast, amphotericin, tenofovir
- Prior to discharge will add an SGLT2-inh for its CCF and renal protective properties.
- Monitor for life threatening complications of AKI as indications for renal replacement therapy: anuria, hyperkalemia, poisoning/intoxication, uremia, pronounced azotemia, severe metabolic acidosis, severe oliguria, volume overload

# Seed Global Health

# Pre-Renal AKI Summary

## *Acute kidney injury* is most commonly pre-renal or ATN

- Defined as a creatinine rise ≥ 26.5 mmol/L over hours to days
- or urine output < 0.5mL/kg/h for 6-12 hours

## Findings typical of pre-renal AKI:

- FENA<1%
- BUN/Cr ratio >20 (for creatinine in mg/dL)
- Bland urine sediment

## Treatment:

- correct underlying cause, give supportive care, avoid nephrotoxic medications, make medication adjustments, correct electrolyte imbalances

## Avoid nephrotoxic meds:

- NSAIDs, ACE-I, ARB, aminoglycosides, contrast, amphotericin, tenofovir

## Complications that may need renal replacement therapy:

- anuria, hyperkalemia, poisoning/intoxication, uremia, pronounced azotemia, severe metabolic acidosis, severe oliguria, volume overload

# Seed Global Health

## Renal Case 2

Chief Concern | Histories | PE | Assessment | Plan

# Seed Global Health

## Chief Concern

Mabvuto is a 58yo male with a PMH of obesity, DM, HTN and HLD who presents a non-healing wound.

# Seed Global Health

## Histories

*HPI*: He has had a non-healing wound on his right foot and needs a pre-op visit prior to surgery. His last hospital admission was 6 months ago where his creatinine was 150 and his GFR was 52. He is currently on metformin 1g bid, lantus 46u, novolog 10u with meals, lisinopril 20mg, hydrochlorothiazide 25mg, atorvastatin 10mg, clindamycin 300mg bid.

*PMH:* Obesity, DM, HTN, HLD

*PSH:* none

*FH:* Obesity, DM, HTN, HLD

*Social:* Lives with his wife 4 children and 3 grandchildren. Works as a gardener. Eats out during the day. Denies smoking, has 4 beers nightly, denies drugs. Enjoys watching football, drumming and playing with his grandchildren.

# Seed Global Health

## Physical Exam

VITALS: T: 36.9, HR 78, RR 16, BP 147/84

GEN: Obese male in no acute distress

CV: S1, S2 normal, RRR, no m/r/g, radial 2+ b/l, dorsalis pedis 1+ b/l
RESP: CTAB, no w/r/c
ABD: soft, non-tender, non-distended, bowel sounds present
MSK: no edema
SKIN: Stage 4 ulcer at the 1st metatarsal head on the R foot
NEURO: no sensation to monofilament test in b/l feet

Labs

# Seed Global Health

## Labs

| FBC | |
|---|---|
| WBC | 7.5 |
| Hgb | 13 |
| Hct | 36 |
| Plt | 220 |

| RFTs/LFTs | |
|---|---|
| Na | 137 |
| K | 4.0 |
| Bicarb | 23 |
| Cl | 103 |
| BUN | 12 |
| Cr | 180 |
| Glucose | 10.6 |
| GFR | 42 |
| T bili | 7 |
| AST | 35 |
| ALT | 32 |
| Alk Phos | 125 |

| Urine | |
|---|---|
| LE | Negative |
| Blood | Negative |
| Nit | Negative |
| Bili | Negative |
| Alb/Cr | 652 |

| Other | |
|---|---|
| A1c | 8.3 |
| Chol | 4.8 |
| LDL | 3.4 |
| HDL | 1.1 |
| Trigs | 2.1 |

*indicates the test was likely not indicated with this clinical presentation

Imaging

# Seed Global Health

## Assessment

- Mabvuto is a 52yoM with a PMH of DM, HTN, HLD and obesity who presents with progressive kidney disease.  He has CKD due to a decreased GFR > 3 months, his stage is G3B/A3 from diabetes and hypertension.

- Other causes of CKD:
  - Prerenal: hypertension, renal artery stenosis, emboli.
  - Renal: diabetes, nephritic, nephrotic (SLE), cystic, drug/infection interstitial.
  - Postrenal: stone, cancer, BPH, stricture, fibrosis

# Seed Global Health

## Plan

- Need to correct the underlying problem which in this case is uncontrolled hypertension and diabetes.
- Goal blood pressure is <140/90 in CKD
- Goal A1c is <7 unless there are other co-morbidities or he progresses to CKD-IV
- He should be on renal protective medications including ACE-I, SGLT-2, GLP-1.
- Avoid common nephrotoxic medications like NSAIDs
- If he develops CKD-IV (IIIb) will need to refer to nephrology and monitor for complications of CKD with FBC, renal and liver function studies, Vit D, parathyroid, phosphorus
- Make medication adjustments as needed for decreased renal clearance
- Monitor renal function every 3 – 6 months depending on severity/progression of disease .

# Seed Global Health

## *Chronic kidney disease* is most commonly cause by DM and HTN

- Decreased renal function ≥ 3months
- GFR (G) Staging: >90: 1, 60-89: 2, 45-59: 3A, 30-44: 3B, 15-29 4, <15: 5
- Proteinuria (A) Staging: <30: A1, 30-300: A2, >300: A3

## Treatment by stage:

- G1-2/A1: Diagnosis. Treat underlying condition. Reduce risk.
- G3a-3b/A2: Evaluate and treat complications.
- G4/A3: Prepare for renal replacement therapy (referral to nephrology)
- G5: renal replacement therapy

## Medications used for renal protection:

ACE-inhibitor, ARB, SGLT-2 inhibitor

## Complications:

- Anemia, hyperkalemia, mineral and bone abnormalities with PTH, calcium, phosphorus, 25-hydroxy VitD, alkaline phosphatase

## Common medication adjustments:

- Analgesics, antifungals, antiglycemics, antivrials, antimicrobials, allopurinol, baclofen, colchicine, digoxin, lithium, LMW heparin, NOACs

# CKD Summary

# Seed Global Health

## Renal Case 3

Chief Concern | Histories | PE | Assessment | Plan

# Seed Global Health

## Chief concern

Bwalya is a 32yo female who presents to the emergency department feeling unwell.

# Seed Global Health

## Histories

*HPI*: Bwalya is a 32yoF with no significant PMH who presents 3 days after starting treatment for a UTI with gentamycin and feels she is getting worse. She has a hard time describing what is wrong but just feels bad all over. She has never had labs before other than the UA that showed a UTI.

*PMH:* none, takes ibuprofen 800mg tid as needed for headaches

*PSH:* none

*FH:* No early heart disease or cancers

*Social:* From Northern Province. Lives with her husband and 2 children ages 4 and 8yo. Works as a nurse. Enjoys dancing and eating out. Denies smoking, alcohol and drugs.

# Seed Global Health

## Physical Exam

VITALS: T: 37.1, HR 93, RR 16, BP 103/56

GEN: female appearing stated age in mild distress
CV: S1, S2 normal, RRR, no m/r/g, radial 2+ b/l, dorsalis pedis 1+ b/l
RESP: CTAB, no w/r/c
ABD: soft, non-tender, non-distended, bowel sounds present, no CVA tenderness
MSK: trace pitting edema b/l lower extremity
SKIN: no rash
NEURO: CN II-XII intact, strength 5/5, sensation equal and intact, reflexes 2+ diffusely, coordination intact

Labs

# Seed Global Health

## Labs

| FBC | |
|---|---|
| WBC | 7.5 |
| Hgb | 13 |
| Hct | 36 |
| Plt | 420 |

| RFTs/LFTs | |
|---|---|
| Na | 135 |
| K | 5.8 |
| Bicarb | 23 |
| Cl | 97 |
| BUN | 23 |
| Cr | 165 |
| Glucose | 4.8 |
| Ca | 9.5 |
| T bili | 10 |
| AST | 35 |
| ALT | 32 |
| Alk Phos | 97 |

| Urine | |
|---|---|
| LE | Negative |
| Blood | Negative |
| Nit | Negative |
| Bili | Negative |
| FENA | >2% |
| Micro | Muddy casts |
| UPT | Negative |

| Other | |
|---|---|
| A1c | 5.4 |
| Chol | 4.8 |
| LDL | 3.4 |
| HDL | 1.1 |
| Trigs | 2.1 |

*indicates the test was likely not indicated with this clinical presentation

# Seed Global Health

## Assessment

- Bwalya is a 32yoF with no significant PMH who presents generally feeling unwell 3 days after starting gentamycin for a UTI. This is likely an aminoglycoside induced acute tubular necrosis (ATN). There is no concern for pyelonephritis or other systemic disease as her physical and labs do not have CVA tenderness, elevated WBC, fever, elevated LE or NIT in urine.

- Other causes of AKI:
  - Pre-renal from volume depletion and hypotension.
  - Renal: ATN, glomerulonephritis, nephritis.
  - Postrenal: stone, TB, BPH, stricture

# Seed Global Health

## Plan

- Need to correct the underlying problem, stop gentamycin
- Can give fluids if she shows signs or has labs consistent with dehydration.
- Monitor for overload, hyperkalemia and metabolic acidosis until she recovers
- Avoid other nephrotoxic medications: NSAIDs, ARB, ACE-I, contrast, amphotericin, tenofovir
- Monitor for life threatening complications of AKI as indications for renal replacement therapy: anuria, hyperkalemia, poisoning/intoxication, uremia, pronounced azotemia, severe metabolic acidosis, severe oliguria, volume overload
- She should fully recover and not need long term follow up

# Seed Global Health

# AKI - ATN Summary

## Acute kidney injury is most commonly pre-renal or ATN

- Defined as a creatinine rise ≥ 26.5 mmol/L over hours to days
- or urine output < 0.5mL/kg/h for 6-12 hours

## ATN Phases:

- Initiating: Decreased GFR, increased creatinine and BUN
- Maintenance: salt/water overload, hyperkalemia, metabolic acidosis
- Recovery: increase in urine volume, loss of water/sodium/potassium and risk of infection

## Findings typical of ATN AKI:

- FENA >2%
- Muddy, granular, epithelial cell casts

## Treatment:

- correct underlying cause, give supportive care, avoid nephrotoxic medications, make medication adjustments, correct electrolyte imbalances

## Avoid nephrotoxic meds:

- NSAIDs, ACE-I, ARB, aminoglycosides, contrast, amphotericin, tenofovir

## Complications that may need renal replacement therapy:

- anuria, hyperkalemia, poisoning/intoxication, uremia, pronounced azotemia, severe metabolic acidosis, severe oliguria, volume overload

# Seed Global Health

## Gastrointestinal Case 4

Chief Concern | Histories | PE | Assessment | Plan

# Seed Global Health

## Chief Concern

Musonda is a 72yoM with a PMH of hypertension and depression presenting to the emergency room for urinary retention.

# Seed Global Health

## Histories

*HPI*: He last urinated yesterday morning and feels like there is a bowling ball in his pelvis.  He has never had this happen before and the only recent change was an over-the-counter pill he took from his daughter for his allergies.  Current medications lisinopril 10mg, hydrochlorothiazide 12.5, fluoxetine 20mg.

*PMH:* hypertension, depression

*PSH:* appendectomy

*FH:* No early heart disease or cancer

*Social:* Originally from Eastern Province.  Lives with his wife.  Use to work as a carpenter.  Enjoys watching football.  No smoking, alcohol or drugs.

# Seed Global Health

## Physical Exam

VITALS: T: 36.9, HR 78, RR 16, BP 182/98

GEN: Obese male in mild distress

CV: S1, S2 normal, RRR, no m/r/g, radial 2+ b/l,
RESP: CTAB, no w/r/c
ABD: soft, non-tender, non-distended, bowel sounds present, suprapubic fullness/mass and tenderness. No CVA tenderness.
MSK: no edema
RECTAL: Normal tone, no masses or fissures. Enlarged prostate..

Labs

Imaging

# Seed Global Health

## Labs

| *FBC | |
|---|---|
| WBC | 7.5 |
| Hgb | 13 |
| Hct | 36 |
| Plt | 220 |

| RFTs/LFTs | |
|---|---|
| Na | 137 |
| K | 4.2 |
| Bicarb | 23 |
| Cl | 103 |
| BUN | 12 |
| Cr | 210 |
| Glucose | 5.2 |
| GFR | 37 |
| T bili | 11 |
| AST | 35 |
| ALT | 32 |
| Alk Phos | 97 |

| Urine | |
|---|---|
| LE | Negative |
| Blood | positive |
| Nit | Negative |
| Culture | Pending |

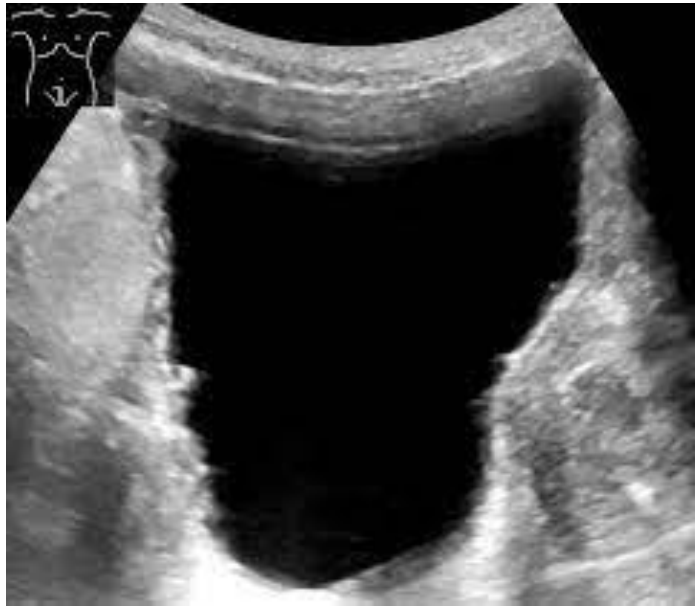
| Other | |
|---|---|
| PSA | 3.7 |

Imaging

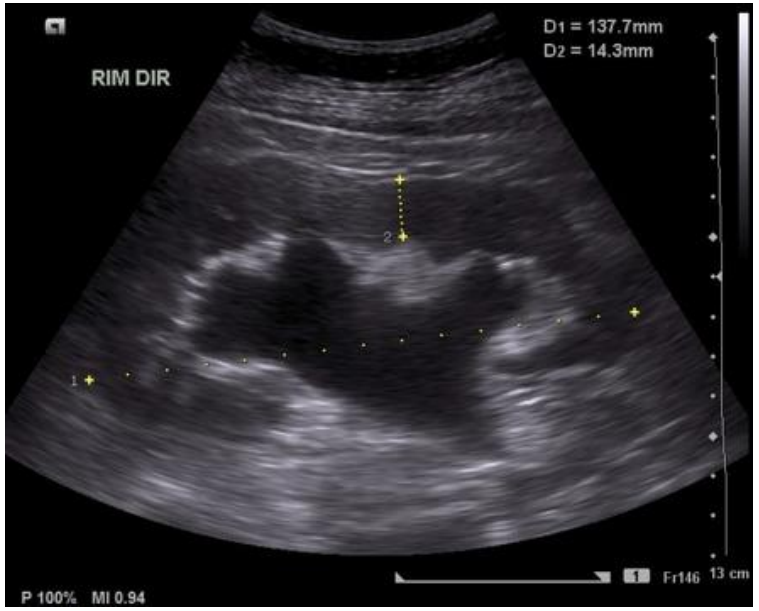
*indicates the test was likely not indicated with this clinical presentation

# Seed Global Health

## Imaging



*U/S bladder with 1500mL




*U/S of kidney with b/l hydronephrosis

Labs

*indicates the test was likely not indicated with this clinical presentation

# Seed Global Health

## Assessment

- Musonda is a 72yoM with a PMH of hypertension and depression who presents with acute urinary retention secondary to taking an alpha adrenergic decongestant with background benign prostatic hyperplasia.  At this point it is unclear if he has acute or acute on chronic kidney disease as there are no baseline labs for comparison.

- Other causes of CKD:
  - Prerenal: dehydration/hypovolemia, hypertension, renal artery stenosis, emboli
  - Renal: diabetes, nephritic, nephrotic (SLE), cystic, drug/infection interstitial
  - Postrenal: stone, cancer, stricture, fibrosis

# Seed Global Health

## Plan

- Need to correct the underlying problem which in this case is bladder decompression with catheterization and stop the decongestant, both of these will also treat his elevation in blood pressure.
- Can add tamsulosin or other alpha-1-adrenergic antagonist to relieve mechanical obstruction.
- Avoid other medications with anti-cholinergic properties i.e. decongestants, beta agonists, TCAs, antiparkinsonian agents, muscle relaxants and others
- Hold the ACE-I while she is in AKI and resume once renal function has resolved.
- Avoid other nephrotoxic medications: NSAIDs, ARBs, aminoglycosides, contrast, amphotericin, tenofovir
- Return in 3-7 days to perform a voiding trial to remove the urinary catheter
- Can repeat renal labs in 1 week and if still abnormal repeat in 3 months to diagnosis chronic kidney disease

# Seed Global Health

# Urinary retention Summary

## Urinary obstruction can cause both AKI and CKD

- M>F
- BPH, surgery, pain, constipation, other obstructive processes, acute medical illness or neurologic condition, urinary infection, or medications

## Diagnosis:

- Bladder ultrasound
- Urinary catheter
- Post void residual measurement
- Additional imaging is suspicion for obstruction, renal dysfunction, or malignancy

## Treatment:

- Catheterize (< 70 years old with a smaller prostate and < 1,000 mL of urine at the time of catheterization)
- Indwelling catheterization for 3 – 7 days with an alpha blocker if secondary to BPH
- Alpha blocker or cholinergic agent

## Medication classes that can cause acute urinary retention

- Anti-cholinergics, decongestants, beta agonists, TCAs, antiparkinsonian agents, muscle relaxants, antiarrhythmics, antipsychotics

## Reasons for hospitalization:

- Urosepsis, acute renal failure, or obstruction related to malignancy or spinal cord compression