NHS England

Kidney basics

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Functions of the kidneys

The kidneys have numerous functions and don't just produce urine

- Play a key role in regulating blood pressure
- Produce Erythropoietin that is vital in the production of red blood cells
- Maintains calcium and phosphate balance via the nephrons and through the activation of Vitamin D
- Maintain acid/base balance
- Maintain electrolyte balance, such as potassium and sodium
- Removal of waste products such as urea, creatinine, drugs and toxins

The launderette theory of renal function…..

Pre

Renal

Post

Pump

Inflow pipes

Cleaner

Outflow pipes

Blood supply in

Damage to kidney itself

Drainage of urine

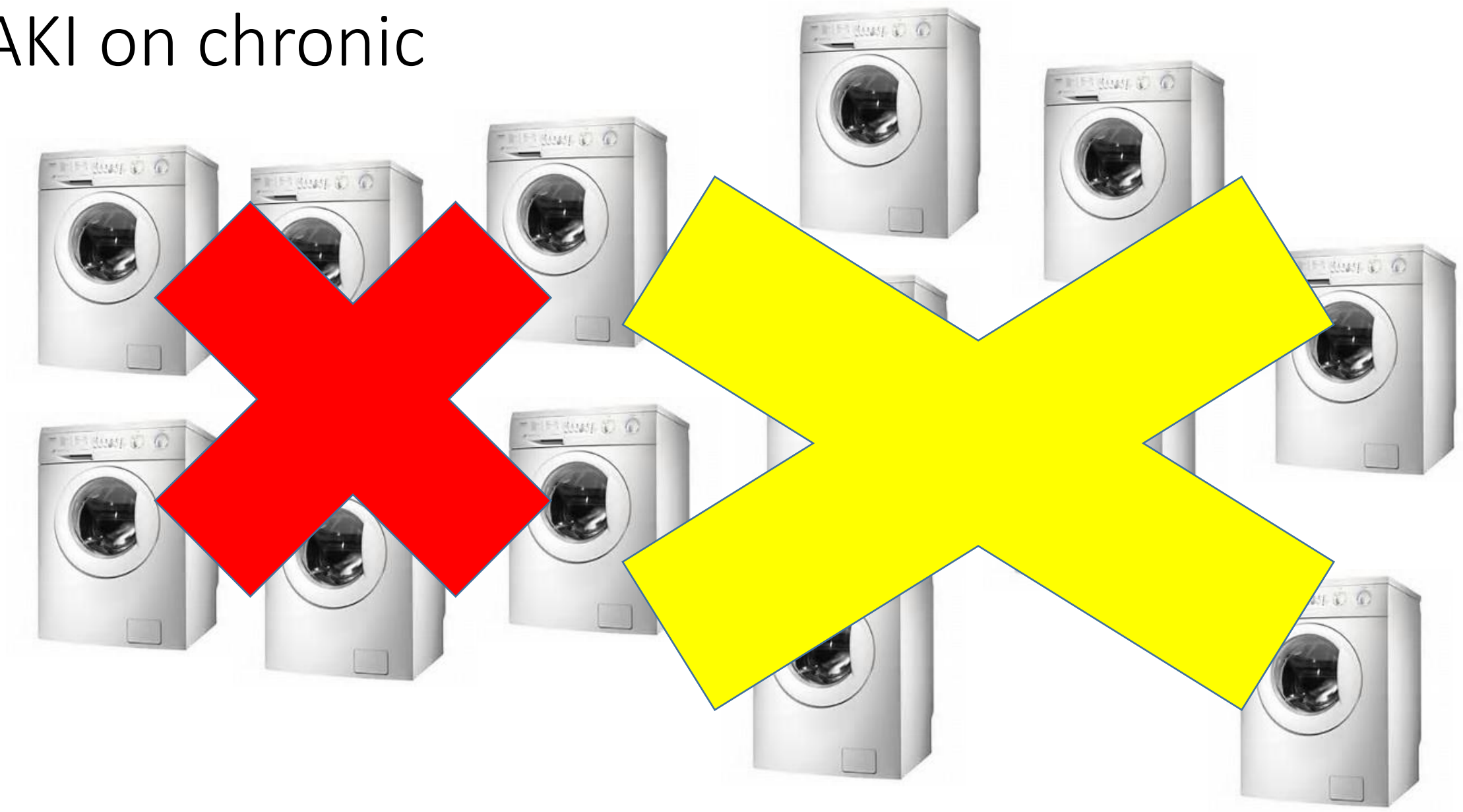
Acute kidney injury

Sudden insult can be largely reversed if treated quickly

Post AKI

Chronic kidney disease

AKI on chronic



Post AKI on CKD

The tea bag……

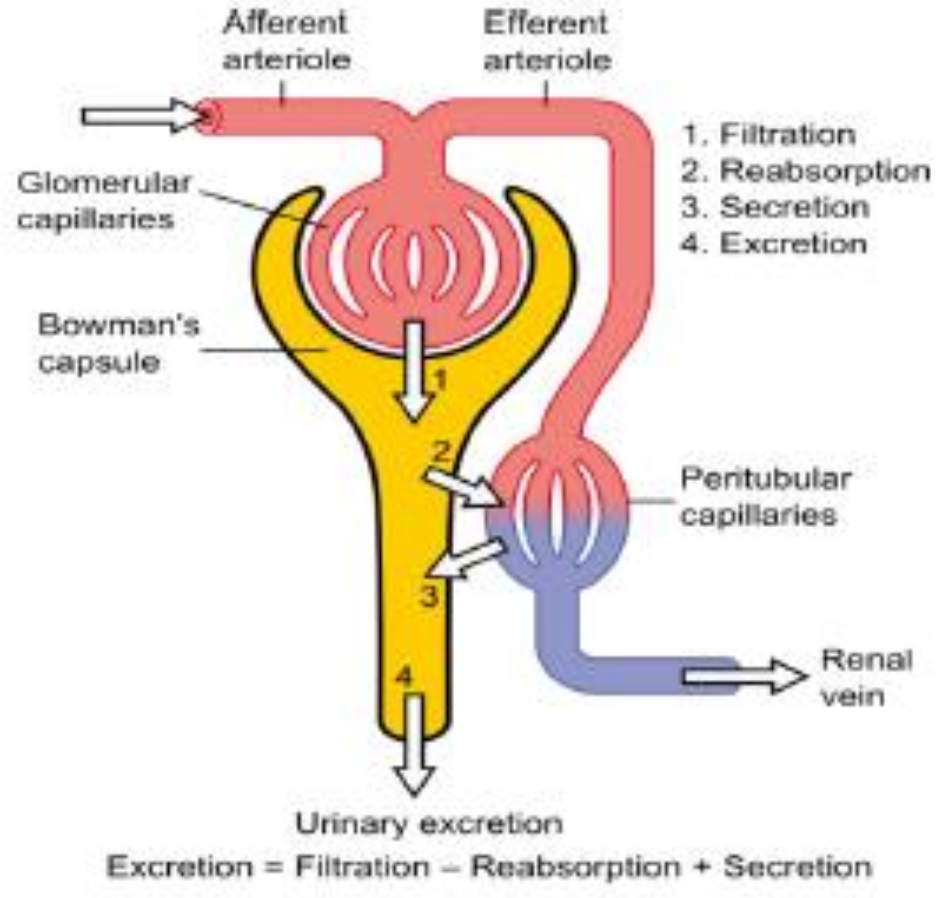
Kidney Dysfunction

- Kidney dysfunction can be seen as chronic or acute in nature
- Chronic Kidney Disease (CKD) is the gradual decline in renal function over months or usually years
- Acute Kidney Injury (AKI), formally known as acute renal failure, is the sudden deterioration of renal function over hours or days.
- People with CKD can also experience episodes of AKI – known as acute on chronic.
- People with CKD are most at risk of developing AKI

Drugs affecting blood supply in

Blood supply in

- ACEin /ARB
- NSAIDs
- Diuretics
- Blood pressure tablets
- Spironolactone



Drugs affecting kidney itself

Damage to kidney itself

- Gentamicin
- Amphotericin
- Carboplatin
- Lithium

Drugs to be aware of in kidney failure

- Metformin
- Insulin
- Opioids
- Gabapentin / pregabalin

NHS England

Acute kidney injury

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https://www.thinkkidneys.nhs.uk/aki/

RCGP AKI http://www.rcgp.org.uk/aki

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Drainage of urine

Consider INSULT and RISK FACTORS

Acute insult

Risk factors

Acute insult

Risk factors

CAUSES

Cardiac causes: MI, acute arrhythmia, acute LV dysfunction
Dehydration; diarrhoea and vomiting, poor intake, increased stoma output
Blood loss; trauma, GI bleed
Sepsis
Liver failure

Inflammatory renal disease; vasculitis
Myeloma
Drugs
Rhabdomyolysis
Pre-eclampsia

Obstruction:
Prostate enlargement: BPH or Ca
Malignancy; bladder, cervical, uterine, pelvic
Uterine fibroids
Bladder stones
Ureteric stone in single kidney

Pump

Inflow pipes

Cleaner

Outflow pipes

RISK FACTORS

Cardiac failure, uncontrolled AF, ileostomy, dementia, medication, elderly, immunosuppressed, vascular disease, diabetes, liver disease

Chronic kidney disease
Previous AKI

Catheter (blocking)
Known BPH or Prostate cancer
Stents

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Drugs increasing risk

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- NSAIDs
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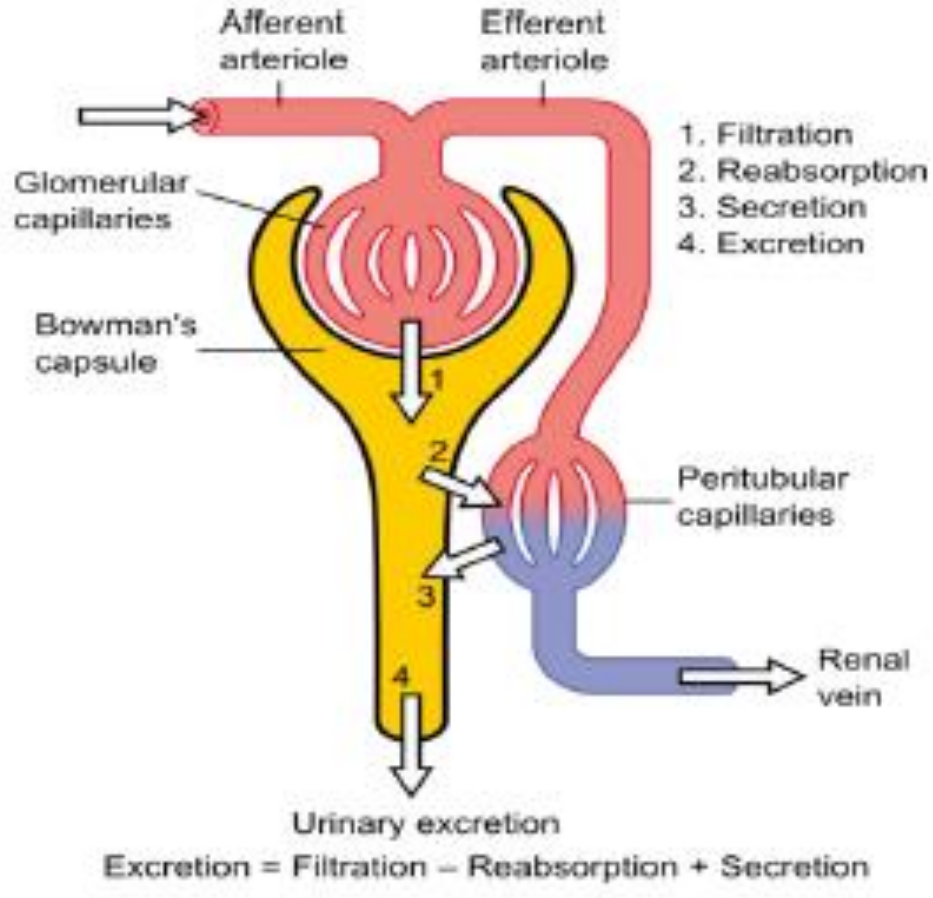
- Blood pressure tablets
- Spironolactone

Blood supply in



Drugs increasing risk: NEPHROTOXINS

Damage to kidney itself

- Gentamicin
- Amphotericin
- Carboplatin

Idiosyncratic; interstitial nephritis

- PPI
- Antibiotics
- NSAIDs
- And many others….

Drugs to be aware of in kidney failure

- Metformin
- Insulin
- Opioids
- Gabapentin / pregabalin

Detecting AKI

Testing

Blood tests

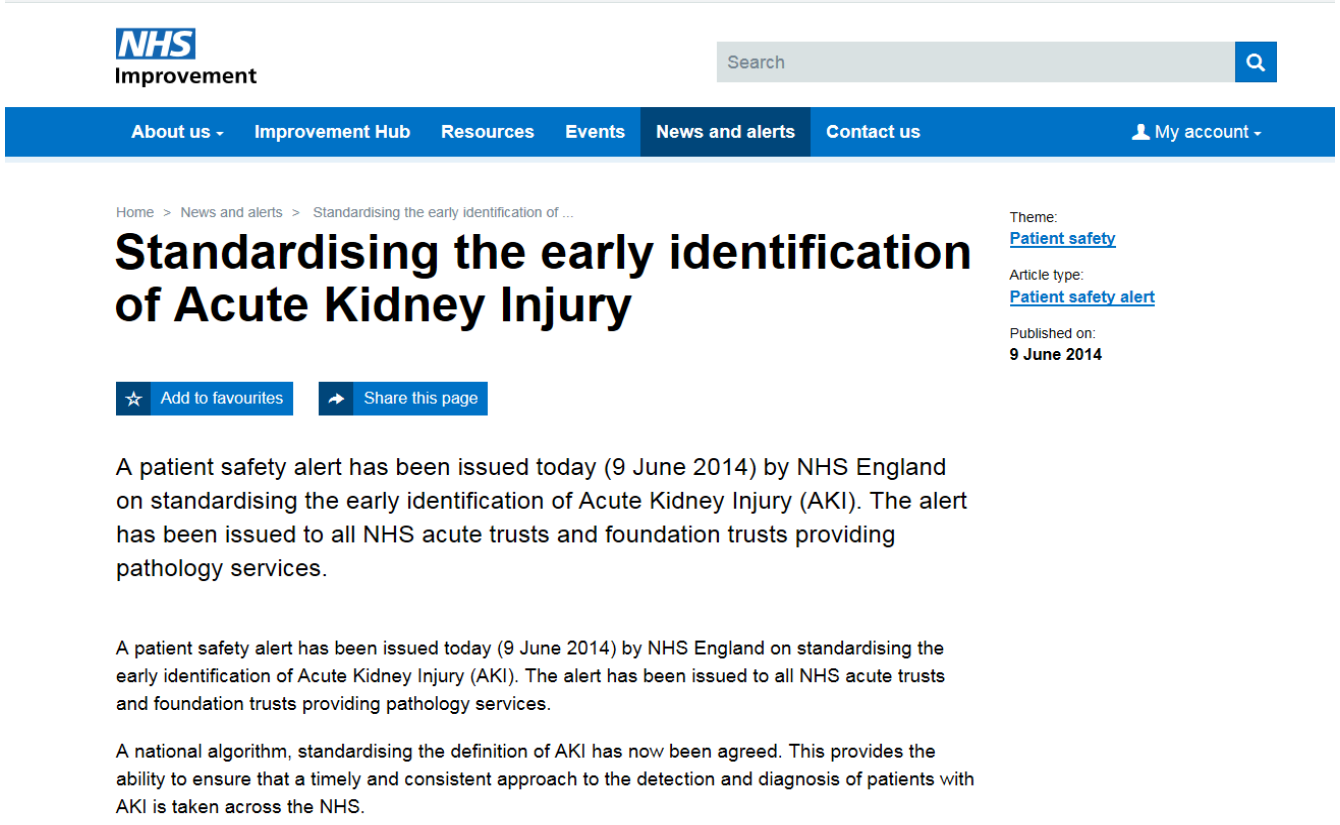
- Serum creatinine
- Need previous test to compare with
- No eGFR in AKI

AKI stage	
AKI stage 1	Cr >1.5x baseline or ↑ 26µmol/l in 24 hrs
AKI stage 2	Cr >2.0x baseline
AKI 3 stage 3	Cr >3.0x baseline or 1.5x and >354 µmol/l

Urine tests

- Urine dipstick
  - Blood and protein

AKI alerts



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Standardising the early identification of Acute Kidney Injury

Theme: Patient safety

Article type: Patient safety alert

Published on: 9 June 2014

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A patient safety alert has been issued today (9 June 2014) by NHS England on standardising the early identification of Acute Kidney Injury (AKI). The alert has been issued to all NHS acute trusts and foundation trusts providing pathology services.

A patient safety alert has been issued today (9 June 2014) by NHS England on standardising the early identification of Acute Kidney Injury (AKI). The alert has been issued to all NHS acute trusts and foundation trusts providing pathology services.

A national algorithm, standardising the definition of AKI has now been agreed. This provides the ability to ensure that a timely and consistent approach to the detection and diagnosis of patients with AKI is taken across the NHS.

This algorithm has been endorsed by NHS England and it is recommended that the algorithm is implemented across the NHS. When integrated into a Laboratory Information Management System (LIMS) the algorithm will identify potential cases of AKI from laboratory data in real time and produce a test result. The laboratory system will then send the test result, using existing IT connections to patient management systems.

AKI Warning Stage Test Result Confirm or refute automated AKI Test Result by comparing patient's current creatinine within clinical context against baseline creatinine	Clinical Context Within Which Blood Test Taken# If clinical context is unknown, then assume high pre-test probability until proven otherwise	
	LOW Pre-test Probability of AKI Stable Clinical Context	HIGH Pre-test Probability of AKI Context of Acute Illness
AKI Warning Stage 1 Current creatinine ≥1.5 x baseline level (or creatinine rise >26 µmol/L 48 hrs)	Consider clinical review ≤ 72 hours of e-alert* If AKI confirmed → manage as per table 2	Consider clinical review ≤ 24 hours of e-alert* Likely Stage 1 AKI → manage as per table 2
AKI Warning Stage 2 Current creatinine ≥2 x baseline level	Consider clinical review ≤ 24 hours of e-alert* If AKI confirmed → manage as per table 2	Consider clinical review ≤ 6 hours of e-alert* Likely Stage 2 AKI → manage as per table 2
AKI Warning Stage 3 Current creatinine ≥3 x baseline level (or creatinine 1.5 x baseline and >354 µmol/L)	Consider clinical review ≤ 6 hours of e-alert* If AKI confirmed → consider admission	Consider Immediate Admission* Likely Stage 3 AKI

#Clinical Context

Why was the blood test taken?

- Routine chronic disease monitoring
- Drug monitoring
- Assessment of acute illness

Creatinine rise within stable clinical context may reflect unstable CKD instead of AKI, especially if longer time period between current and baseline creatinine.

***AKI Risk Factors/Clinical Features Prompting Earlier Review**

- Poor oral intake/urine output
- Evidence of hyperkalaemia, especially if moderate(K+ 6.0-6.4) or severe (K+ ≥ 6.5)¥
- Known history of CKD stages 4 & 5 or history of kidney transplant
- Deficient Immunity
- Frail with co-morbidities (CKD, diabetes, heart failure, liver disease, neurological or cognitive impairment)
- Past history of AKI
- Suspected intrinsic kidney disease
- Suspected urinary tract obstruction

Management

"Think" Cause	"Think" Medication#	"Think" Fluids	"Think" Review¥
History of acute Illness? • Think Sepsis • Think Hypotension Intrinsic kidney disease? (E.g. vasculitis) • Think Urinalysis Urinary tract obstruction?	Any medication which could exacerbate AKI? Consider withholding: • NSAIDs • Diuretics • Antihypertensive medication Any medication which may accumulate and cause harm during AKI? Any new medication that may cause AKI?(E.g. drug induced tubulo-interstitial nephritis)	What is the patient's volume status? If hypovolemia present: • When did patient last pass urine? • Can the patient increase fluid intake? • Is admission for IV fluid replacement and monitoring required? Does the patient have and/or need carer support?	Does the patient need acute admission? If not, when will you review? Have you ensured handover?¥

Tightrope walkers

Heart failure

- Poor pump

- Diuretics
- ACEin / ARB
- Spironolactone

- CKD

Treat the patient and the bloods not just one or the other

Take advice

Just keep the ship steady…..

Mrs AG 83 yr old lady

- Baseline CKD with
  - eGFR 34ml/min.
  - creatinine 135umol/l but fluctuates
- Heart failure on furosemide 80mg daily
- ACE inhibitor: ramipril 5mg daily
- BP 125/50
- Diabetic on gliclazide

- Diarrhoea and vomiting

- Bloods:
- Creatinine 180umol/l

AKI 1 alert

Action?

Mr PK 65 yr old male

- Baseline CKD last measured 2 years ago
  - creatinine 160 umol/l
  - eGFR 40ml/min
  - ACR 40mg/mmol
- Diabetic. Control not great on metformin
- Hypertension
  - Clinic BP 160/95
- Recheck bloods as in the surgery
- Results:
  - Creatinine 220umol/l
  - (eGFR 28ml/min)
  - ACR 80mg/mmol
- AKI 1 alert
- Action?

83 yr old man

- Renal function checked 1 year ago
  - Creatinine 100umol/l
  - eGFR 66 ml/min
- 12 month history of increased frequency and nocturia
- 1 week history of less urine out put
- 2 day history of high fever
- BP 90/50, tachycardic and unwell
- Creatinine 400umol/l
- K 6.5 mmol/l
- AKI 3 alert
- Action?

56 yr old woman

- Renal function checked 2 years ago as borderline hypertensive
  - Creatinine 50 umol/l
  - eGFR >90 ml/min

- 2 month history of non –specific illness with weight loss
- 3 month history of nose bleeds
- Rash: 1 week
- Creatinine 150umol/l

82 yr old male

- Baseline renal function
  - Creatinine 120 umol/l
  - eGFR 53ml/min
- Fell and hurt ribs
- Constipated
- Not so well

- Creatinine 220 umol/l
- Calcium 2.8 mmol/l
- Hb 89g/l
- ESR 120

- Immunoglobulins raised IgG 26g/l, others suppressed
- Serum protein electrophoresis paraprotein IgG

- Serum free light chains

Beware…..

- Protein supplements in young people
- Trimethoprim

- Last renal measure was:
  - In hospital on iv fluids or after long admission / period of poor nutrition
  - In pregnancy

Summary AKI

- It’s common and it increases risk of death
- Balance of insult vs risk factor
- Review reason for blood tests in the first place for speed of review needed
- Repeat if unexpected and patient well

- Restart needed medication promptly on recovery; take advice if needed