Supporting the delivery of equitable, high quality AKI care through collaboration

We are part of London strategic clinical networks
We work with Think Kidneys
We were funded by Health Education North Central and East London

This information also available at londonaki.net and on our Londonaki app for Android, iPad and iPhone

Hospital guidelines databases and e-alert notifications can be linked to www.londonaki.net/clinical

Full supporting educational resources at: www.londonaki.net/academy

Twitter: @londonaki
The London AKI Manual 2.0 (2015) contents have been updated in line with the following recent guidance

NICE Clinical Guideline 169 (2013)
NICE Clinical Guideline 174 (2014)
NICE Quality Standard 76 (2014)
Joint UK Renal Association, Royal College of Radiologists and British Cardiovascular Intervention Society guidance on prevention of contrast-induced acute kidney injury (CI-AKI) in adult patients (2014)
London Health standards on inter-hospital transfers 2014

The manual synthesises other available National guidance (referenced). Its contents were informed in consultation with network clinical leads across London in 2012. Updates have been ratified by the London AKI Network Board

Updates will be reviewed every three years on the basis of new national guidance or emergent evidence
The manual collates available evidence, national guidelines and clinical standards into clear AKI patient pathways and accessible, practical advice. It is designed for those managing AKI in general ward areas. It also aims to clarify the interaction between general wards, local critical care and regional kidney unit services. The availability of a written guideline with this content is an NCEPOD standard for each NHS Trust.

Use of the guidelines and manual is optional. Trusts may operationalize the manual contents as a Trust guideline or adapt its contents to local needs. Trusts are encouraged to link guideline databases to our clinical guideline (http://www.londonaki.net/clinical) and users may access our general educational resources on www.londonaki.net/academy

We will guarantee that this guideline will be quality assured, updated on a three yearly basis and that the feedback of network members will inform its development.

Definitions of AKI have not changed. AKI is present if there has been a 1.5 rise in serum creatinine from a presumed 7 day baseline or a >26micmol/l rise within 48 hours. The National AKI detection algorithm will produce a ‘test message’ incorporating an annualised median baseline, however clinicians must use discretion in interpreting such test messages.

The AKI care bundle (management and investigation) should be instituted for all patients classified as AKI i.e. 1.5 x rise from the most recent baseline Cr (in the last year) or 6 hours of oliguria (0.5mls/kg/hr). While the bundle may be instituted earlier (e.g. for creatinine rises of >26micmol/ml) we recommend pathway activation as a basic standard of care for patients who have even mild AKI at this threshold.

Patients who progress to, or have, AKI 3 which represents >80% loss of kidney function, should be discussed with the local nephrology (2013 NICE guidance) with the exception of multi-organ failure patients managed in critical care. We also recommend that such severe, ward-based AKI patients should be discussed with local critical care teams.

Nephrology advice should be sought on any AKI patient unless the cause has been identified and that cause can be effectively treated by the base team.

Patients with even mild AKI should be referred to nephrology services if primary renal disease is suspected (e.g. glomerulonephritis, tubulointerstitial nephritis, haemolytic uraemic syndrome). Such patients need specialist nephrology diagnosis (possibly including renal biopsy) and management.

If transfer to critical care is required this should be as soon as possible. Transfer target to kidney unit is 24 hours, but there are currently heavy demands on acute renal bed usage at some sites.

Patients with evolving multi-organ failure should be managed locally in critical care. They will generally not meet transfer safety criteria. Guidelines for this and who should be referred from ITU to renal are in the manual.

The basic panel of investigations is USS, dipstick and routine haematology and biochemistry. More specialist tests (anti-GBM etc) may be done but results delivery should not delay the referral process.

USS should be performed<24 hours for all non-recovering AKI where the cause is not obvious. The target is <6 hours where urinary obstruction with infection is suspected. (NICE 2013).

In general single organ support should be provided within the regional renal unit. Some patients need stabilisation prior to transfer as outlined in the guideline. In some patients having on-going specialist care (e.g. complex surgery or cancer care) it may be preferable to manage the patient in the local ITU to maintain continuity with the base speciality teams.

Temporary lowering of K with insulin and dextrose does not facilitate safe transfer (as there may be rebound in transit) and hyperkalaemic patients should have onsite CVVH or bicarbonate prior to transfer such that the K lowering is likely to be sustained.

We would recommend early discussion with your nephrology or critical care teams when there is any uncertainty regarding the most appropriate clinical plan.

These are guidelines rather than binding protocols. Guidelines inform and harmonise practice but are not a substitute for the proper clinical assessment of individual cases. We will guarantee that our materials represent consensus, National guidelines, available evidence and are up to date. We cannot assume clinical responsibility for the consequences of deployment of these guidelines, appropriately or otherwise.
## Risk, Prevention and Recognition

### Some AKI Is Predictable, Preventable and/or Recognised Late

- **Risk Assess for AKI**
  - The risk of AKI is contributed to by the acute insult and background morbidity

#### Background
- Elderly (>65)
- CKD
- Cardiac failure
- Liver disease
- Diabetes
- Vascular disease
- Background nephrotoxic medications

#### Acute ‘STOP’
- Sepsis and hypoperfusion
- Toxicity
- Obstruction
- Parenchymal kidney disease

### Prevent AKI - The 4 ‘M’s

- **Monitor Patient**
  - (observations and EWS, regular blood tests, pathology alerts, fluid charts, urine volumes)
- **Maintain Circulation**
  - (hydration, resuscitation, oxygenation)
- **Minimise Kidney Insults**
  - (e.g. Nephrotoxic medications (NSAID, aminoglycosides, ACE/ARB, diuretics), surgery or high risk interventions, iodinated contrast and prophylaxis, hospital acquired infection)
- **Manage The Acute Illness**
  - (e.g. sepsis, heart failure, liver failure)

### Recognise AKI

- 1.5 rise from recent baseline creatinine, >26 rise in 48 hours, prompt from National algorithm or 6 hours of oliguria

### AKI Develops

### INSTITUTE CARE BUNDLE

- Prevent AKI progression by rapid diagnosis, supportive care, specific therapy and appropriate referral
AKI Care Bundle

Institute in all patients with a 1.5 x rise in creatinine or oliguria (<0.5mls/kg/hr) for 6 hours (for 26.4 micmol/l rises activating National detection algorithm assess and consider institution or recheck)

This is a Medical Emergency

Full set of observations, circulatory assessment, treat life-threatening complications, if NEWS triggering give oxygen, begin resuscitation and contact critical care outreach team

Diagnose the cause(s) and treat all – STOP AKI
Sepsis and hypoperfusion, Toxicity, Obstruction, Primary renal disease

Sepsis and hypoperfusion
- Circulatory assessment (history, heart rate, blood pressure, JVP, capillary refill (should be <3 secs), conscious level)
- Bolus fluids (e.g. 250-500mls balanced crystalloid) until volume replete with regular review of response.
- Senior review if no response 2 litres filling
- Stop antihypertensives if relative hypotension
- Infection/sepsis screening (history, examination, cultures, CRP) and antibiotics if suspected
- If severe sepsis ‘sepsis six’ and antibiotics < 1 hour

Toxicity
- Ascertain full drug history including contrast exposures
- Avoid further nephrotoxic insults if possible
- Stop ACE/ARB
- Stop NSAID
- If poisoning AKI (e.g. lithium, ethylene glycol) get specialist renal and toxicology help

Obstruction
- Ascertain any urological history. High index of suspicion if malignancy
- Examine or bedside scan for bladder, consider urinary catheter
- Perform renal tract imaging (ultrasound or CT KUB) <24 hours unless non-obstructive cause clear.
- If obstructed and infected urinary tract suspected (pyonephrosis) imaging <6 hours.
- If likely/suspected obstructed AKI refer urology.
- Target time to relief of obstruction 12 hours after diagnosis, immediate if infected.

Primary renal disease
- Ascertain relevant history (e.g. autoimmune disease, myeloma, HUS/TTP)
- Urine dipstick (all AKI patients). If protein high measure PCR.
- Check CK (rhabdo), CRP, FBC, If platelets low do blood film, bill, LDH, relics (HUS/TTP)
- Consider myeloma screen (Igs, Ig electrophoresis, serum free light chains, urine bench jones)
- Consider renal immune screen (ANCA, anti-GBM, ANA, complement, rheumatoid factor, Igs)
- If likely/suspected primary renal injury refer nephrology

General supportive care and escalation
- Once euvoalaemic give maintenance fluids (e.g. output plus 500mls), fluid chart, daily weights, regular fluid assessment
- Regular (at least 4 hourly) observations/NEWS with clear escalation plans
- Review all drug dosages, consider proton pump inhibitor, consider dietetic review and nutrition
- Urea, electrolytes, bone and venous bicarbonate at least daily, consider ABG
- Monitor for complications, treat and escalate
- Severe AKI (AKI 3) should be discussed nephrology and critical care regardless of cause

Follow up
- Ensure patient/carers have adequate support and information
- Monitor recovery to completion and ensure adequate follow up arrangements in place
# AKI Care Bundle Checklist

**Patient Name:** ................................................................................

**No:** ............................................ **DOB:** ...........................................

## URGENT ASSESSMENT
- ABC and full set of observations
- Oxygen therapy?
- National early warning system triggering
- Critical care outreach called (if triggering)

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
</table>

## DIAGNOSE THE CAUSE(S)
- Sepsis and hypoperfusion
- Toxicity
- Obstruction
- Primary renal disease

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
</table>

## TREAT THE CAUSE(S)
- Bolus fluid to restore hypovolaemia
- Sepsis screening and antibiotics
- Severe sepsis antibiotics <1 hour and 'sepsis six'
- Relative hypotension stop antihypertensives
- Stop nephrotoxins (including ACE/ARB/NSAID)
- If obstruction confirmed referred urology
- Obstruction relieved
- If primary renal disease suspected referred nephrology
- If indicated therapy for renal disease given

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
</table>

## GENERAL SUPPORTIVE CARE AND ESCALATION
- Maintenance fluid prescription and monitoring plan
- Physiological monitoring plan
- Maintenance drugs and dosages reviewed
- Monitoring blood tests arranged

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
</table>

## AKI REFERRAL AND ESCALATION
- Referral pathway reviewed
- Referred nephrology (AKI 3, no recovery, complications cause unclear or primary renal disease)
- Referred local critical care (AKI 3, no recovery, complications)

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
</table>

## FOLLOW UP
- Patient/carer adequate support and information
- Follow up arrangements in place and communicated to relevant clinicians

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
</table>

Signed: .............................................................

Date: ..................................................................

Position: ...........................................................

Fix patient sticker here
The London AKI Network has Developed the ‘STOP’ Acronym to Improve Awareness of AKI Causes

**S**epsis & hypoperfusion  **T**oxicity  **O**bstruction  **P**rimary renal disease

<table>
<thead>
<tr>
<th>SEPSIS &amp; HYPOPERFUSION</th>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe Sepsis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haemorrhage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dehydration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac Failure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liver Failure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renovascular Insult (E.G. Aortic Surgery)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOXICITY</th>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nephrotoxic Drugs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iodinated Radiological Contrast</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBSTRUCTION</th>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bladder Outflow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stones</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tumour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical Ligation Of Ureters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extrinsic Compression (E.G. Lymph Nodes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retroperitoneal Fibrosis</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRIMARY RENAL DISEASE</th>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glomerulonephritis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tubulointerstitial Nephritis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhabdomyolysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haemolytic Uraemic Syndrome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myeloma Kidney</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malignant Hypertension</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Signed: ..............................................................

Date: ..............................................................

Position: ...........................................................
**AKI Complications**

- **Hyperkalaemia, Acidosis, Pulmonary Oedema, Reduced Conscious Level**
- **Begin Medical Therapy and Get Help**
- **Local Critical Care Team and Local Nephrology Team (if onsite)**

**Hyperkalaemia**
Medical therapy of hyperkalaemia is a transient measure pending imminent recovery in renal function or transfer to kidney unit or critical care for renal replacement therapy. If ECG changes give calcium gluconate 10mls 10%.
If bicarbonate <22mmol/L and no fluid overload give 500mls 1.26% sodium bicarbonate over 1 hour. K>6.5mmol/L or ECG changes give insulin 10 international units in 50mls of 50% dextrose over 15 minutes & salbutamol 10mg nebulised (caution with salbutamol in tachycardia or ischaemic heart disease).
Insulin/dextrose and salbutamol reduce ECF potassium for <4 hours only.

**Acidosis**
Medical therapy of acidosis with bicarbonate should be reserved for emergency management of hyperkalaemia (as above) pending specialist help.
P<7.15 requires immediate critical care referral.

**Pulmonary Oedema**
Sit the patient up and give oxygen (60-100% unless contraindicated)
If haemodynamically stable give furosemide 80mg IV. Consider repeat bolus and infusion at 10mg/hour
If haemodynamically stable commence GTN 1-10mg/hour titrating dose.

**Reduced Conscious Level**
Manage uremic coma as per all reduced consciousness (airway management) pending critical care transfer and emergency renal replacement therapy.

**These are Holding Measures Prior to Specialist Help from Critical Care or Nephrology Services**
Referral from Ward

All AKI
with
Blood or protein on dipstick
Possible autoimmune disease/glomerulonephritis, myeloma
Possible HUS/TTP, hypertension
Poisoning.
Renal transplant and CKD stage 4/5

All AKI
with
Obstruction on USS
(NB partially obstructed patients may have normal or high urine volumes).

Local Renal Team
*If transfer decided see AKI transfer policy*

Local Urology Team
*If nephrostomy or stenting required proceed immediately*

Progression to AKI 3 Or AKI 3 at Recognition or AKI Complications and Imminent Recovery Unlikely

Local Renal Team
*or*
Local Critical Care Team
(essential if the patient is developing multi-organ failure)

If the Patient Is Too Ill To Transfer (see AKI Transfer Policy)
Contact Local Critical Care Team

Institute AKI Care Bundle While Transfer Pending

Dataset Needed for Kidney Unit Referrals
U and E, Calcium, Phosphate, ABG/lactate, FBC, coagulation, LFTs.
Heart rate, respiratory rate, blood pressure, Oxygen saturations.
AVPU or GCS score.
Urine output.
AKI grade and pre-morbid Cr level.
Urine dipstick.
USS if obtained.
Co-morbid history.
MRSA status (if known).
Referral from Ward to Kidney Unit Checklist

The following data are required for referral to your local renal service
Please use this checklist to ensure you have all this essential information
This checklist is also available on the London AKI iPhone App

**Patient Name:** ..........................................................................................................

**No:** ............................................... **DOB:** ......................................................

<table>
<thead>
<tr>
<th>Item</th>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea and Electrolytes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arterial Blood Gases and Lactate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urine Dipstick</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USS Result (if performed)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline Renal Function (if known)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Past Medical History</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood Pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart Rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen Saturations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory Rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avpu or GCS Assessment of Conscious Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Urine Volume</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mrsa Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whether Diarrhoea Last 48 Hours</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Signed: ...............................................................

Date: ..................................................................

Position: ...........................................................

Fix patient sticker here

**website:** www.londonaki.net

**email:** info@londonaki.net
Transfer From Ward to Kidney Unit  
(interhospital transfer)

The following is a guideline for whether patients are safe to transfer from a ward to a kidney unit in another hospital. All AKI patients for transfer should be assessed by a senior (ST4+) doctor.

**Hyperkalaemia**
No ECG changes.
K < 6.0mmol/L.
If K lowered to <6.0 after presentation this must be potentially sustained (e.g. bicarbonate therapy or dialysis/CVVH) not transient therapy (insulin and dextrose).

**Renal Acidosis**
pH > 7.2.
Venous bicarbonate > 12mmol/L.
Lactate < 4mmol/L.

**Respiratory**
Respiratory rate > 11 and < 26/min.
Oxygen saturations > 94% on not more than 35% oxygen.
If patient required acute CPAP must have been independent of this treatment for 24 hrs.

**Circulatory**
Heart rate > 50/min and < 120/min.
Blood pressure > 100mmHg systolic.
MAP > 65MMHg.
Lactate < 4mmol/L.
(lower BP values may be accepted if it has been firmly established these are pre-morbid).

**Neurological**
Alert on AVPU score or GCS >12.

If Criteria not Met Emergency Referral to Local Critical Care
*Once stabilised follow ITU to acute kidney unit transfer policy.*
The following is to enable renal teams to screen referrals for transfer safety. All AKI patients for transfer should be assessed by a senior (ST4+) doctor. This checklist is also available on the London AKI iPhone App.

Patient Name: ..........................................................................................
No: .................................................. DOB: ...............................................  

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium &lt; 6.0mmol/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH &gt; 7.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venous Bicarbonate &gt; 12mol/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium (ionised &gt; 1mmol/l, total &gt; 2mmol/l)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactate (&lt; 4 mmol/l)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood Pressure (&gt; 100mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAP (&gt; 65mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart Rate (&gt; 50/min and &lt; 120/min)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen Saturations (&gt; 94% on not more than 35% O2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory Rate (&gt; 11/min and &lt; 26/min)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVPU Alert or GCS &gt; 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All AKI patients for transfer should be assessed by a senior (ST4+) doctor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRSA Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whether Diarrhoea in Last 48 Hours</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Signed: .................................................................
Date: ...........................................................................
Position: ........................................................................
Requests for nephrology advice (not-transfer) on critical care patients should be made to liaison nephrologist for the hospital or, if unavailable, to local on-call renal team.

Referral for nephrology opinion is at the discretion of the consultant intensivist and generally not necessary in patients with AKI in the context of multi-organ failure.

Referral is recommended if

- Possibility of AKI as an initiating event (with subsequent systemic decompensation) - i.e. AKI 3 early in illness.
  - Single organ failure.
- AKI with possible vasculitis, lupus or autoimmune disease.
- AKI in myeloma or malignancy or tumour lysis.
- AKI with unexplained pulmonary infiltrates or pulmonary haemorrhage.
  - HUS/TTP.
- AKI in pregnancy.
- AKI with urological abnormalities.
- AKI with malignant hypertension.
- AKI with poisoning.
Transfer From Critical Care to Kidney Unit
(interhospital transfer)

Phone Local Renal Team

If the Patient is Accepted for Transfer, a Handover to Critical Care in Receiving Hospital Should be Done and Critical Care Outreach Informed

Further discussion with receiving hospital intensivist not required if condition stable or improving

Below is a Guideline for What Would be Considered a Safe ITU to Kidney Unit Transfer. These Transfers Should be Discussed at a Senior Level.

Metabolic
K < 6.0, ionised Ca > 1mmol/L.
pH normal.
Bicarbonate > 16mmol/L.
Lactate normal.

Respiratory
Respiratory rate >11/min and < 26/min.
Saturations > 94% on not more than 35% oxygen.
If patient required acute CPAP must have been independent of this treatment for 24 hrs.
If ventilated <1 week should have been independent of respiratory support for 48hrs.
If longer term invasive ventilation should have been independent of all respiratory support for 1 day for each week ventilated and for a period of not less than 48 hours.

Circulatory
Heart rate > 50/min and < 120/min.
BP > 100mmHg systolic.
MAP > 65MMHg.
If given inotropes given must have been inotrope independent > 24 hours.

Neurological
Alert AVPU (unless stable, chronic neurological impairment).
Monitor Function To 72 Hours in High Risk Cases
If oliguria or rising creatinine early referral to local renal team.
NB there is no proven role for N-Acetyl cysteine, post-contrast dialysis/CVVH or routine cessation of metformin or ACE inhibitors.

High volume (>100mls) iodinated contrast procedure and CKD with eGFR<60 (particularly diabetic nephropathy) or AKI

Other risk factors: dehydration, heart failure, severe sepsis, cirrhosis, nephrotoxins (NSAIDS, aminoglycosides).

Risk factors are multiplicative.

Give Prophylaxis if High Risk

Volume expansion (unless hypervolaemic) with normal saline or 1.26% bicarbonate

Sample regimens
IV Na bicarbonate 1.26% 3mls/Kg/hr for 1 hour pre-procedure and 6 hours post-procedure
or
IV 0.9% normal saline 1ml/kg/hr 12 hours pre and 12 hours post procedure

Contrast Induced Nephropathy (CIN) Prophylaxis

website: www.londonaki.net
email: info@londonaki.net

Assess Risk

Is Contrast Procedure Necessary?

Resuscitate to Euvolaemia

Minimise contrast, use low or iso-osmolar contrast

Yes

Referral from Primary Care

AKI 3 at recognition (creatinine 3 x baseline)

Local Renal Team

Direct Admission to Kidney Unit for Assessment

AKI 2 at recognition (creatinine between 2 and 3 x baseline)

Local Acute Medical Team

Follow AKI Care Bundle and Referral Guideline

AKI 1 at recognition (creatinine between 1.5 and 2 x normal)

Follow Primary Care AKI Bundle
**Contrast Induced Nephropathy (CIN) Prophylaxis**

**Assess Risk**

- High volume (100mls) or intra-arterial iodinated contrast procedure
  - and
  - CKD with eGFR<60 (particularly diabetic nephropathy)
  - or AKI

  Other risk factors >75, dehydration, heart failure, severe sepsis, cirrhosis, nephrotoxins (NSAIDS, aminoglycosides). High volume or arterial contrast.

  Risk factors are multiplicative.

**Is Contrast Procedure Necessary?**

- Yes

**Resuscitate to euvoilaemia**

**Give Prophylaxis if High Risk**

  - Volume expansion (unless hypervolaemic) with normal saline or 1.26% bicarbonate
  - Sample regimens
    - IV Na bicarbonate 1.26% 3mls/Kg/hr for 1 hour pre-procedure and 6 hours post-procedure
    - or
    - IV 0.9% normal saline 1ml/kg/hr 12 hours pre and 12 hours post procedure

**Minimise contrast, use low or iso-osmolar contrast**

**Monitor Function To 72 Hours in High Risk Cases**

  - If oliguria or rising creatinine early referral to local renal team.
  - NB there is no-proven role for N-Acetyl cysteine or post-contrast dialysis/CVVH.
  - Cessation of metformin should be considered if serum Cr above reference range or eGFR<60.
  - Cessation of ACE inhibitors should be considered if acutely ill.
Perioperative AKI

Preoperative AKI Risk Assessment
(anaesthetic and surgical teams) in pre-assessment clinic or ward

ASA score, consider pre-operative CPEX testing.
Pre-morbid factors: 65 years old, CKD, diabetes, vascular disease, cardiac failure, liver failure.
In emergency surgery consider current patient stability/illness severity.
Type of surgery: If ‘major’ operation or known high risk (e.g. cardiac bypass, intraperitoneal surgery,
likely heavy blood loss or involving pelvis or renal tract).
Risk of perioperative nephrotoxic medications.

Consider pre-optimisation in ward or critical care area and scheduled post-operative admission to critical care.
There is no role for the routine use of dopamine or frusemide in perioperative AKI prevention.
Discontinue or avoid nephrotoxic drugs if possible.
If risk of long-term renal insufficiency (e.g. nephrectomy in CKD discuss with nephrology team).
Optimise circulation and oxygenation during surgery.

Postoperative AKI Risk Assessment

As per pre-op assessment. Assess surgery undertaken, blood loss, perioperative haemodynamic stability,
perioperative oxygenation and perioperative oliguria.

Monitor
Observations (blood pressure, heart rate, urine volumes, regular blood tests)

Postoperative resuscitation as appropriate

If postoperative AKI develops
Institute AKI Care Bundle and Referral Pathway

Consider and Treat Specific Surgical Causes
Blood loss, hypovolaemia, surgical sepsis, hypotension due to epidural or opiate anaesthesia,
postoperative urinary retention or obstruction of the renal tract as a surgical complication.
**Fluids**

### Adult Maintenance Fluids

**Baseline Requirements**
- 50-100mmol sodium, 40-80mol potassium
- and 1.5-2.5L water per 24 hours
- Oral, enteral or parenteral route

**Adjust estimated requirements according to changes in sensible or insensible losses**

**Sensible Losses**
- (measurable)
  - Surgical drains
  - Vomiting
  - Diarrhoea
  - Urine
  - (variable amounts of electrolytes)

**Insensible Losses**
- Respiration
- Perspiration
- Metabolism
- Increase in pyrexia or tachypnoea
  - (Mainly water)

**Regular assessment of volume and hydration status**
- Daily weights
- Fluid charts
- Measured electrolytes

**Available parenteral solutions (if required)**
- Hartman’s solution/Ringer’s lactate
- Normal Saline
  - 5% dextrose
  - 0.4%/0.18% dextrose/saline
- Potassium usually added additionally

### Adult Resuscitation or Replacement Fluids

**Give According to Clinical Scenario**

**General Volume Replacement or Expansion**
- Give balanced crystalloid solutions (Hartman’s solution/Ringer’s lactate)
  - These contain small amounts of potassium.
  - Avoid in hyperkalaemia. If AKI only use these if close (HDU) monitoring of potassium or

**Colloids**
- Avoid high molecular weight (>200kDa starches in severe sepsis due to risk of AKI
- Assess vital signs, postural blood pressure, capillary refill, JVP and consider invasive or non-invasive measurement using flow-based technology

**Haemorrhage**
- Give blood and blood products
  - Balanced crystalloid or colloid may be given while blood awaited
  - Clinical assessment as above

**Severe Free Water Losses (hypernatraemia)**
- 5% dextrose
- or 4%/0.18% dextrose/saline

**Hypochloraemia**
- (vomiting, NG drainage)
  - Give normal saline
  - (Potassium repletion usually also required)
Obstetric AKI Pathway

Institute in all cases with creatinine >90µmmol/L or serial creatinine rise of 26µmmol/L or 20ml/hr urine for 12 hours (if PET excluded)

**THIS IS POTENTIALLY A MEDICAL EMERGENCY**

- Full set of physiological observations BP/HR/RR/SATS/TEMP
- Assess for signs of shock/hypoperfusion- low BP/high HR/confusion/pale & cold skin
- Review history and past results If MEOWS triggering- high flow oxygen, Review senior/HDU/ITU

**Fluid therapy in AKI**

- If hypovolaemic give crystalloid 250ml. Followed by 125 ml/hr* Re-assess Catheterise if obstruction and measure hourly urine output

**Monitoring in AKI**

- Venous blood gas & lactate, U&E twice a day while creatinine rising Fluid chart, regular fluid assessment and observations

**Investigations in AKI**

- If proteinuria URGENT PCR Ultrasound (obstruction), Liver Profile, If low platelets blood film (fragmented RBC/PLT), LDH, Bilirubin, Reticulocytes

**Supportive AKI care**

- Sepsis- ANTIBIOTICS within an hour. Review drug chart/thromboprophylaxis

**Causes Think STOP AKI**

- Prerenal Sepsis/hypovolaemia (PPH)
- Renal Toxicity NSAIDS, PET, HELLP, HUS, TTP
- Postrenal Obstruction or ureteric damage during delivery

* Caution with PET

website: www.londonaki.net
email: info@londonaki.net
“STOP” - causes of AKI
Sepsis and hypoperfusion (hypovolaemia, heart failure, hepatorenal)
Toxicity (drugs, contrast)
Obstruction
Parenchymal kidney disease (myeloma, rhabdomyolysis, RPGN, HUS, TIN)

Rising creatinine = rising mortality

KDIGO Staging System for Acute Kidney Injury

<table>
<thead>
<tr>
<th>Stage</th>
<th>Serum creatinine</th>
<th>Urine output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>rise ≥ 26 µmol/L within 48hrs or rise ≥1.5- to 1.9 X baseline SCr</td>
<td>&lt;0.5 mL/kg/hr for &gt; 6 consecutive hrs</td>
</tr>
<tr>
<td>2</td>
<td>rise ≥ 2 to 2.9 X baseline SCr</td>
<td>&lt;0.5 mL/kg/hr for &gt; 12 hrs</td>
</tr>
<tr>
<td>3</td>
<td>rise ≥3 X baseline SCR or rise 354 µmol/L or commenced on renal replacement therapy (RRT) irrespective of stage</td>
<td>&lt;0.3 mL/kg/hr for &gt; 24 hrs or anuria for 12 hrs</td>
</tr>
</tbody>
</table>
References:


11. British Consensus Guidelines on Intravenous Fluid Therapy for Adult Surgical Patients. BAPEN Medical, the Association for Clinical Biochemistry, the Association of Surgeons of Great Britain and Ireland, the Society of Academic and Research Surgery, the UK Renal Association and the Intensive Care Society. 2008 - update 2011.


Acknowledgements

- We would like to thank Chris Kirwan for preparing the section on perioperative acute kidney injury, Danny Gale for preparing the section on acute kidney injury in thrombotic microangiopathy and Anita Bannerjee for preparing the section on AKI in pregnancy.
- We would like to thank Nick Macartney and Jeremy Dawson for their help with the bundle checklist.
- We would like to thank Health Education North Central and East London for Sponsoring the development of the manual.
- Chris Laing oversaw preparation of the London AKI Manual on behalf of London AKI Network

Permissions

These materials are copyrighted. We are very happy for the contents of this manual to be used in not-for-profit, non-London AKI Network materials. Please contact us for permissions and please do credit us.