Acute kidney injury (AKI)

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See also: Hypertension (Microguide > Paediatrics & Neonatology > Paediatrics > A-Z > H)

Background

AKI =
- A recent increase of >1.5x in creatinine from a previous baseline or a value of > 1.5 x upper limit of the reference interval for age.
- Usually associated with a fall in urine output <0.5ml/kg/hr for 8 hours.
- Creatinine result should be interpreted in the context of age, body and muscle mass and ethnicity.

BSUH reference ranges – for use in BSUH only

<table>
<thead>
<tr>
<th>Stage</th>
<th>Creatinine change from baseline/</th>
<th>Urine output</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>upper limit or eGFR (mL/min/1.73m²)</td>
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</tr>
<tr>
<td>1</td>
<td>&gt;1.5-2x or eGFR &lt; 75</td>
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<tr>
<td>2</td>
<td>2-3x or eGFR &lt; 50</td>
<td>&lt;0.5mls/kg for 8 hours</td>
</tr>
<tr>
<td>3</td>
<td>&gt;3x or eGFR &lt; 35</td>
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*AKI Warning Score

eGFR should be calculated using the method below. Alternatively contact a member of the paediatric pharmacy team for assistance with the calculation.

BSUH Paediatric Clinical Practice Guideline – Acute kidney injury

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### Assessment

#### Causes

<table>
<thead>
<tr>
<th>Pre-renal</th>
<th>Considerations in the history</th>
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<tbody>
<tr>
<td>- Hypovolaemia</td>
<td>• Signs and symptoms of hypovolaemia e.g. vomiting or diarrhoea, decreased UO, dizziness, lethargy</td>
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<tr>
<td>- Impaired Cardiac output</td>
<td>• FH of renal artery stenosis</td>
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<tr>
<td>- Renal vessel occlusion</td>
<td>• PMH: biliary atresia, cardiac disease</td>
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<tr>
<td>- Hepato-renal syndrome</td>
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</table>

#### Intrinsic renal disease

- Glomerulonephritis
- Involvement of renal microvasculature- HUS, HSP
- Interstitial nephritis
- Drugs
- ATN
- Tumour lysis syndrome

#### Post-renal or obstructive

- Posterior urethral valves
- Bilateral ureteric obstruction (trauma, calculi)
- Urethral obstruction (trauma, calculus)

#### Considerations in the history

- Recent viral illness
- Change in urine colour e.g. red or "coca cola" coloured
- History of transplant or nephrotoxic drugs
- Abdominal pain
- Reduced UO
- History of trauma
- History of kidney stones
- Frequent UTI’s

### eGFR Calculation

In children, eGFR is calculated using the following formula, in which:

\[
eGFR(\text{mL/min/1.73m}^2) = \frac{k \times \text{height(cm)}}{\text{serum creatinine (micromole/L)}}
\]

- For children <1 year, k = 30
- For children >1 year, k = 40
**Paediatric Clinical Practice Guideline**

**Management**

### 1. Risk Assessment
- Clinical history including infective symptoms, input output, Hx of transplant, renal disease, nephrotoxic drugs
- Fluid assessment - peripheral circulation, oedema, UO, mucous membranes
- Signs of cardiac failure
- Neurological exam - ?electrolyte derangement
- Full set of observations
  - BP (changes are late & measurements in isolation not usually helpful)

### 2. Initial management
- Stop **nephrotoxic drugs** and consider alternatives in acute illness
- Monitor **PEWS, weight and input / output** closely
- Check **renal function** early
- Optimise fluid balance
- Educate parents on risks of dehydration - give quantitative targets (100:50:20 rule)

### 3. Investigations
- **U&E, FBC, bone profile, blood gas** (bicarbonate)
- **Urinalysis, urine microscopy**

### High risk groups
- Nephro-urological, cardiac, liver disease
- Malignancy, bone marrow transplant
- Dependence on others for access to fluids
- Medication: ACE-I ARB, NSAID, diuretics, calcineurin inhibitors

### High risk scenarios
- History of reduced UO
- Sepsis
- Hypoperfusion or dehydration
- Nephrotoxic drug / toxin exposure
- Renal disease or urinary tract obstruction
- Major surgery

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**Urine output <0.5mls/kg/hr for 8 hour OR High risk scenario OR Concerns in high risk group**

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**Cr between ULRI and 1.5x ULRI**
- Repeat U&E - immediately then as advised by senior clinician or ECH

**AKI stage 1**
- If clinically relevant investigations as per AKI 2/3

**AKI stage 2 or 3**
- **C3/4, ASOT, immunoglobulins, ANA, ANCA, anti-GBM, CK, LDH, blood film**
- **Urinary tract USS**
- **CXR and echocardiography**
- **Catheterisation if obstructed**
Fluid management in AKI

Clinical assessment of Fluid Status
- Fluid assessment - peripheral circulation, oedema, urine output
- Signs of cardiac failure - raised JVP, hepatomegaly, peripheral pitting oedema, bilateral lung creps
- Blood pressure (changes are late and measurements in isolation not usually helpful)
  - Low BP with cool peripheries -> intravascular depletion and shock
  - High BP with warm peripheries -> fluid overload

Hypovolaemia
1. Fluid challenge 10 ml/kg 0.9% sodium chloride
   STAT
2. Initial fluid replacement = insensible losses (400ml/m²/day) + UO (last 24h)

Euvolaemia
- Fluid challenge 10 ml/kg 0.9% sodium chloride over 1 hour

Overloaded
- Furosemide IV infusion 3-5 mg/kg up to 4 times a day (max dose 250mg; max 1g/day) may be considered but this
  should be a decision by a senior clinician

If any concerns outside of this list, please discuss with ECHL

If renal function continuing to improve, set fluid target.
Ongoing management “Monitor, Maintain, Minimise”

1. Monitor

   o **Strict and accurate input / output**
     At least [daily weights](#)
     - ALWAYS plot height and weight on a growth chart
     - Ideally at the same time each day, especially in small children
   o **Blood pressure at least four hourly**
   o **Nutrition** - children with AKI are in a catabolic state and therefore need monitoring to ensure meeting adequate calorie requirement
   o **Investigations**
     - Bloods: [DAILY U&E](#). Management of electrolyte abnormalities especially [hyperkalaemia](#)
     - Urinalysis at least daily

2. Maintain

   o Ensure adequate circulatory volume – address hypoperfusion urgently with fluid boluses (10 ml/kg) and inotropic support once volume is restored.

3. Minimise

   o Further harm should be reduced by stopping nephrotoxic drugs and restarting when appropriate with dose adjustments
   o Intravenous contrast should also be avoided

References
- [https://www.nuh.nhs.uk/download.cfm?doc=docm93jijm4n840](https://www.nuh.nhs.uk/download.cfm?doc=docm93jijm4n840)