Cheshire & Mersey
Critical Care Network

Cheshire and Merseyside
Strategic Clinical Networks

Cheshire & Mersey AKI Network Manual

2nd Edition, April 2016

PRIMARY & COMMUNITY CARE

HOSPITAL

INTRODUCTION

Purpose of the manual:
Acute Kidney Injury [AKI] is common and potentially fatal. Despite its high incidence, mortality and cost, national audits have shown that care of AKI patients is variable and often poor. This updated manual offers Trusts a suite of clinical guidelines and pathways, designed to help staff deliver evidence based care to prevent and reduce the impact of acute kidney injury. The guidelines were drawn up to help any clinician who is faced with AKI, including most importantly, the ones with least experience of the condition. In addition, recommendations on where to seek help and when, contact numbers, transfer checklists and referral pathways across the region have been included to prevent delays in getting patients the care that they need, regardless of where in the region they are treated. Organisations can adapt these documents to complement any work that is already embedded locally. These guidelines and pathways are designed to integrate with the primary care guidelines which have been developed in tandem, and to support organisations in delivering AQuA (Advancing Quality Alliance) standards around acute kidney injury.

Isn't there national work developing around acute kidney injury?
There is a national programme of work, led by the national Clinical Director for kidney disease which recommends local implementation. Members of the regional group feed into the national work and as improvements are made in practice; those changes will be incorporated into future versions of the manual.

Who wrote the manual?
The guidelines and pathways that comprise the manual have been written and developed through consensus by a multi-disciplinary, multi organisational group across Cheshire and Merseyside that is linked into ongoing national work. A survey was conducted in 2013 across all Trusts in the region to understand the services available and the gaps, both actual and perceived in comparison to the recent NICE guidelines. Varied sources including NICE guidance, NCEPOD recommendations and pre-existing local work have been utilised to formulate this manual. The group's work was then checked, reviewed and signed off in October 2014. The current update went through a similar process, including a feedback exercise from all AKI leads and AKI teams in the region's hospitals and taking into account more recent national guidance, and was signed off by the Cheshire & Merseyside Strategic Clinical Networks Kidney Group (April 2016), and by the Cheshire & Mersey Critical Care Network (April 2016).

Design & developments:
The manual is designed to allow any clinician to get to the part that is most relevant to their patient without having to trawl through a large document. References and source material have therefore been included in a separate folder.

To best utilise these tools, each Trust was encouraged to appoint a senior clinician as their AKI lead and implement the NHS England advice on AKI e-alerts to clinicians from their laboratory IT systems. Trusts were also asked to incorporate these transfer policies into their bed management practices and include AKI in their professional development programmes. Most Trusts implemented these requests before this revision.

All further updated versions of this manual will be posted on the websites of the Strategic Clinical Networks and the Critical Care Network, and sent to AKI champions in each organisation.

Please note that clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. When there is any uncertainty regarding the most appropriate clinical plan, early discussion with the nephrology or critical care teams is recommended.

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PREVENTION OF ACUTE KIDNEY INJURY (AKI)

RISK FACTORS FOR AKI

- Chronic kidney disease (adults with eGFR less than 60 ml/min/1.73 m^2)
- Renal transplant recipients
- Heart failure
- Liver disease
- Diabetes
- History of acute kidney injury
- Oliguria (urine output less than 0.5 ml/kg/hour)
- Cognitive impairment that may limit access to fluids
- Hypovolaemia
- Use of drugs with nephrotoxic potential (such as non-steroidal anti-inflammatory drugs)
- NSAIDs, aminoglycosides, angiotensin-converting enzyme [ACE] inhibitors, angiotensin II receptor antagonists [ARBs] and diuretics) within the past week, especially if hypovolaemic
- Use of iodinated contrast agents within the past week
- Urological obstruction – symptoms/ history or conditions that may lead to obstruction
- Sepsis
- Deteriorating BP, heart rate, respiratory rate.
- Age 65 yrs or more.

ACTIONS

AVOID NEPHROTOXIC POTENTIAL MEDICATION WHEREVER POSSIBLE eg. Trimethoprim, NSAIDs

Additional information on https://www.thinkkidneys.nhs.uk/aki/wp-content/uploads/sites/2/2016/02/Potentially-Problematic-Drugs-and-Actions-to-Take-in-Primary-Care.pdf

If patient has an Acute Illness

- Assess volume status including BP and ensure adequate hydration.
- Temporarily suspend antihypertensives or agents that can lower BP such as opiates, nitrates, if BP is low.
- Temporarily suspend all nephrotoxic potential medications.
- Check U&E's. If Serum K^+ is > 5.7 mmol/L, refer in to AED.
- If not responding clinically, or is oliguric, or if U&E's show progressive worsening, arrange urgent admission unless advance directive states otherwise.

If patient is clinically stable

- Replace any nephrotoxic potential medication with a non-nephrotoxic alternative if possible.
- Recheck U&E's 7 days after any dose increase of a nephrotoxic potential medication that is essential for treatment eg ACE Inhibitors, Angiotensin Receptor Blockers or diuretics.
- Temporarily suspend nephrotoxic potential medication before exposure to unavoidable risk such as IV contrast. Follow guidance for contrast prophylaxis.
- Recheck U&E's 7 days after any episode of AKI or exposure to any potential insult such as major surgery or nephrotoxin including IV contrast.
- After an episode of AKI, hold medication with nephrotoxic potential, if possible for 6 weeks to enable tubular recovery. If earlier recommencement required, monitor renal function within a week of restart. Consider restarting only if still indicated.
- If worsening of urea or creatinine noted 10% or more from baseline, suspend nephrotoxic potential medication recheck U&E's in a week. If continues to worsen, refer to nephrologist or general physician.
  If Serum K^+ is > 5.7 mmol/L, refer in to AED.

PRIMARY CARE AKI MANAGEMENT GUIDELINE

AKI ALERT RECEIVED FROM LABORATORY

An alert for AKI is generated within the laboratory information management system (LIMS) calculating the creatinine using the NHS England detection algorithm. This identifies ***potential*** cases of AKI which then requires clinical verification

Check patient's previous urea, creatinine and electrolyte results [U&E's] to differentiate from stable or progressive Chronic Kidney Disease [CKD] vs AKI. Use the classification of AKI below to assist you.

'False positive AKI alerts' can occur particularly when the previous creatinine (baseline) is > 3 months but particularly >12 months from current test.

'False negative AKI alerts' can occur when an AKI may have occurred in the recent past impacting on the median calculated

Stage	Serum Creatinine Criteria	Urine Output Criteria
1	26umol/L rise or 1.5 – 1.9 X reference in 48 hrs	< 0.5 ml/kg/hr > 6 consecutive hrs
2	Increase 2 – 2.9 X reference in 48 hrs	< 0.5 ml/kg/hr > 12 consecutive hrs
3	Increase ≥3 X reference in 48 hrs Or ≥354 µmol/L or commenced on renal replacement therapy (RRT)	< 0.3 ml/kg/hr > 24 consecutive hrs or anuria for 12 hrs

Action Review by GP / community nurse practitioner
Diagnose & treat any acute illnesses contributing to AKI

ESSENTIAL STEPS TO BE INITIATED BY PRIMARY CARE CLINICAL TEAM

***think FLUiDS*:**

Fluid balance: Check for signs of dehydration. Encourage oral fluid and assess for need for support for hydration

Low BP check BP and if low (SBP<110), withhold anti-hypertensive and diuretics
(If history of angina/ cardiac arrhythmia, reduce dose of beta blocker rather than stop)

Urine: dip test & microscopy. Consider intrinsic kidney disease if protein & blood present in absence of UTI/trauma

Inspect Bladder: Consider possible urinary tract obstruction and arrange for catheter if bladder palpable

Drugs and Toxins: Stop NSAID eg: Ibuprofen, COX 2 Inhibitors, Trimethoprim, ACE Inhibitors, Angiotensin receptor blockers. Avoid any nephrotoxic potential medications. Discuss AKI Sick Day guidance.

Sepsis: Look for signs of sepsis and treat aggressively following sepsis guidelines e.g. UK Sepsis Trust guidance

REFERRAL

If Serum K^+ is > 5.7 mmol/L, refer in to AED, unless advance directive states otherwise

If patient unwell and not responding clinically, or remains oliguric, or requires IV therapy, refer in to AED unless advance directive states otherwise

If patient is well:

- Continue with ***essential steps*** listed above
- Repeat U & E's in 24 - 48 hours.
- Renal screen*: if haematuria/proteinuria in the absence of a UTI, or suspected vasculitis/ myeloma, discuss with Renal on-call team or Acute Medicine (Medical Admissions Unit / Emergency Admissions Unit)
- Refer to hospital if vasculitis or acute nephritis suspected OR worsening U&E's or persistent oliguria despite treatment, unless advance directive states otherwise

***Renal screen:** ANCA, Anti-GBM Ab, Autoantibodies, Serum Immunoglobulin & paraprotein, urine Bence Jones Protein, Urine albumin creatinine ratio

RECOVERY

Review medications and before re-starting any nephrotoxic potential medication, consider a) Is it required? b) Is the patient stable for restart? C) What is the clinical or biochemical risk vs benefit of restarting medication?
U&Es should be checked within 1-2 weeks after recommencement of potential nephrotoxic medications
Discuss future risk reduction with patient/ carers.

AKI SICK DAY GUIDANCE –
FOR HEALTHCARE PROFESSIONALS

(Produced in collaboration with Pan Mersey Area Prescribing Committee)

What are AKI 'Sick day guidance' and why do we need them?

Acute Kidney Injury (AKI) is common, costly and has a high mortality; however a proportion of AKI is avoidable. To prevent avoidable AKI, healthcare professionals must have an awareness of risk factors and triggers for AKI.

During acute illness, nephrotoxic potential medications, including ACE inhibitors, ARBs, NSAIDs and diuretics can cause or further exacerbate AKI in patients who are at risk. Metformin is associated with an increasing risk of lactic acidosis in patients with AKI. 'Sick day guidance' has therefore been designed to provide advice patients on what to do to prevent AKI.

When should I advise about 'Sick day guidance'?

'Sick day guidance' should be given to patients deemed at high risk of developing AKI based on individual risk assessment of risk factors (see box below) when they have an acute illness such as:

- Vomiting or Diarrhoea (Unless only minor)
- Febrile Illness
- Illness causing excessive thirst

Chronic Kidney Disease (eGFR < 60ml/min/1.73m^2 in	Hypovolaemia
Renal transplant recipients	Sepsis
Heart failure	Deteriorating BP, heart rate, respiratory rate
Liver disease	Age 65 yrs or more
Diabetes	Urological obstruction
History of AKI	Use of iodinated contrast agents in the past
Oliguria (urine output less than	Cognitive impairment that may limit access to fluids
Use of drugs with nephrotoxic potential within the past week, especially if hypovolaemic	Surgery – either emergency surgery in presence of sepsis or hypovolaemia or intraperitoneal surgery

What advice should I give to patients?

To ensure patients understand the information on 'Sick day guidance' for AKI provided to them, it is suggested that patients should be offered the following explanation:

- Some medicines shouldn't be taken when you have an illness that makes you dehydrated. This is because of the risk of causing Acute Kidney Injury. Illnesses that can cause dehydration are vomiting, diarrhoea and fever. This advice does not apply to minor sickness or a single episode of loose stools
- The medicine you are taking that falls into this category is: [*tell patient which medicine*]
- If you have heart failure and are under a heart failure team, contact your GP or heart failure team for further advice before stopping the medications

AKI SICK DAY GUIDANCE –
FOR PATIENTS/CARERS

(Produced in collaboration with Pan Mersey Area Prescribing Committee)

What is Acute Kidney Injury (AKI) and why have I been given 'Sick day guidance' for AKI?

Your kidneys are vital organs that lie on either side of your backbone just below the ribs. Your kidneys have a key role in making urine through which they help remove waste products that may be harmful to the body. They also determine your body's water balance, by adjusting the amount of water you pass in the urine. Your kidneys also process many medications whose levels in the blood can be affected when kidney function is reduced.

AKI is a term used to describe a sudden and recent reduction in kidney function. This can be dangerous as it affects other organs in your body. AKI can be caused by a variety of individual factors or a combination of them but most commonly when you have an acute illness, where you lose more fluid from the body than you can replace. During this time, it is important to follow the 'Sick day guidance' for AKI as described below to help you to prevent AKI.

What are the signs of AKI?

You may not have any symptoms until your kidney function deteriorates significantly. Aki can however have the following symptoms:

Passing less urine than usual	Feeling generally unwell
Abdominal pain	Headaches
Confusion	Itching
Drowsiness	Nausea and vomiting
Feeling tired	Twitches

When do AKI 'Sick day guidance' apply?

Your doctor has given you this leaflet as you have risk factors for AKI. Follow the 'Sick day guidance when you are unwell with any of the following:

- Vomiting or Diarrhoea (unless only a single episode)
- Illness with fevers, sweats or shaking
- Illness causing excessive thirst

What are the AKI 'Sick day guidance'?

- Stay hydrated – drink at least 8 cups a day (1 cup = 200ml) unless you have other instructions from you doctor.
- If you vomit take small sips of water/fluid frequently until symptoms have settled.
- Reduce or avoid alcohol consumption.
- The following medication should be withheld or temporarily stopped, with the advice of a doctor or pharmacist#:
  - Non-steroidal anti-inflammatory drugs e.g. Diclofenac, Ibuprofen, Naproxen, *
  - Angiotensin converting enzyme inhibitors e.g. Lisinopril, Perindopril, Ramipril*
  - Angiotensin receptor blockers e.g. Candesartan, Losartan, *
  - Water tablets (diuretics) e.g. Bumetanide, Furosemide, Bendroflumethiazide, Spironolactone*
  - Metformin.

if you are **under the care of a hospital specialist team e.g. heart failure team, Kidney/Renal Unit or Diabetes team** and taking any of the medicines listed above seek advice from them or your GP before making any changes to your medicines.

*this list is not exhaustive, if you are unsure if your medication falls into these categories then please seek advice from your pharmacist or doctor.

NHS Cheshire & Mersey Critical Care Network

NHS Cheshire and Merseyside Strategic Clinical Networks

ACUTE KIDNEY INJURY BUNDLE

Hosp No	
Name	
Address	
Date of Birth	Age

Date _____ **Time** _____

ASSESSMENT BUNDLE (INITIATE ASAP & COMPLETE WITHIN FIRST 4 HOURS)

A. RISK ASSESS AND PREVENT **(IF IN AKI, skip to B. Diagnose)**

- ☐ Hypovolaemia
- ☐ Deteriorating EWS
- ☐ Oliguria
- ☐ Sepsis
- ☐ Chronic Kidney Disease
- ☐ Potential nephrotoxic medicines
- ☐ Iodinated contrast in past week
- ☐ Recent Intraperitoneal surgery
- ☐ Heart failure
- ☐ Diabetes
- ☐ Renal Transplant
- ☐ Chronic Kidney Disease
- ☐ New onset or significant worsening of urological symptoms
- ☐ Neurological or Cognitive impairment that limits access to fluids
- ☐ Symptoms suggesting complications of AKI
- ☐ Liver disease
- ☐ History of AKI
- ☐ Age ≥ 65
- ☐ **NO RISK FACTOR**

If ANY Risk Factor Present, To Prevent AKI [Tick actions taken]

1. Measure Urea, Creatinine and electrolytes [U&E] immediately & daily ☐
2. Avoid nephrotoxins unless no alternative ☐
3. Set regular monitoring of Early Warning Scores [EWS] & Urine output ☐
4. Set lower trigger for escalation from EWS and Urine output ☐
5. Maintain adequate BP and hydration ☐

B. DIAGNOSE: Confirm AKI using one of the following criteria **(Tick criteria).**

- ☐ Serum creatinine rises by ≥ 26µmol/L within 48 hours
- ☐ Serum creatinine rises ≥ 1.5 fold from the reference value within one week [known / presumed]
- ☐ Urine output is < 0.5ml/kg/hr for > 6 consecutive hours

The reference serum creatinine should be the lowest creatinine value recorded within 3 months of the event. If a reference serum creatinine value is not available within 3 months and AKI is suspected repeat serum creatinine within 24 hours.

IF AKI IS DIAGNOSED STAGE AKI BELOW

Stage	Serum Creatinine Criteria	Urine Output Criteria
☐ 1	26umol/L rise or 1.5 – 1.9 X reference in 48 hrs	< 0.5 ml/kg/hr > 6 consecutive hrs
☐ 2	Increase 2 – 2.9 X reference in 48 hrs	< 0.5 ml/kg/hr > 12 consecutive hrs
☐ 3	Increase ≥3 X reference in 48 hrs Or ≥354 µmol/L or commenced on renal replacement therapy (RRT)	< 0.3 ml/kg/hr > 24 consecutive hrs or anuria for 12 hrs

IDENTIFY & TREAT CAUSE:

Common causes include Hypoperfusion, Obstruction, Sepsis, intrinsic Kidney Diseases, Rhabdomyolysis, Toxins, Trauma / Surgery, Liver decompensation
If unknown, document as unknown

CAUSE _____ **STAGE** _____

IF AKI IS CONFIRMED COMMENCE MANAGEMENT BUNDLE

Name	Grade	Bleep No.	Signature

ACUTE KIDNEY INJURY BUNDLE

Hosp No
Name
Address

Date of Birth Age

Date _____ **Time** _____

MANAGEMENT BUNDLE (INITIATE ASAP & COMPLETE WITHIN FIRST 24 HOURS)

1. BP & HYDRATION:

BP LOW
- ☐ Stop antihypertensives and diuretics
- ☐ Input / output chart commenced
- ☐ IV Fluids prescribed based on volume status
- ☐ Hourly EWS & urine output

BP HIGH
- ☐ Continue antihypertensives
- ☐ All other measures as above except IV fluids

2. MEDICATION:

- ☐ Stop / Avoid all nephrotoxic potential drugs and drugs that can become toxic in AKI
  Including ACE-Inhibitors, Angiotensin Receptor Blockers, Aliskiren, NSAIDs, COX 2 inhibitors, K sparing diuretics, Metformin, Aminoglycosides, IV contrast, Trimethoprim
- ☐ Pharmacist review within 24 hours including dose adjustment

3. INVESTIGATIONS:

- ☐ ABG / Venous Bicarbonate, FBC, U&E, CK, bone profile, Chloride, LFT, CRP, CXR, ECG
- ☐ Urine dipstick, C&S, ACR
- ☐ Urgent Renal Screen in all patients with blood/protein in Urine or AKI 2 or 3:
  ANCA, Anti GBM, Serum Electrophoresis, Urine Bence Jones protein, Coagulation
- ☐ Urgent Hepatitis B Surface Antigen, Hepatitis C Antibody & HIV in all AKI 3 and progressive AKI 2
- ☐ Daily U&E and venous HCO3 until AKI resolved
- ☐ Ultrasound KUB/ CT KUB
  Within 24 hours if obstruction suspected / Cause of AKI unknown / AKI not resolving
  Within 6 hours if suspicion of infected kidney (pyonephrosis) / obstructed single kidney

Reason for not requesting scan: _____

4. CATHETERISE:

- ☐ If haemodynamic compromise or obstruction suspected

5. TREAT COMPLICATIONS:

- ☐ Acidosis
- ☐ Pulmonary Oedema
- ☐ Hyperkalaemia

6. INFORMATION: To patient or carer/s

- ☐ Explain
- ☐ Information sheet given

REFERRAL ADVICE **ALL PATIENTS WITH AKI SHOULD HAVE A SENIOR REVIEW WITHIN 12 HRS** Referrals should be made according to table below UNLESS it has been decided that the particular escalation strategy is not appropriate after SENIOR REVIEW and this is documented in the notes		**Date & Time**
Critical Care Outreach	All patients with AKI meeting local referral criteria for critical care outreach. This DOES NOT replace referral guidelines detailed below	
Renal	AKI Stage 3 : Refer all patients **within 12hr of detection of AKI stage 3** AKI Stage 1 / 2: Complications or progression despite medical management or if possible cause that may need specialist renal treatment (refer to referral criteria)	
Critical Care	Respiratory Failure (Pulmonary Oedema) or Circulatory Failure requiring Inotropes Multi-organ failure or Severe Acidosis (pH<7.2) Patients not responding to medical management or who may need dialysis in centre without on-site renal teams	
Urology	Renal tract obstruction and **immediately** if evidence of pyonephrosis, solitary obstructed kidney, bilateral obstruction or complications of obstruction	

Name	**Grade**	**Bleep No.**	**Signature**

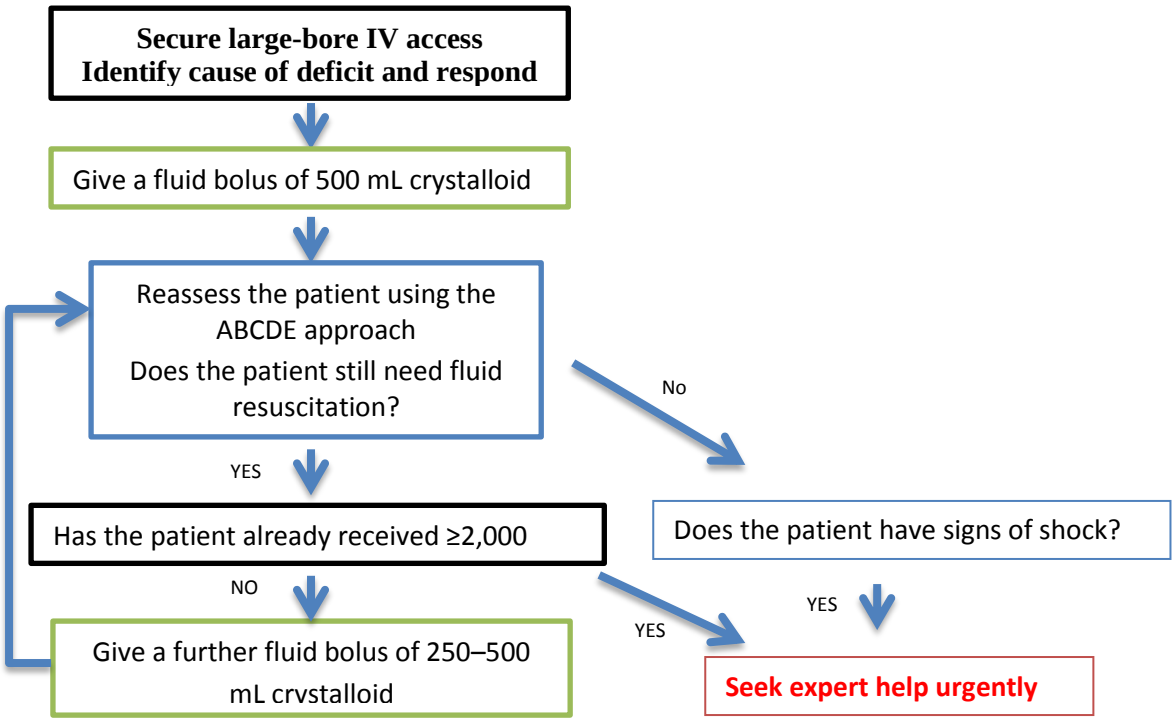
IV FLUIDS IN AKI

RESUSCITATION IN AKI

To facilitate the fluid challenge, an IV cannula of adequate size to infuse the required fluid at a high enough rate must be used.

This usually means at least a pink cannula and administration of 250–500 mL fluid over 5–15 minutes.

Where AKI is suspected, AVOID potassium containing fluids.



TYPES OF FLUID THERAPY

	Definition	Example of fluid
Resuscitation	Re-establishes haemodynamic stability through restoring intravascular volume	Balanced crystalloid: *Hartmann's solution, Ringer's acetate, Plasma-Lyte 148* Crystalloid: 0.9% sodium chloride
Replacement	Provides daily maintenance requirements and replacement of any ongoing abnormal losses	Balanced crystalloid: *Hartmann's solution, Ringer's acetate, Plasma-Lyte 148* Crystalloid: 0.9% sodium chloride
Routine maintenance	Provides daily maintenance requirements ***Daily requirement is 25-30ml/kg of water, 1mmol/kg of Na^+, K^+ and Cl^- and 50-100g of Glucose*** *Maintenance fluids should be adjusted to maintain normal serum electrolyte levels*	*0.18% sodium chloride/4% dextrose* *0.45% sodium chloride* *Combination of 0.9% Sodium Chloride & 5% Glucose* **NB:** Excess Sodium Chloride use can contribute to hyperchloraemia & excess Glucose use in maintenance can contribute to hyponatraemia.

Type of fluid	Na^+	K^+	Cl^-	Ca^{2+}	HCO_3^- precursor	Glucose	Osmo
Resuscitation fluids							
Hartmann's	131	5	111	2	29 (lactate)	0	278
Lactated Ringer's	130	4	109	1.4	28 (lactate)	0	273
Plasma-Lyte 148	140	5	98	0	27 (acetate) 23 (gluconate)	0	295
0.9% sodium chloride	154	0	154	0	0	0	308
Replacement or routine maintenance fluids							
0.45% Sodium chloride	77	0	77	0	0	0	154
0.18% Sodium chloride/4% glucose	31	0	31	0	0	222.2	284
5% Glucose	0	0	0	0	0	277.8	278
0.9% sodium chloride	154	0	154	0	0	0	308

MANAGEMENT OF HYPERKALAEMIA IN AKI

IMMEDIATE MANAGEMENT	TIME
Airway Breathing Circulation Disability Exposure (ABCDE) Approach **Seek expert help if airway, breathing or circulation compromised** Obtain IV access (If using 50% glucose or 10% calcium infusions consider central line) Assess Fluid status and Resuscitate or Replace fluid loss	**0 – 30 MINS** Check & document Early Warning Score **Cardiac Monitor** If unwell, K+ 6.5 mmol/L or acute ECG changes present
Exclude Pseudo-Hyperkalaemia if required. This shouldn't delay treatment Repeat U&E using lithium heparin anti-coagulated sample container Check Venous or Arterial Blood Gas for prompt K^+ result	
Perform 12 Lead ECG	
SEVERITY BASED MANAGEMENT	**Within 60 MINS**
MILD K^+ 5.5-5.9 mmol/l **MODERATE** K^+ 6-6.4 mmol/l **Severe** $K^+ \geq 6.5$ mmol/l **Seek Expert help** **Any Acute ECG Changes** Peaked T waves, Absent P waves, Broad QRS, Sine wave, Bradycardia, VT No / Yes	Commence an infusion of soluble insulin (usually actrapid), 50 units in 50ml 0.9% sodium chloride, starting at 1ml/hr (2ml/hr if patient has diabetes) **Insulin Regimen** *Cap. Blood Glucose < 4:* Reduce by 0.5ml/h Treat hypoglycaemia *Cap. Blood Glucose 4-11:* Continue rate *Cap. Blood Glucose >11:* Increase by 0.5ml/h Monitor every 30min if any change in rate otherwise hourly **Dialysis** If there is poor response to medical therapy discuss with renal / Critical care urgently. Other than chronic dialysis patients, any one with the likelihood of requiring dialysis to have an urgent Hep B, C and HIV serology
Protect the Heart 10 ml 10% **Calcium Chloride or 30 ml of 10% Calcium Gluconate** IV (6.8 mmol) over 5-10 min	
Shift K+ into cells Add 10 units **soluble Insulin** (usually Actrapid) to **250ml 10% Glucose** IV over 30 min (Alternatively 10 units of soluble insulin in **50ml 50% glucose** IV over 15 min) and **repeat** until Potassium < 5.5mmol/L for at least 4hrs. **Salbutamol** 5mg via Nebuliser (can give upto 10-20mg total as back to back). Ensure HR < 120 Give **IV Sodium Bicarbonate (1.26% or 1.4%)** 500ml over 4hr if serum bicarbonate < 20mmol/L and not volume overloaded	
Remove K+ from body Give **calcium resonium** 30g orally stat then 15g qds along with laxative as resonium can often contribute to constipation. Give 30g rectal enema OD to be retained ≥ 6hrs if can't tolerate orally **Sodium resonium** 30g qds can be used in patients with hypercalcaemia **IV Furosemide** 80mg as slow bolus **ONLY** if euvolaemic or overloaded **Consider Dialysis** where there is poor response to medical management discuss with Renal or Critical Care team urgently.	**ONGOING** **Serum Potassium** Potassium **should** be measured at the following times **after** identification and initiation of treatment of hyperkalaemia 1hr 2hr 4hr 6hr 24hr
Monitor & avoid cause **Monitor serum K+ and blood glucose** as suggested **Consider cause** of hyperkalaemia, **prevent further rise and recurrence** **Stop medications** that can cause hyperkalaemia such as ACE-I, ARB, Aliskiren, Trimethoprim, K sparing diuretics & spironolactone **Complete AKI Bundle** if hyperkalaemia is associated with AKI Commence on a **potassium restricted diet** and consider dietician input	

MANAGEMENT OF PULMONARY OEDEMA WITH AKI

IMMEDIATE MANAGEMENT

Airway Breathing Circulation Disability Exposure (ABCDE) Approach
Seek expert help if airway, breathing or circulation compromised
Nurse in upright position
Administer High flow O2 (60 – 100% unless contraindicated)
Obtain IV access
If being administered IV fluids – immediately discontinue
Monitor urine output hourly
Perform 12 Lead ECG and CXR

SUBSEQUENT MANAGEMENT

Is patient **Hypotensive?**

No

Loop diuretics: Was patient already taking these?

No

If diuretic naïve consider Furosemide 40mg IV.

If inadequate response, double the dose every 60 min to a maximum of 400mg.
N.B. max rate is 4mg/min.
If responds to bolus, put onto undiluted furosemide IV infusion via syringe pump titrated up to 10mg/hr aiming to maintain urine output at 0.5 ml/kg/hr
N.B. Max daily dose 1.5g
If known dialysis patient, also contact nephrology on call immediately

Yes

If already on furosemide consider Furosemide 100mg IV.

If inadequate response, double the dose every 60 min to a maximum of 400mg.
N.B. max rate is 4mg/min.
If responds to bolus, put onto undiluted furosemide IV infusion via syringe pump titrated up to 10mg/hr aiming to maintain urine output at 0.5 ml/kg/hr
N.B. Max daily dose 1.5g
If known dialysis patient, also contact nephrology on call immediately

Yes

Consider referral to Critical Care
Contact Nephrology on call team
CPAP & Inotropes

IV Nitrate infusion e.g. Isosorbide Dinitrate (Isoket): Commence 0.05% solution at 1ml/hr or 0.1% solution at 0.5 ml/hr and monitor cardiovascular status, stop if BP<100mmHg and/or HR>120/min

IV Diamorphine (Alternative IV Morphine): Give only if BP > 100mmHg

Has patient responded to treatment?
Reduced breathlessness with improvement in RR, SpO_2 and Urine output > 0.5ml/kg/hr

No

Urgent senior review
Contact Nephrology on call team
Consider referral to Critical Care
Dialysis may be required

Yes

Senior review and discussion with Nephrology team on-call to establish plan for ongoing care

INDICATIONS FOR DIALYSIS & LIMITATION OF TREATMENT

RENAL REPLACEMENT THERAPY

Renal replacement therapy (RRT) options for AKI would include intermittent haemodialysis/ haemodialfiltration, rarely acute peritoneal dialysis under a nephrology team or veno-venous haemofiltration, usually in a critical care unit.

The common indications that trigger consideration of RRT for AKI are:

1. Pulmonary Oedema not responding to medical treatment.
2. Hyperkalaemia not responding to medical treatment
3. Severe Acidosis not responding to medical treatment
4. Uraemic encephalopathy
5. Uraemic pericarditis

RRT options should be discussed with all suitable patients by the parent team in conjunction with the nephrologist/ intensivist when and if required. Decisions on whether a patient is suitable or not are usually based on factors including pre-existing comorbidities and functional status, and overall prognosis.

Preparation for RRT which include screening for blood borne viruses such as Hepatitis B, Hepatitis C and HIV should be performed urgently on all patients with verbal informed consent. Blood requests are to be marked as urgent and the Virology Laboratory personnel are to be informed by phone.

Patients who will require central venous access for RRT should be prescribed Topical MRSA decontamination/suppression therapy as per trust policy e.g. Octenisan bodywash OD and nasal Mupirocin TDS for 5 days, starting as soon as the decision is made.

When patients are assessed to lack capacity, the physician in charge and the nephrologist or intensivist would decide jointly in the best interest of the patient and the decision made should be discussed with their family.

LIMITING TO CONSERVATIVE MEDICAL MANAGEMENT

In those patients in whom prognosis is poor due to the underlying disease process or because they have severe co-morbidity, decisions regarding limitation or withdrawal of RRT will be made by the admitting teams in conjunction with the intensive care/ renal teams following discussions with patient and family, where possible.

Patients who opt for conservative maximum medical management (refused RRT) should receive treatment for all other medical conditions. The majority of informed decisions on non dialytic therapies are taken well before patients are in end stage renal failure. Treatment of other medical conditions should therefore not be withheld.

However, in those patients whose renal failure is severe enough to be life limiting and who have opted for non dialytic treatment, a referral to the Hospital Specialist Palliative Care Team should be considered. In all cases the resuscitation status should be determined and documented as per Trust policy. If the patient is in the dying phase a care plan for the dying ought to be initiated.

CONTRAST INDUCED NEPHROPATHY GUIDANCE

GENERAL INFORMATION
Essential emergency imaging should not be delayed for fear of contrast nephropathy. Contrast nephropathy is usually reversible but can be a significant risk for morbidity and mortality and in the minority may require dialysis treatment. **It is the responsibility of the person ordering the investigation to risk assess, protect and detect contrast nephropathy.**
1. ASSESS RISK
High volume contrast study (>100ml), intra-arterial contrast Acute Kidney Injury Dehydration, Sepsis, hypotension CKD eGFR <60 especially in context of Diabetic Nephropathy, previous kidney surgery, renal transplant, hypertension on treatment Nephrotic syndrome Heart failure Liver failure Multiple myeloma Nephrotoxic medication, including diuretics– review and suspend if appropriate
2. PROTECT
• Consider alternatives (will non-contrast imaging/MR/US answer the clinical question?) • Minimise contrast dose, use low osmolar agents • Avoid repeated studies especially within 48 hours • Avoid volume depletion and NSAIDs/ACE-I/ARBs • Stop diuretics if appropriate, stop metformin • IV pre-hydration if eGFR <60ml/min, unless fluid overload or evidence of decompensated heart failure with Normal saline or isotonic sodium bicarbonate • Oral N-Acetyl Cysteine – unproven benefit but low risk of harm (e.g. 600mg bd day before and day of Procedure) **Examples of fluid administration** **Inpatient emergency imaging** e.g. 250ml bolus normal saline then 1-1.5ml/kg for 12 hours post **Inpatient elective** e.g. 1-1.5ml/kg/hour for 12hours pre and 12hours post **Day case elective** e.g 4ml/kg for 1 hour pre then 1-1.5ml/kg for 6-12 hours post.
3. DETECT & TREAT
Repeat and review U+E 72 hours post study **If serum creatinine has increased by >26µmol/l treat as per AKI guidelines**

PERI-OPERATIVE AKI MANAGEMENT

Cheshire & Mersey Critical Care Network

Cheshire and Merseyside Strategic Clinical Networks

ELECTIVE SURGERY

IN CLINIC (At time of decision of need to book surgery)

Document and make pre-op clinic aware of all risks that apply

☐ Chronic Kidney Disease ☐Heart failure ☐ Liver disease

☐Diabetes ☐ history of AKI ☐ Age ≥ 65

☐ Use of drugs with nephrotoxic potential

IF ANY RISK FACTOR PRESENT

☐ Request Urea, Creatinine and electrolytes (U&E) including eGFR

☐ Observe caution with investigations requiring administration of iodinated contrast (see CIN guidance)

IF PATIENT HAS AKI FOLLOW TRUST AKI GUIDELINE

IN PRE-OP CLINIC

Where risk of AKI is identified

☐ Repeat U&E including eGFR along with FBC, LFT, Bone Profile, Glucose and Coagulation

☐ Consider pre-optimisation in ward or critical care and schedule post-operative admission to critical care

☐ When consenting patient include risk of Acute Kidney Injury as a risk from surgery

☐ Notify operating surgeon and anaesthetist if classified as "At risk of AKI" from clinic

☐ Consider holding medications with nephrotoxic potential from 48hrs prior to 48hrs after surgery

☐ **Assess CKD severity and refer to Nephrologists if indicated**

CKD	eGFR ml/min/1.73m$_2$	Reduction in kidney function
☐ Stage 1	90+	**Normal**
☐ Stage 2	60-89	**Mild**
☐ Stage 3A ☐ Stage 3B	45-59 30-44	**Moderate**
☐ Stage 4	15-29	**Severe**

REFER TO NEPHROLOGY

- ALL CKD 4 and 5
- CKD 3 with Hb < 100, or high Ca, or acidotic or ≥ 1+ proteinuria on WTU
- eGFR decrease of ≥10 over 5 yrs
- eGFR decrease of ≥ 5 over 1 year

☐ **Referral Sent with clinical details & drug list**

INPATIENT

☐ For at risk patients repeat U&E and bicarbonate daily

☐ Initiate MEWS chart, fluid chart and ensure appropriate replacement of fluid losses considered

☐ **Assess daily for post-operative AKI**

- Serum creatinine rises by ≥ 26µmol/L within 48 hours **or**
- Serum creatinine rises ≥ 1.5 fold from the reference value known or presumed to have occurred within 1 week **or**
- Urine output is < 0.5ml/kg/hr for > 6 consecutive hours

IF AKI IS CONFIRMED CONSIDER AND TREAT SPECIFIC SURGICAL CAUSES LISTED IN ELECTIVE SURGERY SECTION & COMMENCE AKI MANAGEMENT BUNDLE

EMERGENCY SURGERY

ALL EMERGENCY SURGERY CARRIES THE RISK OF CAUSING/WORSENING AKI

☐ Consider pre-optimisation in ward or critical care and consider post-operative admission to critical care

☐ Initiate MEWS chart, fluid chart and ensure appropriate replacement of fluid losses considered

☐ Repeat U&E and bicarbonate daily - **Assess daily for post-operative AKI**

IF AKI IS CONFIRMED CONSIDER AND TREAT SPECIFIC SURGICAL CAUSES LISTED BELOW & COMMENCE AKI MANAGEMENT BUNDLE

☐ Blood Loss ☐ Surgical Sepsis ☐ Hypotension due to epidural

☐ Urinary retention ☐ Surgical renal tract obstruction ☐ Hypotension due to opiate

☐ Adjust medication doses to renal function

ACUTE KIDNEY INJURY REFERRAL CRITERIA

Cheshire & Mersey Critical Care Network

Cheshire and Merseyside Strategic Clinical Networks

PLEASE NOTE: You will need to refer to the AKI Transfer Checklist along with this document

All AKI
With

Possible diagnosis that may need specialist treatment

- Vasculitis
- Glomerulonephritis
- Tubulointerstitial nephritis
- Myeloma

AKI with no clear cause
Inadequate response to treatment
Complications associated with AKI
AKI Stage 3
Prior Renal Transplant

NEPHROLOGY HUB REFERRAL

Refer Urgently if meets criteria listed below for renal replacement

Renal Replacement Criteria

Refer patients immediately if any of the following are not responding to medical management:

- Hyperkalaemia
- Metabolic acidosis
- Symptoms or complications of uraemia (for example, pericarditis or encephalopathy)
- Fluid overload
- Pulmonary oedema

All AKI
With

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

LOCAL UROLOGY REFERRAL

Refer Urgently if meets criteria listed below

Urgent Urology Criteria

Immediate referral if one or more of following present:

- Pyonephrosis
- Obstructed single kidney
- Bilateral upper urinary tract obstruction
- Complications of AKI secondary to urological obstruction

When nephrostomy or stenting is used to treat upper tract urological obstruction, undertake as soon as possible and within 12 hours of diagnosis.

CRITICAL CARE REFERRAL

Referral should be made to Local Critical Care Team for patients where AKI is part of multi-organ failure and escalation is considered appropriate
Referral should also be made where the AKI transfer checklist suggests requirement due to criteria that would make transfer to renal hub potentially unsafe

REFERRAL PATHWAYS FOR ADULT PATIENTS WITH AKI

Cheshire & Mersey Critical Care Network

Cheshire and Merseyside Strategic Clinical Networks

PLEASE NOTE: ALL renal hubs have to maintain dedicated renal beds for priority transfer of patients with single organ failure AKI

Uncomplicated single organ failure AKI

With low risk of requiring level 2 critical care respiratory or cardiovascular support.

Multi organ failure AKI

Patients with AKI as part of a systemic disease requiring the support of other organs

Local Renal Hub

Where considered appropriate for transfer by renal team, transfer to local Renal Hub

Complete AKI Transfer Checklist

Refer to Renal Contact Sheet

Local critical care service

For support and stabilisation at local critical care unit.

If patients have multiple organ failure secondary to a systemic disease usually managed by nephrology (such as vasculitis) an onward referral to critical care unit in renal centre should be arranged.

Complete AKI Transfer Checklist

No Local Renal Hub bed available

Alternative Renal Hub

Local renal hub's consultant nephrology team to identify bed in alternative Cheshire & Mersey Renal hub.

Once bed identified Referring team to liaise directly with alternative Renal Hub to effect transfer.

Complete AKI Transfer Checklist

No regional renal bed available & RRT required

1st Available renal bed in region

Local critical care service

Renal Replacement Therapy [RRT] for uncomplicated, single organ AKI should be provided by local critical care service in referring site if no renal hub beds available with priority transfer back to local renal hub or alternative renal unit.

Once admitted to critical care, critical care team to liaise with local renal hub for priority transfer back to local renal hub, or alternative renal unit.

Complete AKI Transfer Checklist

Step-down

Transfer back to be arranged when decided as clinically appropriate by the Critical Care/ Renal team.

ACUTE KIDNEY INJURY TRANSFER CHECKLIST

PLEASE NOTE: The following criteria **MUST** be met to enable renal teams to ensure transfer safety without the involvement of the referring hospital's critical care team. If in doubt, discus case with the local critical care team

Hosp No
Name
Address

Date of Birth Age

ESSENTIAL CRITERIA
AIRWAY
☐ Airway patent & Safe without adjuncts
BREATHING
☐ Respiratory Rate > 9/min and <25/min
☐ Adequate Oxygenation (as per Oxygen guidelines) confirmed by arterial blood gas analysis where required and not on more than 35% Oxygen.
☐ Not requiring CPAP
CIRCULATION
☐ Heart Rate ≥ 50/min and < 120/min
☐ BP ≥ 100mmHg and MAP of ≥ 65mmHg without inotropic support
☐ No request for blood products in last 4 hours
☐ No life threatening haemorrhage in last 24 hours
☐ No CPR in last 24 hours
DISABILITY
☐ AVPU – Alert Discuss any New or background cognitive impairment on referral
METABOLIC
☐ Potassium < 6mmol if AKI If chronic RRT patient Potassium not more than 1mmol above usual pre-dialysis baseline
☐ pH > 7.2
☐ Lactate < 4

AKI TRANSFER INFORMATION
1. Ensure above clinical assessment of transfer safety is made by at least a Middle Grade doctor or above. 2. Urgency of Transfer is a matter of senior (StR or Consultant) clinical judgement. 3. Choice of staff to accompany patient is for senior (StR or Consultant) judgement. If in doubt, critical care service in the referring hospital should be requested to offer an opinion on how the transfer should proceed. 4. Inform receiving unit of Infection Control status of patient where applicable. 5. Complete Intensive Care Bed Information Form for all AKI Transfers to Renal Hub or Critical Care beds. 6. Follow Cheshire & Mersey Critical Care Network (CMCCN) standards for inter-hospital transfer of critical care patients

Name	Grade	Bleep No.	Signature

AKI RECOVERY & DISCHARGE

RECOVERY

Patients recovering from a significant episode of AKI may develop profound diuresis, resulting in:

- a free water deficit
- hypernatraemia/ hyponatraemia and/or
- hypokalaemia and/or
- hypocalcaemia and/or
- hypophosphataemia and/or
- hypomagnesemia and/or
- metabolic alkalosis

During this phase, maintaining patient hydration and replacing electrolytes are of paramount importance. Failure to do so may result in hypovolemic shock and further AKI or life threatening electrolyte imbalances.

Patients may require fluid replacement in very large volumes. Accurate fluid balance with daily weights is very important to prevent patients from becoming dehydrated as they recover from AKI.

DISCHARGE

Patients who have had an episode of AKI are at risk of CKD in the long term; this risk depends upon the severity of the episode of AKI. Patients' kidney function should be checked prior to discharge.

Refer patients to nephrology if they are discharged with an estimated glomerular filtration rate <30 mL/min/1.73 m2.

Medications should be reviewed prior to discharge, with a plan to reintroduce medications that may have been held during the acute illness, eg antihypertensives or diuretics, at an appropriate time. This may require an early follow-up with the GP. Discuss AKI Sick Day guidance.

Patients & carers should be told how and why they developed AKI, their risk factors and future precautions. If not done previously, ensure AKI information leaflet given to patient/ carer.

It is recommended that the GP discharge letter should include:

- cause(s) of AKI
- severity of AKI (state the highest stage during admission)
- requirement for critical care admission or renal replacement therapy
- risk factors for AKI
- kidney function on discharge
- advice on whether medications need to be reviewed or reintroduced.

This information must be available to the GP at the time of discharge to ensure that patient care is not compromised.

KIDNEY UNIT CONTACTS

NHS Cheshire & Mersey Critical Care Network

NHS Cheshire and Merseyside Strategic Clinical Networks

PLEASE NOTE: **This information is correct at the time of publication.**

Aintree University Hospital **Southport District General Hospital** **Ormskirk District General Hospital** **Walton Centre** **Merseycare**	**CONTACT** **Nephrology Consultant on Call** **Aintree University Hospital** **Telephone 0151 5255980** **Also Fax 0151 5292420**
Royal Liverpool University Hospital **Broadgreen Hospital** **Liverpool Heart & Chest Hospital** **Liverpool Women's Hospital** **Warrington General Hospital** **Halton General Hospital** **Whiston & St Helens Hospital** **Nobles Hospital, Isle of Man**	**CONTACT** **Nephrology Registrar on Call** **Royal Liverpool Hospital** **Telephone 0151 7062000**
Arrowe Park Hospital **Clatterbridge Hospital** **Countess of Chester Hospital**	**CONTACT** **Nephrology Consultant on Call** **Arrowe Park Hospital** **Telephone: 0151 6785111** **Chester to Telephone: 01244365000** **Fax: 0151 6047475**
Macclesfield Hospital	**CONTACT** **Nephrology Consultant on Call** **Central Manchester University Hospital** **Telephone: 0161 2761234**
Mid Cheshire Hospitals - Leighton Hospital	**CONTACT** **Renal secretary or Nephrology Registrar on Call** **University Hospital of North Staffordshire** **Telephone: 01782 715444** **Fax: 01270 612512**