1. Introduction and Who Guideline applies to

This guideline describes the assessment and management of children and young people presenting with acute glomerulonephritis.

This guideline applies to children and young people under 18 years of age with glomerulonephritis within the EMEESY Children’s Kidney Network (East Midlands, East of England and South Yorkshire) being managed by the Leicester Children’s Hospital and the Paediatric Emergency Department.

Other related guidelines include:

- Hypertension UHL C88/2016 Hypertension in Children UHL Childrens Medical Guideline
- Abnormal Glomerulofiltration Rate UHL C87/2016 Abnormal Glomerular Filtration Rate UHL Childrens Medical Guideline
- Nephrotic Syndrome UHL C35/2015 Nephrotic Syndrome UHL Childrens Medical Guideline

This EMEESY network guideline has been developed by clinicians from Nottingham Children’s Renal Unit with consultation across the network including from the Leicester Royal Infirmary and has been ratified by the Leicester Children’s Hospital guideline process.
**Title of Guideline** (must include the word “Guideline” (not protocol, policy, procedure etc))  
**Guideline for the assessment and management of acute glomerulonephritis in children and young people**

<table>
<thead>
<tr>
<th>Contact Name and Job Title (author)</th>
<th>Dr A Lunn, Consultant Paediatric Nephrologist,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directorate &amp; Speciality</td>
<td>Directorate: Family Health – Children</td>
</tr>
<tr>
<td></td>
<td>Speciality: Renal</td>
</tr>
<tr>
<td>Date of submission</td>
<td>August 2019</td>
</tr>
<tr>
<td>Date on which guideline must be</td>
<td>August 2024</td>
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<tr>
<td>reviewed (one to five years)</td>
<td></td>
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<tr>
<td>Explicit definition of patient group to which it applies (e.g. inclusion and exclusion criteria, diagnosis)</td>
<td>Children and young people under 18 years age with acute glomerulonephritis</td>
</tr>
<tr>
<td>Abstract</td>
<td>This guideline describes the assessment and management of children and young people presenting with acute glomerulonephritis</td>
</tr>
<tr>
<td>Key Words</td>
<td>Nephritic syndrome, glomerulonephritis, haematuria, renal, child, young person</td>
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</table>

**Statement of the evidence base of the guideline – has the guideline been peer reviewed by colleagues?**

<table>
<thead>
<tr>
<th>1a</th>
<th>meta analysis of randomised controlled trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a</td>
<td>at least one well-designed controlled study without randomisation</td>
</tr>
<tr>
<td>2b</td>
<td>at least one other type of well-designed quasi-experimental study</td>
</tr>
<tr>
<td>3</td>
<td>well–designed non-experimental descriptive studies (ie comparative / correlation and case studies)</td>
</tr>
<tr>
<td>4</td>
<td>expert committee reports or opinions and / or clinical experiences of respected authorities</td>
</tr>
<tr>
<td>5</td>
<td>recommended best practise based on the clinical experience of the guideline developer</td>
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**Consultation Process**  
Paediatric Nephrologists, Paediatric Guidelines Group, Pharmacist, Microbiologist, Immunologist, EMEESY Network Paediatricians

**Target audience**  
Clinicians and healthcare professionals caring for children and young people with acute glomerulonephritis

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This guideline has been registered with the trust. However, clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after the review date.

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**9 Month Review Date Extension Approved at PGC 3rd September 2021**

Glomerulonephritis UHL Childrens Hospital Guideline  
V1 approved by UHL Policy and Guideline Committee Chair’s urgent approval process on 25.9.19  
Trust Ref No: E5/2019  
Next Review: June 2022  
NB: Paper copies of this document may not be most recent version. The definitive version is held in the policy and guidelines library.
Document Control

Document Amendment Record

<table>
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<th>Version</th>
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<tr>
<td></td>
<td>November 2002</td>
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<tr>
<td></td>
<td>December 2004</td>
<td>Dr M Christian</td>
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<td>December 2007</td>
<td>Dr J Evans</td>
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<td>V3</td>
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<td>Dr M Christian</td>
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<td>Dr C Langstaff</td>
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<td>Dr A Lunn</td>
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<tr>
<td>V7</td>
<td>August 2019</td>
<td>Dr A Lunn</td>
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General Notes:

Summary of changes for new version:

- Changes to reflect use of guideline across EMEESY network e.g. specified local guideline or local information leaflet
- Specified timing of follow-up
- Proforma for follow-up visits
- Link to infoKID website for patient / parent information
- Link to EMEESY hypertension guideline
Contents of the Guideline

1. Background

2. Management of initial episode
   2.1. Clinical history
   2.2. Clinical examination
   2.3. Investigations
   2.4. Acute Management
      2.4.1. Penicillin
      2.4.2. Fluid Balance
      2.4.3. Hypertension
      2.4.4. Hyperkalaemia

3. Prognosis and Follow Up
   3.1. Prognosis
   3.2. Follow up / indications for referral to Paediatric Nephrology
   3.3. Follow-up Proforma

4. Audit points

5. References
1. Background
Acute glomerulonephritis develops as a result of abrupt onset of glomerular injury and inflammation that leads to a decline in glomerular filtration rate with sodium and water retention. Urinalysis usually reveals red blood cells (with red blood cell casts if the sample is very fresh) and sometimes low level proteinuria.
Patients may present with:
- macroscopic or microscopic haematuria
- signs of fluid overload such as hypertension and oedema
- renal dysfunction.

In the paediatric age group, the most common cause (about 80% cases) is acute post-streptococcal glomerulonephritis (APSGN).

APSGN may occur at any age, but is most common between the ages of 2 and 15 years (median age at presentation 6 - 8 yrs old). APSGN typically follows either pharyngeal or, less commonly, skin infection with group A streptococcus. The symptoms usually develop:
- 1-2 weeks after a throat infection
- or 3 – 6 weeks after skin infection.
The prognosis for APSGN is good, with 95% patients making a full recovery, with most clinical symptoms resolving spontaneously within 2 – 3 weeks after onset.

Timing of symptoms, ASOT and complement levels in typical cases of Post-streptococcal GN*

Other causes of acute glomerulonephritis have a less good prognosis and should be referred to a Paediatric Nephrologist. Criteria for referral are in this guideline.
The differential diagnoses include:

<table>
<thead>
<tr>
<th>Disease</th>
<th>Associated features</th>
</tr>
</thead>
<tbody>
<tr>
<td>IgA nephropathy</td>
<td>Normal C3</td>
</tr>
<tr>
<td>Membranoproliferative glomerulonephritis (MPGN)</td>
<td>Persisting low C3 and proteinuria beyond 3 months.</td>
</tr>
<tr>
<td>Vasculitides especially:</td>
<td></td>
</tr>
<tr>
<td>☐ Henoch Schonlein Purpura (HSP) – see HSP guideline, may not need referral to nephrologist</td>
<td>Purpuric rash especially on dependent and pressure areas, arthropathy especially of the lower limbs</td>
</tr>
<tr>
<td>☐ Systemic Lupus Erythematousus (SLE)</td>
<td>Butterfly rash, photosensitive rash, arthropathy, Raynaud’s phenomenon, alopecia, pleuritis</td>
</tr>
<tr>
<td>☐ ANCA positive vasculitis</td>
<td>Involvement of respiratory system eg. Nasal ulceration, sinusitis, haemoptysis, cough</td>
</tr>
<tr>
<td>Alport Syndrome</td>
<td>May have family history of deafness or renal disease (usually x-linked dominant)</td>
</tr>
</tbody>
</table>

2. Management of Initial Episode
Most children will require admission to manage fluid overload, oliguria, hypertension or worsening renal dysfunction. Children without fluid overload, hypertension or electrolyte imbalance may be managed as outpatients providing they are reviewed frequently.

2.1. Clinical history
To include history of:
☐ Recent throat or skin infection (up to 6 weeks previously)
☐ Previous episodes of macroscopic haematuria (IgA, Alport syndrome, MPGN,SLE, ANCA positive vasculitis)
☐ Joint pains and swelling (HSP, SLE, ANCA positive vasculitis)
☐ Family history of renal disease or deafness (Alport syndrome)

2.2. Clinical examination
To include:
☐ Height, weight, estimated body surface area (an estimate of dry weight will give a more accurate surface area estimate)
☐ Blood pressure
☐ Assessment of oedema (usually mild - lower limb, sacral, ascites, scrotal, pleural effusions)
☐ Cardiovascular status and perfusion (volume status):
  o Indicators of fluid overload: tachycardia, hypertension, respiratory distress, warm peripheries, hepatomegaly, raised JVP
Indicators of hypovolaemia: tachycardia, hypertension, cool peripheries, delayed capillary refill time

- Examination of the whole body for rashes (esp lower limbs for purpura of HSP and face for butterfly rash of SLE)

### 2.3. Investigations

**Urine for:**
- Dipstick urinalysis
- Urine culture
- Urine microscopy for casts if available (often not seen unless extremely fresh specimen)
- Urine protein:creatinine ratio (confirm with early morning specimen) if proteinuria on dipstick

**Blood for:**
- Paediatric renal profile to include urea, electrolytes, creatinine, calcium, phosphate, chloride, bicarbonate and albumin
- Full blood count
- Antistreptolysin titre (ASOT)
- Ask lab to store blood for Anti-DNAse B titres if ASOT negative
- C3 and C4 levels
- Anti-nuclear antibody (ANA)

**Throat swab**

CXR if hypertensive or fluid overloaded

**Discuss with Consultant Paediatric Nephrologist cases with:**
- estimated GFR <90 ml/min/1.73m² – calculate according to formula in Appendix 2 if not reported by laboratory
- electrolyte imbalance (especially hyperkalaemia)
- hypertension
- nephrotic syndrome or protein:creatinine ratio >50 mg/mmol creatinine
- normal C3 and/or low C4
- signs / results suggestive of a systemic vasculitis (rash, arthralgia, other organ involvement, positive ANA)

Further investigations to consider after discussion:
- Renal Ultrasound
- Anti-neutrophil cytoplasmic antibody (ANCA), anti-glomerular basement membrane antibody (anti GBM antibody) if renal dysfunction or signs suggestive of vasculitis
- General viral titres plus Hep B and C, HIV, Hantavirus
- C1q and C1q antibodies if SLE suspected
- Cryoglobulin titre (cryoglobulinaemia is a small vessel vasculitis, rare in childhood, associated with chronic infections especially hepatitis C, autoimmune disorders and B-cell lympho-proliferative diseases)

### 2.4. Management

Post streptococcal acute glomerulonephritis usually remits spontaneously and treatment is supportive only.
Information from www.infoKID.org.uk⁴ should be offered to parents / patients in addition to any locally available information leaflets and leaflet in Appendix 1.

2.4.1. Phenoxyacetyl Penicillin

This does not alter the natural history of the disease but prevents spread of nephritogenic strains of group A streptococcus. Doses are as follows:

1 – 5 yr 125 mg four times a day for 10 days
6 – 12 yr 250 mg four times a day for 10 days
> 12 yr 500 mg four times a day for 10 days

2.4.2 Fluid Balance

- Fluid input and urine output should be closely monitored.
- All children should be weighed daily.
- All patients should be on a no added salt diet.
- If oliguric (<0.5 ml/kg/hr) restrict fluid input to replacement of insensible losses (400 ml/m²/day) plus previous days urine output
- If overloaded (ie. Hypertensive, raised JVP, oedematous) give furosemide 1 – 2 mg/kg up to twice daily to induce a negative fluid balance.

2.4.3 Hypertension (ie. BP > 95% - see hypertension guideline⁵ at https://www.emeesykidney.nhs.uk/professional-area/individual-guidelines for normal ranges and further advice)

- Discuss with paediatric nephrologist or SPIN paediatrician with expertise in treating hypertension
- Treat fluid overload which is the usual cause (see above)
- If euvoalaemic, use
  - Nifedipine (starting dose 200 – 300 micrograms/kg three times daily)
  - Or Amlodipine (starting dose 100 – 200 micrograms/kg once daily)

Do not use ACE inhibitors as these can reduce renal function. Beta blockers can exacerbate hyperkalaemia.

2.4.4 Hyperkalaemia – discuss with paediatric nephrologist. See hyperkalaemia guideline https://www.emeesykidney.nhs.uk/professional-area/individual-guidelines

- If K<6.0 mmol/l, arrange dietary review and stop medications that might exacerbate hyperkalaemia
- If K 6.0 – 6.5 mmol/l:
  - If not dehydrated, give 1-2 mg/kg Furosemide
  - Check ionised calcium (blood gas) and if low, give slow bolus 10% calcium gluconate (check local hypocalcaemia guideline for dose and method of administration if available)
  - Check acid base status and if HCO₃ <18 mmol/l give sodium bicarbonate 2mmol/kg/day in 4 divided doses
  - Recheck potassium after 4 – 6 hours.
If K>6.5 mmol/l **this is a medical emergency.**
- Continuous cardiac monitoring (Changes associated with hyperkalaemia include tall peaked T waves, flattening or loss of p waves, broad QRS complexes and bradycardia)
- Check and treat hypocalcaemia and acidosis as above
- Give nebulised salbutamol
- Follow hyperkalaemia guideline

3. Prognosis and follow up

3.1 Prognosis

95% of patients with post streptococcal glomerulonephritis will make a complete recovery, however, a small proportion will develop rapidly progressive glomerulonephritis. If renal function is satisfactory and improving and the patient is normotensive, an early discharge should be possible with early and regular outpatient follow up.
### 3.2 Follow up pathway and indications for referral to paediatric nephrology service:

#### On discharge:
- Estimated GFR > 90 ml/min/1.73m²
- Normotensive
- No proteinuria
- Normal albumin

#### On discharge, any of:
- Estimated GFR >90 ml/min/1.73 m²
- Hypertension
- Proteinuria > 50 mg/mmol
- Low albumin

- Timing of follow-up as below for all patients. Some patients may need earlier or more frequent review depending on clinic state.

#### Review at 1-2 weeks
- BP
- Urinalysis

#### Review at 6-8 weeks
- BP
- Urinalysis

#### Review at 3 months
- BP
- Urinalysis
- Complement levels
- Serum albumin
- Creatinine (estimate GFR)

#### If at any stage:
- Hypertension
- Proteinuria > 20 mg/mmol on early morning urine
- Low C4
- Low albumin
- Estimated GFR <90
  - If persistently low C3 at 3 months

#### 6 monthly clinic review:
- BP
- Urinalysis

Note microscopic haematuria may continue for up to 2 years and is of no prognostic relevance. Therefore no need for parents to check dipsticks.

#### Normal urinalysis and normal BP on at least 2 visits

**Discharge**

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**NB:** Paper copies of this document may not be most recent version. The definitive version is held in the policy and guidelines library.
### 3.3 Follow-up proforma

**General Paediatric Follow-Up for children with acute post-infectious glomerulonephritis**

<table>
<thead>
<tr>
<th>Date of diagnosis:</th>
<th>95th centile for BP:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 weeks post diagnosis (date):</td>
<td></td>
</tr>
<tr>
<td>Oedema</td>
<td>YES</td>
</tr>
<tr>
<td>Urine protein ≥1+ → send early morning urine prot:creat ratio (uPCR)</td>
<td>YES</td>
</tr>
<tr>
<td>uPCR &gt;20 mg/mmol?</td>
<td></td>
</tr>
<tr>
<td>BP &gt;95th centile on three occasions</td>
<td>YES</td>
</tr>
<tr>
<td>If YES to any of above:</td>
<td></td>
</tr>
<tr>
<td>1) FBC, UE, Bone Profile, C3, C4</td>
<td></td>
</tr>
<tr>
<td>2) Refer to paediatric nephrology</td>
<td></td>
</tr>
</tbody>
</table>

**If NO to all of above, arrange paediatric review for 6-8 weeks following diagnosis**

| 6-8 weeks post diagnosis (date): | | |
| Oedema | YES | NO |
| Urine protein ≥1+ → send early morning urine prot:creat ratio (uPCR) | YES | NO |
| uPCR >20 mg/mmol? | | |
| BP >95th centile on three occasions | YES | NO |
| If YES to any of above: | | |
| 1) FBC, UE, Bone Profile, C3, C4 | | |
| 2) Refer to paediatric nephrology | | |

**If NO to all of above, arrange paediatric review for 3 months following diagnosis**

| 3 months post diagnosis (date): | | |
| Oedema | YES | NO |
| Urine protein ≥1+ → send early morning urine prot:creat ratio (uPCR) | YES | NO |
| uPCR >20 mg/mmol? | | |
| BP >95th centile on three occasions | YES | NO |
| Low serum albumin | YES | NO |
| eGFR < 90ml/min per 1.73m² | YES | NO |
| Persistently low C3 | YES | NO |
| If YES to any of above: | | |
| 1) Refer to paediatric nephrology | | |

**If NO to all of above, arrange ongoing paediatric review 6 monthly**

| 6 monthly review | | |
| Urine protein ≥1+ → send early morning urine prot:creat ratio (uPCR) | YES | NO |
| uPCR >20 mg/mmol? | | |
| BP >95th centile on three occasions | YES | NO |
| If YES to any of above: Refer to paediatric nephrology | | |
| Macroscopic haematuria | YES | NO |

If no to all of the above on 2 consecutive 6 monthly reviews discharge from follow-up. If previous discussion with Paediatric Nephrologist then discuss with them prior to discharge.
4. Audit Points

1. Are investigations undertaken as per guidelines?
2. Are referrals made to paediatric nephrology appropriate and at the correct time?
3. Has the patient been offered written information about the condition?

5. References


4. InfoKID leaflet [https://www.infokid.org.uk/glomerulonephritis](https://www.infokid.org.uk/glomerulonephritis)

5. Hypertension guideline [https://www.emeeskykidney.nhs.uk/professional-area/individual-guidelines](https://www.emeeskykidney.nhs.uk/professional-area/individual-guidelines)
Appendix 1 – A Guide to Childhood Nephritis Leaflet

CHILDHOOD NEPHRITIS

INTRODUCTION
Nephritis is a condition that affects the kidneys. It requires special attention. Most children with nephritis make a full recovery within a few weeks.

This leaflet has been prepared to help children and their families understand what happens to a child who has nephritis.

WHAT IS NEPHRITIS?
Nephritis is a name given to inflammation of the kidneys. It is usually a reaction to a recent simple infection, such as a sore throat. Kidneys with nephritis don’t work as well as they should. When kidneys are severely affected we call this acute kidney injury or ‘acute renal failure’. Almost always the kidneys recover completely.

WHAT DO THE KIDNEYS DO?
The kidneys are responsible for processing water and the body’s waste products. Urine is produced by the kidneys and consists of water and waste products. The kidneys also help in controlling blood pressure and the prevention of anaemia.

WHAT ARE THE SIGNS OF NEPHRITIS?
If the kidneys don’t make enough urine then the body has more fluid than it needs. This can cause the body to get puffy or swollen (we call this oedema). The swelling usually appears around the eyes first. It can also appear around the ankles.

Inflammation in the kidney can cause blood to appear in the urine. This makes the urine red or brownish in colour. The amount of urine passed is often reduced.

Your child’s blood pressure may be high.

Your child may feel generally unwell because of these things. They may lack energy and be off their food. Occasionally children with nephritis complain of headaches and stomach pains.

WHAT TESTS WILL MY CHILD NEED?
When your child first develops nephritis they will need some blood and urine tests. These are done to see how well the kidneys are working and to look for
the cause of the kidney inflammation. Over the first few days they will need further blood tests to monitor their progress.

We will need to monitor how much urine is passed during the day, and how much your child drinks.

Usually the tests and monitoring are carried out in hospital. Only if your child has unusual features for their nephritis will we consider a renal biopsy. The kidney specialist will discuss this with you and give you more information.

WHAT IS THE TREATMENT?
If the kidney inflammation has occurred after an infection then a course of antibiotics will be given.

The amount of fluid your child drinks may need to be restricted.

If your child has high blood pressure this may need treatment with medicines.

A healthy eating diet is recommended which all the family can follow. It is important that your child does not add salt to their food at the table and also avoids salty snacks such as crisps and soup. You may be advised to reduce your child’s intake of a mineral called potassium. There is a lot of potassium in bananas and fruit juice. Some children require changes in their diet to increase their calorie (energy) intake while they are unwell. A dietician will visit you to offer advice.

WILL MY CHILD GET BETTER?
Most children with nephritis make a full recovery within a few weeks, although it is not uncommon to find some blood in the urine for several months afterwards.

After discharge from hospital your child will often be encouraged to return to school quickly. Progress will be monitored in the clinic until we are sure the kidney inflammation has healed completely.

When your child is well they can return to enjoying all their usual activities.

Occasionally the nephritis does not go away but becomes a chronic condition. In this situation your child may also need a kidney biopsy to diagnose the type of nephritis before we consider further treatment.
WILL THE NEPHRITIS COME BACK?
Sometimes another sore throat or infection can cause the reappearance of blood in the urine but unless there are other signs of nephritis such as swelling, your child will not need to be readmitted.

If you are worried you should contact your GP, Paediatrician or the Children’s Renal Unit.

Compiled by A R Watson and members of the

Nottingham University Hospitals, QMC Campus, Derby Road, Nottingham NG8 2UH
www.childrenskidney.nottingham@nhs.uk
Leaflet funded by The Kinder Appeal,
January 2010
Nottingham University Hospitals NHS Trust
Appendix 2 - Estimated GFR

Estimated GFR is automatically reported in all in-patients in Nottingham Children’s Hospital over 2 years of age.

Where automated GFR is unavailable use the formula;

\[ \text{GFR} = \left( k \times \text{ht (cm)} \right) / \text{creatinine (μmol/l)} \]

Ideally, \( k \) should be validated locally eg in Nottingham;

- \( k = 36 \) for males older than 13
- \( k = 30 \) for all others

If a locally validated \( k \) value has not been established then \( k=40 \) should be used.