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## Department of Paediatric Nephrology

# Investigating Urinary Tract Infections in Children

Urinary tract infections (UTIs) are common, affecting up to 4 % of boys and 12 % of girls by 16 years. Management remains controversial. We have previously circulated our ideas and policies to regional colleagues as protocols in 1990, and 1997. This is the latest update.

Previously we described our practice, gave supporting arguments, and included our information sheets and clinical letters. This version is simpler. We have now provided the evidence base separately in a chapter two of us wrote in 'Clinical Paediatric Nephrology', and omitted it from this protocol. We can post this on request.

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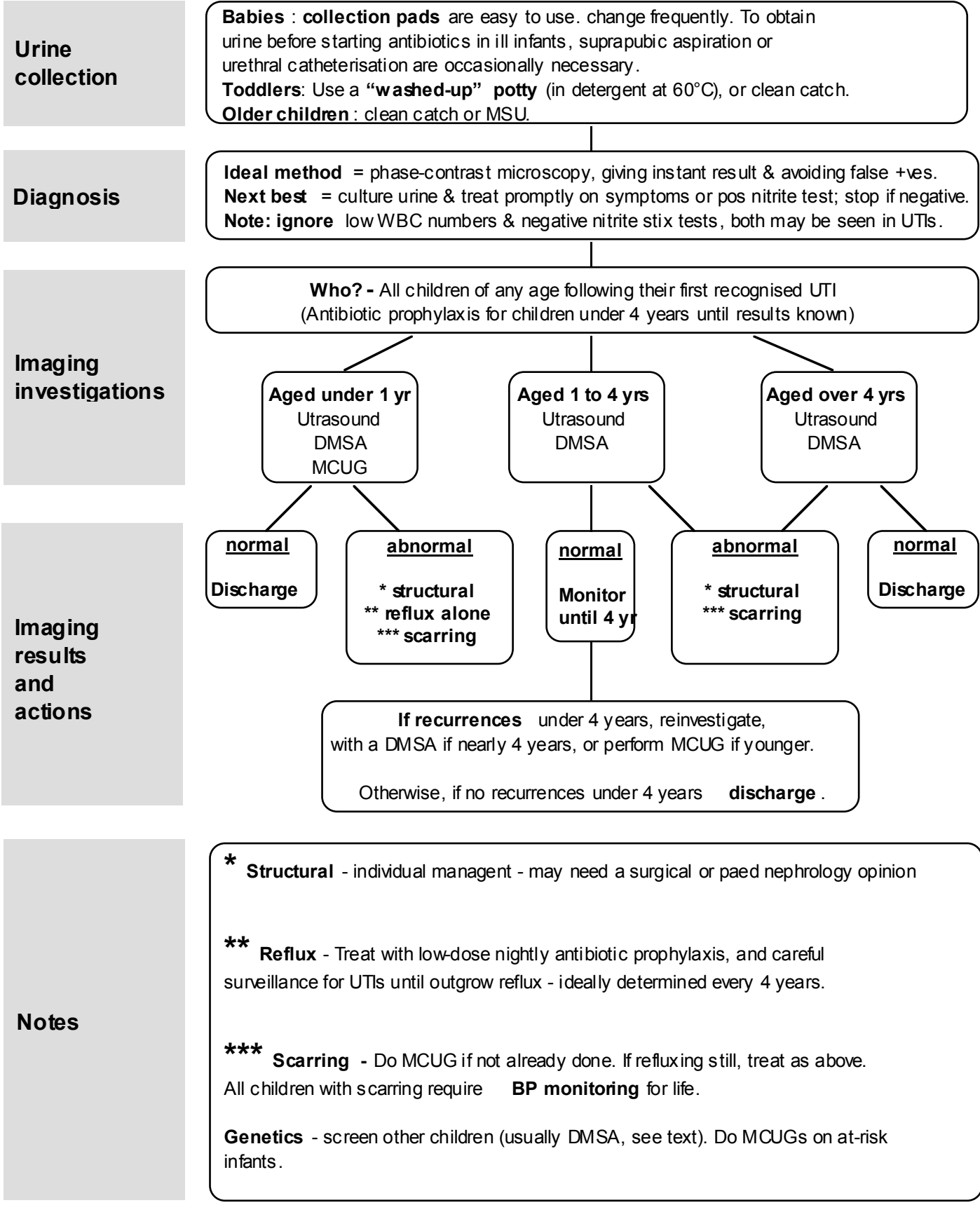
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## UTI management flow sheet



## Urine collection

### BABIES – urine collection pads

Wash the perineum with cotton wool and water, then place a urine collection pad inside the nappy. Check the pad after 15 minutes, and replace it after ½ hour if it is not wet. Withdraw the urine from the soaked fibres with a 10 ml syringe without a needle. If the pad is only slightly moist, urine can be extracted by placing fibres in the syringe barrel and replacing the plunger.

### TODDLERS – washed-up potties

In toddlers it is often much easier to collect urine from a washed-up potty than to collect a clean catch or mid-stream urine. The potty must be thoroughly washed in hot water and washing-up liquid (which removes the biofilm that harbours bacteria), rinsed under the tap, and allowed to dry. Do not attempt to 'sterilise' the potty using bleach or antiseptics, or by rinsing with boiling water, all of which are ineffective.

An alternative is to place a sterile pot inside a potty.

### OLDER CHILDREN – mid-stream or clean catch urines

It is ideal to catch a mid-stream sample straight into a universal bottle, but this may be difficult in younger children. Disposable sterile plastic funnels make this easier in girls.

A clean catch urine (the first part of the stream, or the whole void) from a cleaned child is usually satisfactory, and often easier to collect than a mid-stream sample.

### AVOIDING CONTAMINATION IN GIRLS

Most girls void at least some urine into the vagina, so samples may contain vaginal white cells, epithelial cells, and bacteria (often long Gram-positive anaerobic lactobacilli). Occasionally this may simulate a UTI. If in doubt, collect a repeat sample while the girl voids with her legs and labia parted to produce a clear stream.

### SUPRAPUBIC PUNCTURE / CATHETER SPECIMEN

This is occasionally required, for example if a sick baby requires an urgent septic screen prior to antibiotics. Usually urine can be expressed from the bladder instead. If not, consider catheterising the infant because this may be required anyway – ill babies often need close fluid balance monitoring. It is better to use an 'invasive' method of obtaining urine from a septic baby than not to collect one.

The 'gold standard' status of suprapubic puncture is not evidence-based. Contamination may occur from skin or punctured bowel. The widely quoted notion that *any* growth from a suprapubic puncture sample is diagnostic of a urine infection (for example, a culture of  $<10^5$  organisms/ml) is a myth.

## Urine testing

### STICK-TESTING

Routine stick-testing of urine for **blood**, **protein** and **glucose** is part of the standard examination of any unwell child, not just those suspected of having a UTI. If you use microscopy, use the test stick to transfer the urine drop to the slide. Stick-testing for blood or protein are seldom *diagnostic* of a urine infection because they may occur with many other pathologies. Sometimes a positive result merely reflects a concentrated urine.

**Leucocyte esterase** stick-test results are **irrelevant**. Though the sticks are probably reliable indicators of urinary white cells, these do not predict usefully for urine infection (see below), and so are not helpful.

**Nitrite** sticks indicate **bacterial metabolism**. They are useful if positive, and may assist in the decision to start antibiotics promptly in the absence of microscopy. However, they are valueless if negative because they are negative in 50% of children with a UTI. Thus, if you discard nitrite-negative urines, you will miss half the UTIs.

### TESTING FOR BACTERIA – culture vs microscopy

**BACKGROUND** Urine infections are due to a single bacterial species at concentrations between  $10^7$  and  $10^9$  organisms/ml. In 1959, Kass proposed a diagnostic cut-off of  $>10^5$ /ml for laboratory convenience, not for scientific reasons. Unsurprisingly, a threshold only  $1/1,000^{\text{th}}$  of the true concentration means minor contamination will commonly produce false-positive cultures. About 50% of urines reported as  $>10^5$  bacteria /ml are due to contamination. About 8% of urines from children without a UTI will grow  $>10^5$  bacteria /ml.

**CULTURE** A result takes a minimum of 1 day, up to 2 if sensitivities are requested, and often 3 to 7 days to reach a clinician – longer than it takes to scar a kidney! The false positive rate is approximately 50% (see above). A lab report of  $>10^5$  coliforms/ml could mean contamination with  $10^5$ /ml, or a genuine UTI with  $10^9$ /ml. This problem would be resolved if labs altered their culture technique by pre-dilution to report up to  $>10^7$ /ml rather than up to  $>10^5$ /ml. This is currently being addressed by research within our department.

**MICROSCOPY** Phase-contrast microscopy of unstained, uncentrifuged urine allows bacteria to be counted at concentrations between  $10^6$  and  $10^9$ /ml. This means uninfected urines (up to  $10^6$ /ml) can be recognised and discarded, and UTIs (at least  $10^7$ /ml) can be instantly diagnosed. Parents can be reassured at once, or treatment started without delay. Uncertain samples can be recognised at once, and further urines collected and microscopied until a certain result is obtained. Thus, 'uncertain' and 'contaminated' results are eliminated. Infected urines still need to be cultured to determine antibiotic sensitivities. 'Direct sensitivities' can be requested from the lab, giving a complete result by the following day.

Very rarely, in unusual clinical situations, a laboratory Gram stain is useful to clarify microscopy findings.

**Cost implications** Phase-contrast microscopes are expensive, but cost-effective. We use 3 microscopes + monitors (£12,000) to screen 400 urines weekly, and discard  $>90\%$ . At £4.45 per culture, these microscopes will save over £800,000 in lab costs over 10 years. Huge additional financial and human savings accrue from not falsely diagnosing, treating, imaging and following up children who only had contaminated urines.

### **PHASE-CONTRAST MICROSCOPY** (A separate booklet is available on this).

Bacteria can be seen easily in fresh uncentrifuged urine using phase-contrast microscopy with a Neubauer counting chamber at x400. This near-patient technique can be carried out reliably by appropriately trained medical, nursing or technical staff. Within a unit where the equipment is regularly maintained and used, it is quicker for experienced staff to microscope a urine sample than to fill in a laboratory request form!

- **Uninfected** Urines where no bacteria are seen can be discarded. At the standard magnification of x400, you will see that each field of view can contain one square that is defined by triple-lines, and which itself contains 16 smaller squares. Look at 5 of these main squares, that is look at about 5 fields, to be sure.
- **Infected** Urines with several bacterial rods in each field, with or without white cells, are infected. They should be cultured and direct sensitivities requested. The child can be treated without delay, and the antibiotic choice reviewed the next day in the light of the sensitivity results.
- **Uncertain** Some urine microscopy findings suggest bacterial contamination. These include seeing few bacteria (eg, <2 per main square or field), and seeing bacilli and cocci together. Chains of cocci should be treated with suspicion – they could be due to contamination, or a genuine enterococcal UTI. Collect further urines with scrupulous care until definite diagnosis is made.

Large numbers of epithelial cells in girls indicate vaginal contamination. Repeat collections may need to be made with them voiding with parted labia to avoid this.

Remember that very infrequently, a laboratory Gram stain is useful to clarify near-patient microscopy findings.

### **RECORDING MICROSCOPY RESULTS**

Urine phase-contrast microscopy	
name _____	date ____/____/____
MICRO - Bacteria .....	
WBC .....	RBC .....
Casts, etc .....	
STICKS - Protein .....	
Blood .....	Glucose .....
Other .....	
ACTION - (tick one of the 3 options, ✓)	
Urine not infected, sample discarded .....	<input type="checkbox"/>
Urine contaminated, sample repeated .....	<input type="checkbox"/>
UTI; urine sent for culture & direct sensitivities, and antibiotics started .....	<input type="checkbox"/>
SIGN & PRINT NAME .....	

For clinical and medico-legal reasons it is vital to record accurately in the notes the urine result, especially if it is not cultured. We use these adhesive forms, kept by the microscope, that detail the findings and the action taken.

### **TRANSPORT TO THE LABORATORY**

If samples cannot be transported to the laboratory within 1 hour, refrigerate them to minimise bacterial overgrowth. Do not use boric acid which may be bactericidal in small paediatric samples, producing a false-negative result.

## **WHITE CELLS**

White blood cell (WBC) numbers are so variable in children, they are diagnostically **valueless**. They may be low because WBC may only survive a few minutes, and immunosuppressed and very ill children may not produce them, or high because febrile children mobilise their WBCs generally, or from the vagina.

## **MAKING A DIAGNOSIS OUT OF HOURS IN PRIMARY CARE**

Whereas phase-contrast microscopy allows a confident, immediate diagnosis of UTI, culture takes at least a day, and in practice several days for primary care services, especially if submitted before a weekend. The extensive kidney scarring which can occur within 3 days in animal models almost certainly happens in infants. This makes delaying treatment pending laboratory results problematic. To prevent scarring, you have to treat a possible UTI in an infant as a medical emergency.

We therefore recommend that if a child has a suggestive clinical diagnosis of a UTI, antibiotic treatment is started as soon as a urine sample has been obtained. Treatment can be stopped if the culture is returned negative, and continued if it is positive. If this occurs out of hours, refrigerate the sample and culture at the earliest opportunity. Treating without collecting a specimen should be a rare event.

## **MAKING A CLINICAL DIAGNOSIS OF URINE INFECTIONS**

Sometimes the diagnosis of UTI has to be guessed from clinical details because no urines have been collected or tested, and antibiotics have already been given. This may result in children being inappropriately managed. The decision to investigate or not depends on an assessment of probability, and will inevitably cause both over and under investigation.

If the history suggests balanitis, vulvitis, or dysuria due to a highly concentrated urine (eg, after a vomiting illness), then it is reasonable not to investigate. Otherwise, it is difficult to resist investigating.

### **These may be useful clinical pointers:**

- A definitely red, swollen foreskin is likely to be balanitis and not a UTI, even with a 'positive' MSU.
- Both vulvitis and UTI can produce dysuria and vulval redness, but if the redness is marked at the onset, vulvitis is more likely. Discourage frequent use of anti-fungal creams without clear clinical evidence of thrush. Most girls with vulvitis benefit from a daily bath in water only, avoiding bubble-bath and soap to the vulva, followed frequently by a barrier cream such as zinc & castor oil.
- Children with a systemic illness including fever, malaise and mild dehydration often produce a highly concentrated urine. This may cause dysuria which can be mistaken for a UTI.
- Children with UTIs typically fully recover symptomatically within 1 to 3 days of receiving antibiotics. Children whose symptoms do not appear to have been influenced promptly by antibiotic treatment are less likely to have had a UTI.

## Imaging investigations

Children are most likely to sustain kidney scars before the age of 4, with babies being most vulnerable. New scarring in normal kidneys is unlikely to happen after that age. This influences the choice of imaging tests used.

### WHO TO INVESTIGATE? – Every child after their first recognised UTI

Children whose kidneys are not scarred by about the age of four are unlikely to begin to scar after that. However, you still need to image the kidneys of older children who present with their first recognised UTI. The reason is that their current UTI may not be their first – remember that GPs only diagnose about 25% of infants that present with a UTI. Thus, infants may scar silently, and only have their scars recognised when they present as an older child with a further infection, when UTIs are much easier to diagnose. Children of all ages have a 5% chance of having a scar detected after their first recognised UTI.

### PROPHYLAXIS – Give to under 4s while awaiting investigations

We advise trimethoprim, 2mg/kg at night in children under 4 years, until the imaging results are known. Older children's scars are likely to be old, so we seldom advise them having prophylaxis prior to imaging.

Many parents are reluctant to use antibiotics for that long, fearing they will cause their child to 'develop resistance' or alter their 'immunity'. Many will not raise this anxiety with you, but will be non-compliant because of it. However, the pharmacology of trimethoprim, cephalexin, nitrofurantoin or naladixic acid makes them safe for prophylaxis. This is dealt with in one of the information sheets. The argument is that these drugs are fully absorbed in the small bowel, and are highly concentrated into the urine during renal excretion. This means a tiny dose can be used, too small to kill bacteria systemically and thereby alter immunity. This effectively produces just urinary antiseptics. **To increase compliance, you should always raise this, without being asked.**

## IMAGING INVESTIGATIONS

**Which tests?** On every child, we perform an ultrasound to look for structural abnormalities, and a DMSA to detect focal scarring. Vesicoureteric reflux (VUR) has a central role in the development of scarring associated with UTI, and in an ideal world it would help management if this was assessed in every child under 4 years. However, at present VUR is only reliably detected by direct contrast or isotope micturating cystography (MCUG) which involves catheterisation. Until this is replaced with less invasive tests, we recommend limiting its use to higher risk cases. These are infants up to 1 year, children with repeated infections aged 1 to 4 years, and all children with scars (who may extend their scarring with further UTIs if still refluxing).

There are separate parental information sheets for <1, 1 to 4, and over 4 year olds.

**Ultrasound** This is painless and ionising radiation-free. It provides structural, not functional information, so is the only technique able to image poorly or non-functioning kidneys. It is useful for detecting obstruction, cysts, dysplastic parenchyme, nephrocalcinosis, dilated ureters, and stones. It may be helpful in assessing the bladder wall thickness and emptying. It is extremely operator dependent.

Focal scars may be identified consistently by highly skilled, experienced operators examining co-operative children under extremely rigorous conditions for prolonged studies. It is far too insensitive to detect scars reliably in routine practice, so we do not spend time attempting this routinely.

**Dimercaptosuccinic acid (DMSA) scans** DMSA is an injected radio-pharmaceutical that is taken up from the plasma by proximal tubule cells, producing a highly sensitive 'static' scan of the functioning kidney parenchyme. Normally little enters the urine, and this is not usually seen because imaging is after an interval. The radiation dose is relatively low, similar to 1 plain abdominal x-ray. Scars, cysts, acute inflammation and infarctions and dilated renal pelves appear as 'defects', or areas of reduced activity immediately they occur. Acute inflammation that will resolve later is indistinguishable, so we normally don't scan within 3 months of a UTI.

The DMSA also measures the 'split', or relative function contributed by each kidney (which correlates closely with the divided GFR). The 3<sup>rd</sup> and 97<sup>th</sup> centiles values for either kidney are 41 and 59%. More extreme unexplained splits (eg, without scarring) need careful evaluation, and may require further investigation. Anterior views are needed for horseshoe and ectopic kidneys which lie in front of the vertebrae or iliac crest.

**Plasma creatinine** The DMSA measures the distribution, but not the absolute renal function. Taking a blood for creatinine during the DMSA injection provides this, and should be done routinely.

**Abdominal x-ray** This is not routine. It can occasionally detect ureteric stones that are difficult to see on ultrasound, and should be done if stones are suspected.

**Intravenous urogram (IVU, IVP)** This has **no role in the routine investigation of children with UTIs**. It has virtually no role in paediatric imaging at all. It has a higher radiation dose than other techniques, has a slight anaphylaxis risk, is unpleasant, provides unreliable functional images, and does not identify scars until they have been present for several years.

## **CYSTOGRAPHY**

**Contrast micturating cystourethrogram (MCUG)** This requires bladder catheterisation and has a relatively high radiation dose. Most children tolerate the catheter being passed without sedation or GA, especially if they are very young, or old enough to co-operate and have had the procedure explained in advance by their parents. If catheterisation is difficult, do not struggle with the child. At a later date, catheterise under a brief GA, and perform the MCUG when they wake up. The MCUG identifies bladder and urethral anatomy, as well as reflux.

Some girls, particularly infants, have **fused labia** which makes catheterisation difficult. Examine infant girls' genitalia as they will all require a cystogram. Apply Premarin cream sparingly with a cotton bud in the midline along the line of the fusion, twice daily for up to 2 weeks. Once the labia are separated, apply vaseline twice a day for another week.

**Direct isotope cystography** This requires catheter instillation of isotope into the bladder to detect reflux. The radiation is much lower than a contrast MCUG. It gives no anatomical detail, so is not useful in infant boys.

**Indirect isotopic (MAG3) cystography** This avoids catheterisation, and has a low radiation dose, but misses 50% of cases of reflux if used conventionally. It has a much higher sensitivity in children who are old enough to sit still for repeated periods, including voiding, in front of the gamma-camera, typically over the age of 7.

## Interpreting imaging results

### NORMAL RESULTS

**Children under 1 year** These infants have had no scarring or reflux detected, and thus little risk of developing scars with future UTIs. We therefore discharge them, and recommend that future symptomatic UTIs be treated with antibiotics, but not imaged further. However, because cystograms could miss reflux in up to 10% of cases, we would consider reinvestigating children with frequent, symptomatic recurrences.

**Children aged 1 to 4 years** Though unscarred, these children could still develop a scar under the age of 4 with another UTI, because our imaging protocol does not exclude reflux. We therefore advise that parents and GPs vigilantly and promptly check urines if the child has suggestive symptoms.

If this group do have another UTI we investigate further. In children approaching 4 we usually repeat the DMSA scan. In younger children, we perform an MCUG.

**Children over 4 years** These children have little or no risk of developing scars with future UTIs because the onset of new scarring over the age of four is rare. We therefore discharge them, and recommend that future symptomatic UTIs be treated with antibiotics, but not imaged further. Children with frequent, symptomatic recurrences may need rigorous treatment of constipation, double micturition, or prolonged low-dose antibiotics.

### ABNORMAL RESULTS – 1) SCARRING (there is an information sheet on this)

**Further UTI management** Children with renal scars should have an MCUG to see if they still reflux. If not, they have probably outgrown it, and are no longer at risk of scarring with UTIs. If the history, DMSA and US put the diagnosis of reflux nephropathy in doubt, consider investigating to exclude renovascular disease.

If they still have reflux, they should be maintained infection-free using low-dose nightly antibiotic prophylaxis, with urines being checked readily with a high degree of suspicion for breakthrough infections. This is because there is some evidence that scars may extend if the child still has reflux and urine infections. Prophylaxis needs to be continued until they outgrow their reflux, as defined by a normal MCUG. At present we repeat MCUGs every 4 years. Some children cannot be maintained infection-free, and require referral to the surgeons for consideration of an anti-reflux procedure, either a STING or reimplantation surgery.

**Lifelong BP monitoring** Renal scarring carries a longterm hypertension risk, even with just 1 segment involved. We therefore recommend lifelong BP monitoring. We suggest this is done annually for life in children with few scars, and 6-monthly through childhood for children with more extensive scarring.

After the age of 7 years, this can be done in primary care using an adult cuff and stethoscope. Until then it should be measured using a Doppler and large cuff. We provide this service either in our clinics, or in the Day Unit using the referral form in the appendix.

We provide children with a letter to keep that clearly states the need for lifelong BP monitoring, and advise them to take responsibility for maintaining surveillance, basing the timing around memorable dates (birthdays, Christmas). We see all scarred children for a final education session, make appropriate longterm care arrangements, and ensure they are aware of the genetic implications of reflux.

**Genetics** Vesicoureteric reflux is inherited. First degree relatives, eg siblings, their future children, each have about a 1 in 3 chance of being born with reflux. This should be discussed with the family, and further investigations considered.

Siblings over 4 years can be screened with a DMSA scan. Newborn siblings and their own future offspring should be offered an MCUG. The appropriate plan for screening siblings between these ages will depend on the particular circumstances. In general the younger the child, the more powerful is the argument for doing an MCUG rather than a DMSA scan. Sometimes it is appropriate for the parents to be investigated.

## **ABNORMAL RESULTS – 2) INFANTS WITH REFLUX, BUT NO SCARRING**

(there is an information sheet on this)

### **What does this mean?**

**a)** Until now virtually all infants we have seen with a UTI and VUR have also had scars. To have not scarred either means they do not have any vulnerable renal segments (papillae that allow intrarenal reflux), or the UTI was treated extremely promptly. Recently, we have seen many unscarred infants with UTI and VUR due to the vigilance of GPs enrolled into the direct access service. These children **have had scarring prevented**.

**b)** Infants screened for reflux (for family history, or an ectopic or multicystic-dysplastic kidney) may also have VUR without scarring if they have not had a UTI. They are also **at risk of scarring**.

**Both groups require similar management:**

### **Prevent UTIs until they outgrow the reflux**

All infants with VUR should be treated as if they are at risk of scarring if they have a UTI. This means using prophylactic antibiotics and prompt monitoring for UTIs.

This protection must be maintained **until they lose their reflux**, at whatever age this may occur. This is because children who still have reflux, and who have had the protection provided by using regular antibiotics and surveillance, remain at risk of developing new scars until they grow out of their reflux, and not just until they are 4 years old.

Most children with VUR will outgrow it with time. The number of children with persisting VUR gradually falls with increasing age. This will tend to happen earlier for children with milder reflux, and later or may never happen with severe reflux. About half the babies born with VUR will have lost their reflux by school age. This time-scale influences how often we retest for VUR. The interval chosen is arbitrary, but we presently check every 4 years. This requires catheterisation in younger children. It may be possible to avoid this in older children (eg, over about 7 years) by using indirect isotope (MAG3) studies with prolonged screening times.

## **ABNORMAL RESULTS – 3) STRUCTURAL ABNORMALITIES, OBSTRUCTION AND STONES**

These always lead to further imaging investigations, arranged in conjunction with the paediatric surgeons. Children with stones require blood and urine metabolic studies.

### **PARENT, CHILD & GP LETTERS**

We inform the parents / older children about **normal** imaging results by standard letters (copied to the GP). We use a database for audit, and to generate personalised age- and sex-appropriate letters. You are welcome to copy and adapt it for your own department. An instruction sheet on using the RVI letter system is included after the information sheets. We have also included some examples of letters for different aged children.

# Urine infections in babies under 1 year

## Why do we investigate babies that have had urine infections?

Lots of children get urine infections. Most have normal kidneys, and are not harmed by the infection. However, some children's urine infections have been caused because their kidneys are abnormal, and other children develop kidney scars from the infection. This is why we check children's kidneys after urine infections. Babies are the most likely to develop permanent damage, or scars, so we investigate them particularly carefully.

We need to do 3 tests, which can be done in any order. First we look at the way your baby's kidneys are made and plumbed, using ultrasound. Next we look to see if they have developed any kidney scars, using a DMSA scan. Third, we look to see if the urine in their bladder can flow back up towards their kidneys (reflux), using a bladder x-ray. There is a separate information sheet available about reflux if you want to know more about this.

## Test 1 ... the ultrasound scan

This is the same scan that pregnant women have, and does not hurt. It takes about 20 minutes and is usually done in the x-ray department using a 'microphone' and jelly on your child's tummy. This tells us whether their kidneys, tubes and bladder look normal. Kidney scars are not easily seen in children using this test, so that is why we also need to do a DMSA scan.

## Test 2 ... the DMSA scan

Your child will need a small injection of a tracer called DMSA into a vein. It is like having a blood test, which is also done at the same time. In infants over 6 months we can put some "magic" (local anaesthetic, EMLA) cream on beforehand so the injection doesn't hurt. This is done on the children's day unit. The DMSA then goes round the blood-stream and is picked up by the kidneys. This takes an hour or two, during which your child can play and have a feed. Then in the medical physics department your baby is laid on a special camera, or sat in front of it, to see their kidneys. This takes about 5 minutes. DMSA is radioactive, but the quantity is small, only about the same amount of radiation as an ordinary x-ray.

## Test 3 ... the bladder x-ray (also called micturating cystourethrogram or MCUG)

We put x-ray dye in your baby's bladder to see if it flows backwards up towards their kidneys. To get it in, we slip a soft tube through the hole that your baby wees through. Babies do not like being held still for this, and it is uncomfortable for a few seconds while the tube is being slipped in, but once it is in place they will stop noticing it. Your baby will not feel the dye being put into the bladder – when the bladder is full they feel they need a wee.

## What if my baby has another urine infection while they are waiting?

We strongly advise you to keep your child on a low-dose preventative (prophylactic) antibiotic until we have seen their test results. If they do get another infection, please telephone us on the number below.

## What will the results mean?

**NORMAL** results tell us that your baby's kidneys have grown properly, that they have not been harmed by the urine infection, and that they do not have reflux. This also means that their kidneys should not come to harm in the future from urine infections. So if your child does go on to have a further infection, your doctor would treat them with an antibiotic, but they should not need to have more scans. No test is 100% accurate and therefore if your child goes on to get repeated urine infections we would want to know and review your child's case.

**ABNORMAL** results can mean a lot of different things. If your child's scans are abnormal, we will explain to you exactly what we have found. Sometimes it means going on to have other tests. Usually it means we can help to make sure your baby's kidneys are protected from further harm.

**If there is *anything* you don't understand or are worried about please ask.**

**Children's Kidney Unit, Royal Victoria Infirmary, Newcastle upon Tyne.**

Telephone: (0191) 282 4076 / 282 4917 [Children's Day Unit (0191) 282 5005]

# Urine infections in children aged 1 to 4 years

## Why do we investigate children that have had urine infections?

Lots of children get urine infections. Most have normal kidneys, and are not harmed by the infection. However, some children's urine infections have been caused because their kidneys are abnormal, and other children develop kidney permanent damage, or scars, from the infection. This is why we check children's kidneys after urine infections.

We need to do 2 tests. First we look at the way your child's kidneys are made and plumbed, using ultrasound. Next we look to see if they have developed any kidney scars, using a DMSA scan. Your child can eat and drink normally on the scan days. We will make sure you know exactly when and where to go with them. It can sometimes be a long day – be prepared with a favourite book or toy!

## Test 1 ... the ultrasound scan

This is the same scan that pregnant women have, and does not hurt. It takes about 20 minutes and is usually done in the x-ray department using a 'microphone' and jelly on your child's tummy. This tells us whether their kidneys, tubes and bladder look normal. Kidney scars are not easily seen in children using this test, so that is why we also need to do a DMSA scan.

## Test 2 ... the DMSA scan

Your child will need a small injection of a tracer called DMSA into a vein. It is like having a blood test, which is also done at the same time. We can put some "magic" (local anaesthetic, EMLA) cream on beforehand so the injection doesn't hurt. This is done on the children's day unit. The DMSA then goes round the blood-stream and is picked up by the kidneys. This takes an hour or two, during which your child can play or have lunch. Then in the medical physics department your child lies or sits in front of a special camera to see their kidneys. This takes about 5 minutes. DMSA is radioactive, but the quantity is small, only about the same amount of radiation as an ordinary x-ray.

## What if my child has another urine infection while they are waiting?

We strongly advise you to keep your child on a low-dose preventative (prophylactic) antibiotics until we have seen their test results. If they do get another infection, please telephone us on the number below.

## What will the results mean?

### **NORMAL**

Normal results tell us that your child's kidneys have grown properly, and that they have not been harmed by the urine infections they have had so far. There is over a 90% chance that your child's scans will be normal.

However, children can still harm their kidneys with further urine infections. This usually happens before the age of about 4 years. This means that your child should have their urine tested for infection quickly whenever they are unwell or have a temperature without there being an obvious cause. If they do have another infection before they are 4 years old, we would like to see them again and arrange some further tests.

### **ABNORMAL**

Abnormal results can mean a lot of different things. If your child's scans are abnormal, we will explain to you exactly what we have found. Often it means going on to have other tests. Usually it means we can help to make sure your child's kidneys are protected from further harm.

**If there is *anything* you don't understand or are worried about please ask.**

**Children's Kidney Unit, Royal Victoria Infirmary, Newcastle upon Tyne.**

Telephone: (0191) 282 4076 / 282 4917 [Children's Day Unit (0191) 282 5005]

# Urine infections in children over 4 years old

## Why do we investigate children that have had urine infections?

Lots of children get urine infections. Most have normal kidneys, and are not harmed by the infection. However, some children's urine infections have been caused because their kidneys are abnormal, and other children develop kidney permanent damage, or scars, from the infection. This is why we check children's kidneys after urine infections.

We need to do 2 tests. First we look at the way your child's kidneys are made and plumbed, using ultrasound. Next we look to see if they have developed any kidney scars, using a DMSA scan.

Your child can eat and drink normally on the scan days. We will make sure you know exactly when and where to go with them. It can sometimes be a long day – be prepared with a favourite book or toy!

## Test 1 ... the ultrasound scan

This is the same scan that pregnant women have, and does not hurt. It takes about 20 minutes and is usually done in the x-ray department using a 'microphone' and jelly on your child's tummy. This tells us whether their kidneys, tubes and bladder look normal. Kidney scars are not easily seen in children using this test, so that is why we also need to do a DMSA scan.

## Test 2 ... the DMSA scan

Your child will need a small injection of a tracer called DMSA into a vein. It is like having a blood test, which is also done at the same time. We can put some "magic" (local anaesthetic, EMLA) cream on beforehand so the injection doesn't hurt. This is done on the children's day unit. The DMSA then goes round the blood-stream and is picked up by the kidneys. This takes an hour or two, during which your child can play or have lunch. Then in the medical physics department your child lies or sits in front of a special camera to see their kidneys. This takes about 5 minutes. DMSA is radioactive, but the quantity is small, only about the same amount of radiation as an ordinary x-ray.

## What will the results mean?

### **NORMAL**

Normal results tell us that your child's kidneys have grown properly, and that they have not been harmed by the urine infections they have had so far. There is over a 90% chance that your child's scans will be normal.

This also means that their kidneys should not come to harm in the future from urine infections. That means that if your child does go on to have further infections, your doctor would treat them with an antibiotic, but they should not need to have any more scans. However if your child goes on to get repeated urine infections we would be happy for them to be referred back as we may be able to offer further advice.

### **ABNORMAL**

Abnormal results can mean a lot of different things. If your child's scans are abnormal, we will explain to you exactly what we have found. Often it means going on to have other tests. Usually it means we can help to make sure your child's kidneys are protected from being harmed any further.

**If there is *anything* you don't understand or are worried about please ask.**

**Children's Kidney Unit, Royal Victoria Infirmary, Newcastle upon Tyne.**

Telephone: (0191) 282 4076 / 282 4917 [Children's Day Unit (0191) 282 5005]

# Using preventative antibiotics for urine infections

## Why use preventative (prophylactic) antibiotics?

Urine infections can cause kidney damage in some children, and unpleasant symptoms in others. Taking regular antibiotics cannot guarantee to stop urine infections, but they reduce the chances. Taking antibiotics regularly to prevent urine infections is called prophylaxis.

## What time should they be taken?

It is best to give preventative antibiotics once a day at bed-time. This is because older children do not empty their bladder at night, so this is the time that their urine gets most stagnant, and is more likely to become infected.

## How long are they needed for?

This depends on your child's kidney condition.

- It is a good idea for children who are under 4 years of age and have a urine infection to take preventative antibiotics until we have seen that their scans and x-rays are normal.
- If a child has reflux (with or without a scar) we advise that they stay on preventative antibiotics until we have shown that they have grown out of it. This may take many years. There is another information sheet available about reflux.
- They can be used for children who get repeated urine infections, which cause unpleasant symptoms, even if they don't have any abnormality like reflux, or any risk of kidney scarring.

## Are they safe?

We do not like to prescribe any medicines unless they are essential, but we are very happy to use preventative antibiotics for the urine (trimethoprim, cephalexin, nitrofurantoin and naladixic acid) because they can be of great benefit, and they are very safe. Usually we avoid using antibiotics for a long time because they can kill the 'friendly' germs in your body, as well as the harmful ones. Preventative antibiotics are a special case. The antibiotic is taken into the child's system, and then cleaned out of the body in the urine. The antibiotic becomes highly concentrated in the urine. This means that a small dose is still get enough to keep the urine free of germs. They are like giving an antiseptic for the urine. This also means that the dose of antibiotic we use will not be enough to kill other germs, except ones in the urine. Your child's immunity is not affected. The benefits of preventative antibiotics far outweigh any drawbacks.

## What about other antibiotics?

If your child needs another antibiotic for any reason, that is fine, but they should carry on taking the prophylaxis. You should tell the person prescribing the antibiotic that your child is already taking urinary prophylaxis.

## Will they guarantee to keep my child free from urine infections?

No, but the chances are very greatly reduced. You will still need to keep looking out for urine infections. If your child has symptoms such as a temperature, vomiting, or being generally unwell, you still need to have their urine checked without delay. The biggest cause of "breakthrough" urine infections is forgetting doses or running out of medicine.

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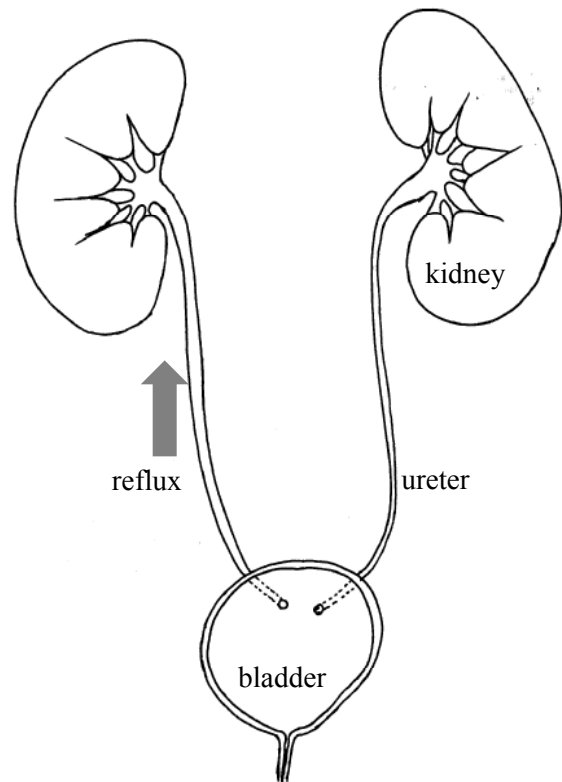
# Reflux

## What is reflux?

**Normally**, the kidneys make urine which flows down thin tubes called ureters into the bladder. It then stays there until your child passes urine and completely empties their bladder.

**If your child has reflux**, their urine can also flow back up from the bladder, towards their kidneys. This is because the valve at the end of the ureter is too short and does not work properly. Most children who have reflux eventually grow out of it.

**Urine infections** are more common in a child with reflux. This is because reflux makes it more difficult for the bladder to empty properly, which means the urine gets stagnant.



## Why does reflux matter?

If your child has reflux and gets a urine infection, the urine can flow back up to the kidneys, taking the infection with it. This can cause infection in the kidney which can leave a **permanent scar**. This can happen in just a few days.

This is called **reflux nephropathy** or **pyelonephritis**.

Kidney scars increase the risk of developing high blood pressure in the future and are the biggest cause of high blood pressure in children and young adults.

## How did my child get reflux?

Reflux runs in families and is inherited on genes. If your child has reflux, it is likely that you or your partner is carrying the gene. This does not always mean you have had reflux because not everybody with the gene actually gets reflux. But, it does mean we should think about testing your other children for reflux or scarring, and sometimes you.

If you go on to have more children, we suggest they have a bladder x-ray to test for reflux early on. Your babies will have about 1 chance in 3 of having reflux. If they do, you can protect them from getting kidney scars. We would give your child the same advice for when they have children of their own in the future.

## Testing for reflux

This is usually done by a bladder X ray test (MCUG or micturating cystourethrogram) or occasionally by an indirect renogram. These are explained in a separate information sheet.

**If there is *anything* you don't understand or are worried about please ask.**

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# Testing for reflux

## Contrast micturating cystourethrogram (MCUG or bladder X ray test)

This is the most reliable test in children for diagnosis of reflux and picks up at least 90% of reflux. Because it gives information about the anatomy of the bladder and ureters as well as reflux, it is the most commonly used test in young children.

Your child's bladder is like a bag inside the body where urine from the kidneys is stored until it is emptied out when your child goes to the toilet. The test involves passing a small tube into the bladder. The x-ray contrast, which is used to show the bladder, is run in through this tube.

When you arrive in the Children's X-Ray Department the radiographer will explain the test to you, and answer any questions you may have before we begin.

After the x-ray nurse/doctor has washed between your child's legs s/he will insert a small tube, called a catheter, into the bladder. A local anaesthetic jelly is used to lubricate the catheter, which is held in place with a piece of sticky tape.



### The test

The radiographer/doctor will run warm x-ray contrast through the tube and into the bladder. After a short while, when the bladder is full, your child will pass urine around the tube and the tube will slide out.

X-ray pictures are taken while the bladder fills up and during emptying

## Parent Points

The test takes about 30 minutes. It is done to show the bladder and urethra (its outlet tube), and to see if urine goes backwards from the bladder to the kidneys (reflux), or if there is a blockage.

Passing the tube is a little uncomfortable and for older children can be embarrassing. Once it is inside it can hardly be felt.

After the test some children may sting a little when they wee. Drinking plenty of fluid and a warm bath will both help. If the problem persists you should contact your GP or the Children's Day Unit.

**Children's X-Ray Department** Telephone: (0191) 282 4428  
**Children's Day Unit** Telephone: (0191) 282 5005]  
**Children's Kidney Unit,** Telephone: (0191) 282 4076 / 282 4917  
 Royal Victoria Infirmary, Newcastle upon Tyne.

# Kidney scars

## What are scars?

Some babies are born with **reflux** of urine back from their bladder towards their kidneys (there is a separate information sheet about this).

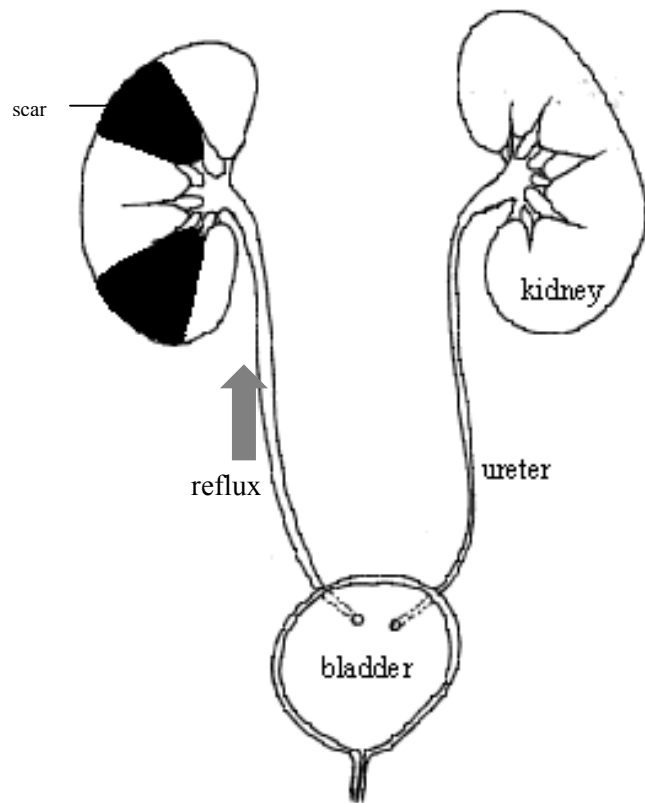
Urine infections are more frequent in children with reflux. If your child has reflux and gets a urine infection, the urine can flow back up to the kidneys, taking the infection with it. This can cause infection in the kidney which can leave a **permanent scar**.

This condition may be called **reflux nephropathy**, or **pyelonephritis**.

## What does it mean to have a scar?

If a child has a kidney scar, we ....

- test to see if they still have their reflux
- try to avoid more scars occurring by preventing further urine infections with prophylactic antibiotics
- start life-long blood pressure monitoring
- consider testing their brothers and sisters, and advise the same for their own children.



## Testing for reflux

This is explained in a separate information sheet. If your child still has reflux, they need to be protected from further scarring. If they have already grown out of, this is good news. It means they will not get more scars, even if they get more infections.

## Preventing more scars

While your child still has reflux, there is a chance that more urine infections could lead to further scarring. To protect them against this risk we use a low-dose bed-time preventative (prophylactic) antibiotic until they grew out of the reflux. The ones we use are very safe, and do not lead to resistant germs or alter your child's immunity. We have written a separate information sheet about this.

The antibiotics reduce the risk a lot, but cannot guarantee that your child will not get any more urine infections. So you need to continue to look out for symptoms that could mean another urine infection. If you suspect they may have one you need to collect a urine sample to take to your own doctor, or to the Children's Day Unit to test.

## Blood pressure monitoring

Kidney scars can cause very high blood pressure, often many years later. If blood pressure is detected early it is easy to treat – if not, it can cause serious illness. We advise that your child has their blood pressure monitored at least every year for life. There is an information sheet about this.

## How did my child get reflux?

Reflux is inherited on genes. This often means we advise testing brothers and sisters if they have any, and sometimes yourselves. We also advise about testing any more children you may have, and your children's children. This is covered in more detail in the information sheet on reflux.

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# Monitoring for high blood pressure

## Why monitor the blood pressure?

One of the jobs that healthy kidneys do is to measure and regulate blood pressure. In some kidney conditions they can start to do this wrongly, and sometimes this puts the blood pressure up. This is especially common with kidneys which have scars or cysts, but can also happen with some other kidney illnesses. High blood pressure can keep rising until it becomes serious, but if it is caught early it is easy and safe to treat. This is why lots of children with kidney problems need to have their blood pressure monitored.

## Does high blood pressure matter?

**Yes** – very high blood pressure matters a lot. It can cause extremely serious illnesses, including ...

- strokes
- heart attacks and heart failure
- kidney failure.

**But these can be prevented** – as long as blood pressure is checked regularly. If your child's blood pressure does rise, it should only creep up slowly. This means it should not reach a serious level before your next blood pressure check is due. So, your child's blood pressure should not become dangerous if they get it regularly checked.

## How often should the blood pressure be monitored?

Children cannot tolerate high blood pressure as well as adults can, so we advise children with kidney problems to have their blood pressure checked **at least once a year**. In some special cases it may be advised more frequently.

Because people with kidney conditions can develop high blood pressure at any age, we advise that they have their blood pressure monitored for the rest of their lives.

## Who should measure it?

It can be difficult to measure blood pressure in small children. It is best to do it with special equipment, so it is usually easier for us to measure it in the hospital clinic or day unit until children are about 7 years old.

Children from 7 years can usually have their blood pressure measured by their general practitioner or the practice nurse. This can be done using a stethoscope or hand held doppler using the same sized blood pressure cuff as used on adults.

The automatic blood pressure machines you can buy are extremely unreliable. Even if they start off reading properly, we have found that they can lose their accuracy – and there is no way you would be able to tell this.

## Who should organise the monitoring?

Parents will normally organise this for their children

It is best if older teenagers **take charge**. If they get into the habit of remembering, the monitoring will continue to work, even if they move away, change doctors, etc. It is best to use special dates such as birthdays or Christmas to jog the memory.

You need a system that will work easily for you and your child, and that will work for them forever. The GP or practice nurse will not usually be able to remind you to get it done.

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# The Newcastle Upon Tyne Hospitals

NHS Trust



Royal Victoria Infirmary  
 Queen Victoria Road  
 Newcastle upon Tyne  
 NE1 4LP

Tel: 0191 232 5131  
 Fax: 0191 261 5881

## Department of Paediatric Nephrology

### Day Unit Blood Pressure Record

Stick patient's sticker here

Please inform the paediatric nephrology consultant of the day if the systolic BP is above ..... mm Hg, or below ..... mm Hg.

date	systolic BP	comments (eg, settled, upset)	signature /name	follow-up date

Please measure BP every ..... months, until .....  
 (this must be filled in to define the end-point of repeated Day Unit measurements)

Signed .....

Print name .....

Date .....

Day Unit staff to measure BP, give follow-up date, and photocopy sheet for notes at each visit.