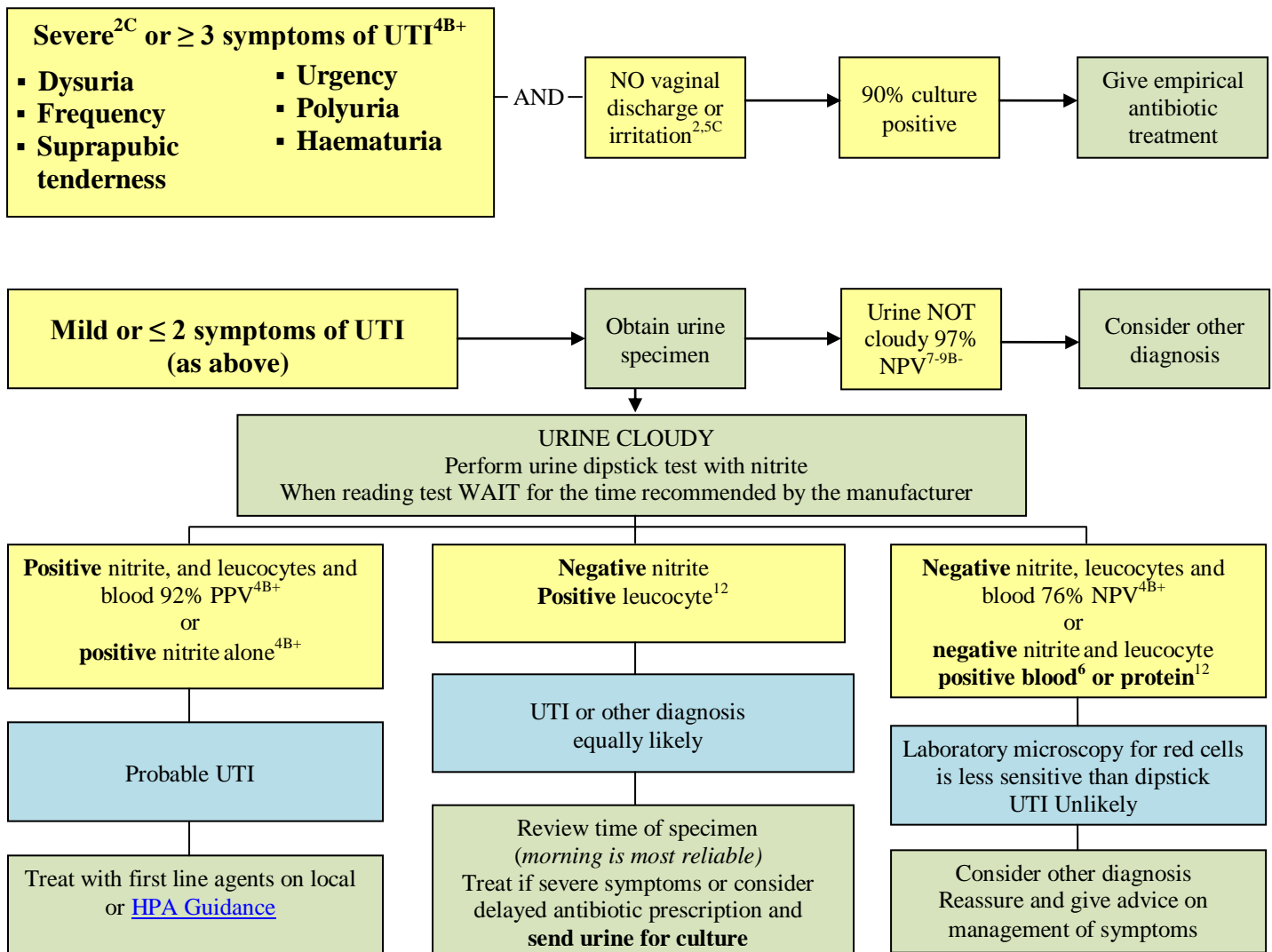


URINARY SYMPTOMS IN ADULT WOMEN <65 DO NOT CULTURE ROUTINELY¹⁻⁵
In sexually active young men and women with urinary symptoms consider *Chlamydia trachomatis*^C



URINE CULTURE IN WOMEN AND MEN > 65 YEARS

- **Do not send urine for culture in asymptomatic elderly with positive dipsticks**
- Only send urine for culture if two or more signs of infection, especially dysuria, fever > 38° or new incontinence.^{4,5C}
- Do not treat asymptomatic bacteriuria in the elderly as it is very common.^{1B+}
- Treating does not reduce mortality or prevent symptomatic episodes, but increases side effects & antibiotic resistance.^{2,3,B+}

URINE CULTURE IN WOMEN AND MEN WITH CATHETERS

- **Do not treat asymptomatic bacteriuria in those with indwelling catheters**, as bacteriuria is very common and antibiotics increase side effects and antibiotic resistance.^{1B+}
- Treatment does not reduce mortality or prevent symptomatic episodes, but increase side effects & antibiotic resistance.^{2,3,B+}
- Only send urine for culture in catheterised^{7B-} if features of systemic infection.^{1,5,6C} However, always:
 - Exclude other sources of infection.^{1C}
 - Check that the catheter drains correctly and is not blocked.
 - Consider need for continued catheterisation.
 - If the catheter has been in place for more than 7 days, consider changing it before/when starting antibiotic [treatment](#).^{1,6C, 8B+}
- Do not give antibiotic prophylaxis for catheter changes unless history of symptomatic UTIs due to catheter change.^{9,10B+}

WHEN ELSE SHOULD I SEND A URINE FOR CULTURE?

- **Pregnancy:** If symptomatic, for investigation of possible UTI.^{1B+}
In all at 1st antenatal visit - as asymptomatic bacteriuria is associated with pyelonephritis & premature delivery.^{1, 2B+}
- Suspected **pyelonephritis**^{3C} (*loin pain and fever*).
- Suspected UTI in **men**.^{1,4C}
- **Failed antibiotic treatment or persistent symptoms**.^{5A+, 6B-}
E. coli with [Extended-spectrum Beta-lactamase enzymes](#) are increasing in the community.
ESBLs are multi-resistant but usually remain sensitive to nitrofurantoin or fosfomycin.^{7,8B+, 9A+}
- **Recurrent UTI, abnormalities of genitourinary tract, renal impairment** — more likely to have a resistant strain.

SAMPLING IN WOMEN AND MEN

Refrigerate specimens to prevent bacterial overgrowth^{1B+} or use specimen pots with boric acid (fill to the line).^{1B+}

- In women: the specimen should be mid-stream.^{1,2C} Cleansing with water^{3,4,5B-} and holding the labia apart^{3,4B-} are not essential. Cleansing with antiseptic leads to false negatives.^{6B-}
- In men: the specimen should be mid-stream.^{1,2C}
- People with catheters: using aseptic technique, drain a few mL of urine, then collect a sample from catheter sampling port.^{11C}

HOW DO I INTERPRET A CULTURE RESULT?

- Single organism $\geq 10^4$ colony forming units (CFU)/mL¹
 - Or $\geq 10^5$ mixed growth with one predominant organism
 - Or *Escherichia coli* or *Staphylococcus saprophyticus* $\geq 10^3$ CFU/mL¹
- } Usually indicates UTI in patient with urinary symptoms.¹
Higher counts have even higher positive predictive value.
- Do not treat asymptomatic bacteriuria in the elderly as it does not reduce mortality or prevent symptomatic episodes.^{B+}

White blood cells²

- White cells $\geq 10^4$ /mL are considered to represent inflammation.
- In adults 'no white cells present' indicates no inflammation & reduces culture significance.
- Pregnancy is associated with physiological pyuria.

Sterile pyuria²

- In sterile pyuria consider *Chlamydia trachomatis* (especially if 16-24 years), other vaginal infections, other non-culturable organisms, including TB or renal pathology.

Epithelial cells/mixed growth²

- Presence indicates perineal contamination, which reduces significance of culture.

Red cells³

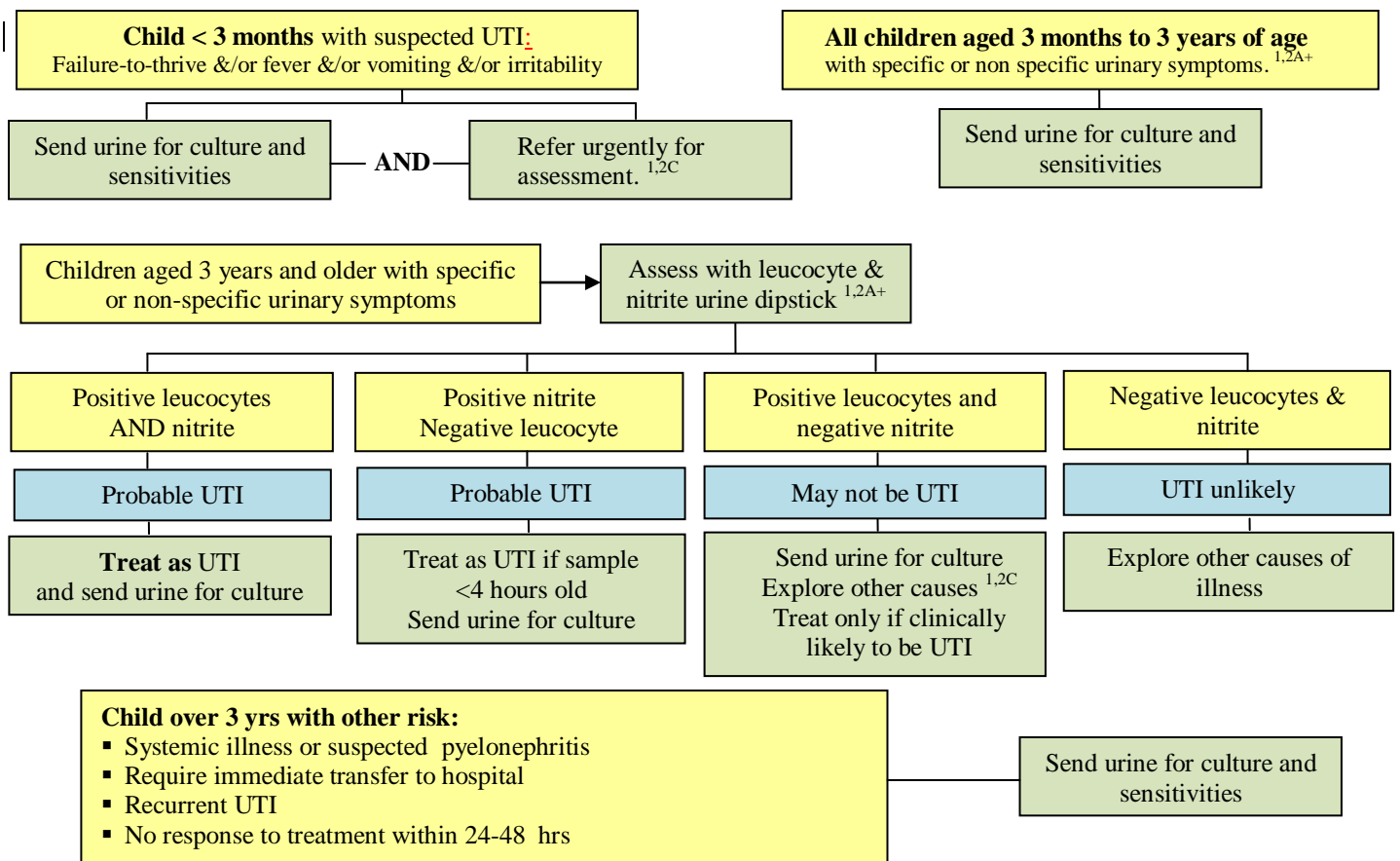
- May be present in UTI, patients with persistent haematuria post UTI should be referred.
- Lab microscopy for red cells is less accurate than dipstick due to red cell lysis in transport.

IS A FOLLOW-UP URINE SAMPLE NEEDED?

Follow-up urine samples are not usually indicated, except when treating asymptomatic bacteriuria in pregnancy.

CHILDREN

Consider UTI in any sick child and every young child with unexplained fever.^{1,2A+}



SAMPLING IN CHILDREN:

- In toddlers: clean catch urine using potties washed in hot water (60°C) with washing up liquid are suitable.^{1B-2}
- In infants: clean catch urine is preferable;² a collection pad in a nappy may be used but is less accurate^{3B} - changing the pad every 30 minutes until urine is passed reduces contamination.^{4B-} Bag urines are less comfortable.^{2,3B-}

INTERPRETATION OF CULTURE RESULTS:

- Single organism $\geq 10^4$ colony forming units (CFU)/mL indicates UTI;¹ In supra-pubic aspirates any growth is significant.
- All children need clinical assessment for risk factors: If risk factors or non E coli UTI, renal imaging needed ([NICE](#) page 12).
- White blood cells²: In children pyuria may be absent or, in contrast, present due to fever without UTI.^{3c}

KEY A B C indicates grade of recommendation

Local adaptation:

- We would discourage major changes to the guidance but the Word format allows minor changes to suit local service delivery and sampling protocols.
- To create ownership agreement on the guidance locally, dissemination should be taken forward in close collaboration between primary care clinicians, laboratories and secondary care providers.

Grading of guidance recommendations

In the development of this guidance a full Medline search for recent articles since the last review in 2008 was undertaken, other searches were undertaken at the discretion of the experts and development team. The guidance has been reviewed by members of CKS, The BIA, BSAC, RCGP and The Department of Health Antimicrobial Resistance and Health Care Associated Infections Advisory Group. It is in line with [CKS](#), [SIGN](#) & [NICE](#).

The strength of each recommendation is qualified by a letter in parenthesis.

Study design	Recommendation grade
Good recent systematic review of studies	A+
One or more rigorous studies, not combined	A-
One or more prospective studies	B+
One or more retrospective studies	B-
Formal combination of expert opinion	C
Informal opinion, other information	D

We welcome, in fact encourage, opinions on the advice given and future topics we should cover. We would be most appreciative if you could email any evidence or references that support your requests for change so that we may consider them at our annual review. Comments should be submitted to Dr Cliodna McNulty, Head, PHE Primary Care Unit, Microbiology Laboratory, Gloucestershire Royal Hospital, Great Western Road, Gloucester GL1 3NN. Email: Katherine.Butler@phe.gov.uk

REFERENCES

Adult women — acute uncomplicated UTI

- Affects up to 15% of women each year.¹
 - **Routine urine culture is unnecessary.**^{2,3C}
 - Use symptoms, urine appearance and dipstick tests to diagnose UTI to reduce antibiotic use & laboratory investigations^{1,4B+} as 50% of women with symptoms of UTI have negative culture.^{4B+}
 - The presence of [vaginal discharge](#) reduces the likelihood of UTI to about 20%⁵ - consider STIs and vulvovaginitis.
1. Carr J. Urinary tract infections in women: diagnosis and management in primary care. *BMJ* 2006; 332: 94-7. *Useful review with treating MCQ.*
 2. SIGN. Management of suspected bacterial urinary tract infection in adults: a national clinical guideline. *Scottish Intercollegiate Guidelines Network*. 2006 <http://www.sign.ac.uk/guidelines/fulltext/88/index.html> (Accessed 2nd March 2011). *Diagnosis in women: expert consensus is that it is reasonable to start empirical antibiotics in women with symptoms of UTI without urine dipstick or urine culture. Expert consensus is that in women with symptoms of vaginal itch or discharge, alternative diagnoses to UTI should be explored. Based on evidence from poor quality RCTs, the SIGN guideline group recommended that dipstick tests should only be used to diagnose bacteriuria in women with limited symptoms and signs (no more than two symptoms).*
 3. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin no. 91: treatment of urinary tract infections in nonpregnant women. *Obstetrics and Gynecology* 2008;111(3):785-794. *Diagnosis in women: expert consensus is that it is reasonable to start empirical antibiotics in women with symptoms of UTI without urine culture.*
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 5. Bent S, Nallamothu BK, Simel DL, Stephan DF, Saint S. Does this woman have an acute uncomplicated urinary tract infection? *JAMA* 2002;297:2701-10. *A systematic review of diagnostic studies found that the presence of vaginal discharge or vaginal irritation substantially reduces the probability of UTI, to around 20%.*

6. Rodgers M, Nixon J, Hempel S, Aho, T, Kelly J, Neal D, Duffy S, Ritchie G, Kleijnene J and Westwood M. Diagnostic tests and algorithms used in the investigation of haematuria: systematic reviews and economic evaluation. *Health Technology Assessment* 2006;10: no 18. <http://www.hta.ac.uk/project/1363.asp> (Accessed 2nd March 2011) *This systematic review found that it was not possible to define the most effective diagnostic strategy for the investigation of microscopic and macroscopic haematuria in adults as insufficient data were currently available. The detection of microhaematuria was not found to be a useful test to either rule in or rule out the presence of a significant underlying pathology such as urinary calculi or bladder cancer. An algorithm was therefore developed by expert consensus (see the [Appendices](#) of the systematic review) to guide further investigations.*
7. Bulloch B, Bausher JC, Pomerantz WJ, Connors JM, Mahabee-Gittens M, Dowd MD. Can urine clarity exclude the diagnosis of urinary tract infection? *Pediatrics* 2000;106:60-63. *This was a prospective cohort of 159 children (aged from 4 weeks to 19 years) presenting to an emergency department with possible UTI. Catheterized or midstream clean-catch urine specimens were collected for culture. The finding of clear urine on visual inspection had a negative predictive value of 97.3%.*
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10. Czerwinski AW, Wilkerson RG, Merrill JA, Braden B *et al.* Further evaluation of the Griess test to detect significant bacteriuria. *Part II Am J Obstet Gynaecol* 1971;110:677-81. *Nitrite is produced by the action of bacterial nitrate reductase in urine. As contact time between bacteria and urine is needed, morning specimens are most reliable. Early morning urines give more accurate nitrite results, as bacteria must be in contact with the urine for sufficient time to allow reduction of nitrates to nitrites.*
11. HPA. Management of infection guidance for primary care for consultation and local adaptation. 2010 http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1279888711402 (Accessed 2nd March 2011).
12. European Urinalysis Guidelines. Eds. Kouri T, Flogazzi G, Gant V, Hallender H, Hofmann W, Guder WG *Scand J Clin Lab Invest* 2000;60:1-96. *Very extensive guidelines (aimed at laboratory staff) for interpretation of urine culture and microscopy. Reasons for false positive and negative results: see page 54. Other causes of leucocytes in urine: Leucocyte esterase detects intact and lysed leucocytes produced in inflammation. Neutrophils are found in UTI and also glomerulonephritis, interstitial nephritis and aseptic cystitis. The appearance of lymphocytes in urine is associated with chronic inflammatory conditions, viral diseases and renal transplant rejection. Macrophages are also suggested to reflect inflammatory activity of renal disease. Other causes of haematuria: haematuria remains a major sign of urinary tract and renal disease. It may also reflect a general bleeding tendency, or be caused by strenuous exercise or menstruation. Other causes of proteinuria: protein is found in UTI and also in bladder or prostatic disease, and in vaginal discharge. Intermittent proteinuria may be due to fever, exercise, epileptic seizure, congestive heart failure, or be orthostatic (occurs in the upright position only). Persistent proteinuria can be due to rhabdomyolysis, acute haemolysis, IgA nephropathy, drug-induced nephropathy*

The elderly and people with catheters

1. SIGN. Management of suspected bacterial urinary tract infection in adults: a national clinical guideline. *Scottish Intercollegiate Guidelines Network*. 2006 <http://www.sign.ac.uk/guidelines/fulltext/88/index.html> (Accessed 2nd March 2011). *Asymptomatic bacteriuria in the elderly: elderly women and men with should not receive antibiotic treatment for asymptomatic bacteriuria. There is evidence that mortality and the number of symptomatic episodes are not reduced, but for every three people given antibiotics, one will experience adverse effects (such as rash or GI symptoms), NNH = 3. Asymptomatic bacteriuria in people with catheters: catheterised people with asymptomatic bacteriuria should not receive antibiotic treatment. There is conflicting evidence on whether repeated treatment of asymptomatic bacteriuria prevents symptomatic episodes in people with long-term catheters. However, there is evidence that repeated treatment of asymptomatic bacteriuria increases the risk of colonisation by antibiotic resistance bacteria. When to send a sample for culture in people with catheters: expert opinion is that no constellation of symptoms and signs can accurately predict the likelihood of a symptomatic UTI in catheterised people (and therefore, the need to send a sample for culture). In catheterised people who present with fever, experts recommend looking for associated localising (loin or suprapubic tenderness) or systemic features and exclude other potential sources before sampling and considering antibiotic treatment. Catheter change before treating symptomatic infection: expert opinion, based on one small RCT, is that people with long-term indwelling catheters should have the catheter changed before starting antibiotic treatment for symptomatic UTI. Catheter change increases the likelihood of successful treatment.*
2. Abrutyn E, Mossey J, Berlin JA, Boscia J, Levison M, Pitsakis P, Kaye D. Does asymptomatic bacteriuria predict mortality and does antimicrobial treatment reduce mortality in elderly ambulatory women? *Ann Int Med* 1994;827-33. *This cohort study found that asymptomatic bacteriuria occurs in 25% of women >65years and 10% of men >65years. However, it was not a risk factor for mortality in elderly women without catheters. Those with asymptomatic bacteriuria were subsequently randomized to treatment or no treatment. There was no difference in the risk of mortality between the treated and untreated groups.*

3. Nicolle LE, Mayhew WJ and Bryan L. Prospective randomized comparison of therapy and no therapy for asymptomatic bacteriuria in institutionalized elderly women. *The American Journal of Medicine* 1987;83:27-33. *There was no difference in morbidity or mortality in those randomised to antibiotics or no antibiotics (50 participants). However, antibiotic treatment was associated with an increased risk of adverse effects.*
4. Benton TJ, Young RB, Lepper SC. Asymptomatic bacteriuria in the nursing home. *Annals of long-term care* 2006;14:17-22. *A useful discussion of the difficulties in deciding when bacteriuria in the elderly requires treatment.*
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Laboratory testing for culture and sensitivity

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Sampling technique in men and women

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2. European Urinalysis Guidelines. Eds. Kouri T, Flogazzi G, Gant V, Hallender H, Hofmann W, Guder WG *Scand J Clin Lab Invest* 2000;60:1-96. *Very extensive guidelines (aimed at laboratory staff) for interpretation of urine culture and microscopy. Midstream urines are recommended because the first portion of urine is always contaminated by commensal urethral flora in both men and women.*
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- Roberts AP, Robinson IE, Beard KW. Some of the factors affecting bacterial colony counts in urinary infection. *BMJ* 1967;1:400-3. *Suprapubic specimens and midstream samples taking using perineal cleansing with chlorhexidine were both taken from a series of 20 women presenting with suspected UTI. The colony count was reduced in 12 of the midstream plus chlorhexidine cleaning samples compared with the suprapubic sample from the same woman.*
- NICE. Infection control: prevention of healthcare-associated infections in primary and community care. *National Institute of Health and Clinical Excellence* 2003. <http://guidance.nice.org.uk/CG2> (Accessed 2nd March 2011). *Expert opinion is that urine samples from catheters should be obtained from the catheter sampling port, to reduce the risk of contamination. Maintaining a sterile, continuously closed catheter system is central to the prevention of catheter-associated infection.*

Interpretation of culture result in adults

- European Urinalysis Guidelines. Eds. Kouri T, Flogazzi G, Gant V, Hallender H, Hofmann W, Guder WG *Scand J Clin Lab Invest* 2000;60:1-96. *Laboratory decision-limits for significant bacteriuria: see section 7.2.3, page 29. The cut-offs for symptomatic urinary tract infection caused by primary pathogens (E. coli and S. saprophyticus) are set by the European Confederation of Laboratory Medicine at $\geq 10^3$ CFU/mL in mid-stream urine specimens. For secondary pathogens (such as Enterobacter species, Enterococcus species, Klebsiella species, P mirabilis, P. aeruginosa etc) cuts off are set as $\geq 10^4$ cfu/mL for women and $\geq 10^3$ CFU/mL for men.*

*Evaluating urine culture findings has long been dominated by Kass's criteria for significant bacteriuria. Kass found that 95% of women with pyelonephritis had $\geq 10^8$ CFB/L ($\geq 10^5$ CFU/mL) or one bacterial species in a clean-catch mid-stream urine, and that such a finding in two consecutive mid-stream urine specimens in asymptomatic women would, with 95% probability, give the same result in a third mid-stream urine specimen (Kass EH. *Trans Assoc Am Phys* 1956; 69: 56-63; Kass EH. In: *Quinn Biology of pyelonephritis*. Boston: Little & Brown; 1960. p. 399-412.). Kass also showed that $<10^7$ CFB/L indicated contamination during sample collection, whereas bacterial concentration in the interval of 10^7 - $<10^8$ CFB/L was difficult to interpret. Despite the fact that the criteria were developed for acute pyelonephritis and asymptomatic bacteriuria in women, they began to be used generally, even for symptomatic lower urinary tract infection.*

*Stamm et al examined 187 sexually active young women with dysuria and urinary urgency (Stamm WE et al. *N Engl J Med* 1982; 307: 462-8). Cultures of mid-stream urine samples were compared to urine cultures obtained through suprapubic aspiration or urethral catheterisation. Enterobacteriaceae were isolated from bladder urine in 98 (52%) women. S. saprophyticus, S. aureus and enterococci were cultured in 26 (14%). The women who had 'coliform' bacteria in bladder urine were further analysed regarding the number of CFB/L. If 10^8 CFB/L mid-stream urine was used as a cut-off for 'significant' bacteriuria, the sensitivity was 51% and the negative predictive value was 65%. If, on the other hand, a cut-off of 10^5 CFB/L mid-stream urine was used, the sensitivity was 95% with a negative predictive value of 94%, whereas specificity declined from 99% to 85%. Thus, low cut-off of 'coliform' bacteria in mid-stream urine more accurately predicted bladder infection in symptomatic women than in asymptomatic. Many additional studies support the observation that low bacterial concentrations of E. coli in particular have diagnostic relevance, even in mixed flora. Findings of E. coli have been interpreted as the first phase in urethritis in an ascending infection.*

- HPA. Investigation of Urine. *Health Protection Agency. National Standard Method BSOP 41*. 2009 <http://www.hpa-standardmethods.org.uk/documents/bsop/pdf/bsop41.pdf> (Accessed 2nd March 2011). *White blood cells: significant pyuria is defined by the HPA as $\geq 10^4$ WBC/mL, although higher numbers are often found in healthy, asymptomatic women. A level of $\geq 10^5$ WBC/mL has been suggested to be more appropriate for discriminating infection. Sterile pyuria (i.e. pyuria in the presence of no growth on routine culture media) may be the result of many factors including genital tract infection, infection with C. trachomatis, infection with a fastidious organism, prior treatment with an antibiotic, renal calculi, bladder neoplasm, catheterisation, renal tuberculosis, or lysis of WBC in alkaline urine (as occurs in infections with Proteus species).*
- Joint consensus statement on the initial assessment of haematuria. Renal Association & British Association of Urological Surgeons. July 2008. [http://www.renal.org/Libraries/Other_Guidlines/Haematuria - RA-BAUS_consensus_guideline_2008.sflb.ashx](http://www.renal.org/Libraries/Other_Guidlines/Haematuria_-_RA-BAUS_consensus_guideline_2008.sflb.ashx) This joint working party agreed that urine testing for haematuria should only be performed for identifiable clinical reasons; there is currently no evidence to support opportunistic screening of the general population. Urine dipstick of a fresh voided urine sample, containing no preservative, is considered a sensitive means of detecting the presence of haematuria. Significant haematuria is considered to be 1+ or greater. Trace haematuria should be considered negative. Routine microscopy for confirmation of dipstick haematuria is not necessary. Significant haematuria is diagnosed if there is any single episode of visible haematuria; any single episode of symptomatic non-visible haematuria (in absence of UTI or other transient causes); persistent (2 out of 3 dipsticks positive) asymptomatic non-visible haematuria (in absence of UTI or other transient causes). Haematuria in association with UTI is not uncommon. Following treatment of UTI, a dipstick should be repeated to confirm the post-treatment absence of haematuria. Other causes of transient haematuria include exercise induced haematuria, rarely myoglobinuria and menstruation.

Refer to urology: All patients with visible haematuria (any age). All patients with s-NVH (any age). All patients with a-NVH aged ≥ 40 yrs.

Children

- NICE. Urinary tract infection in children. Diagnosis, treatment and long-term management. Clinical guideline 54. 2007 <http://guidance.nice.org.uk/CG54> (Accessed 2nd March 2011). *Urine culture: evidence from systematic reviews is that urgent microscopy and culture is the preferred method of diagnosis in children aged 3 months to 3 years of age. However, antibiotics should be started while awaiting results of MSU in children with specific urinary symptoms. In those without specific urinary symptoms, use positive nitrite on dipstick testing to start empirical antibiotics. Evidence from systematic reviews is that, in children over the age of 3 years dipstick testing is as useful as culture. MSU is only needed in this age group if UTI is*

recurrent, or the child has a high or intermediate risk of serious illness, or if only one of nitrite or leucocyte esterase is positive. Children under 3 months of age: expert opinion is that children under 3 months of age with suspected UTI should be referred urgently for assessment.

2. Price E, Pallett A, Gilbert RD & Williams C. Microbiological aspects of the UK National Institute for Health and Clinical Excellence (NICE) guidance on urinary tract infection in children. *J Antimicrob Chemother* 2010;65:836-41.

Sampling technique in children

1. Rees JC, Vernon S, Pedler SJ, Coulthard MG. Collection of urine from washed-up potties. *Lancet* 1996;348:197. *This study tested four methods of cleaning the potty to reduce faecal contamination of the sample. Washing potties using washing up liquid with hot water at 60°C before taking a urine specimen was the most effective method of reducing faecal contamination. Cleaning potties with Dettol or bleach were less successful.*
2. NICE. Urinary tract infection in children. Diagnosis, treatment and long-term management. Clinical guideline 54. 2007 <http://guidance.nice.org.uk/CG54> (Accessed 2nd March 2011). This guidance reviews all the evidence around sample collection in children, and suggests that clean catch and supra-pubic aspirate provide the most diagnostically accurate samples.
3. Lynster LCT, Nayar DM, Pedler SJ, Coulthard MG. Home collection of urine for culture from infants by three methods. Survey of parents' preferences and bacterial contamination rates. *BMJ* 2000;320:1312-3. *In this series of 44 infants, parents collected three urine samples using a urine pad, bag, and clean-catch method (in a randomized order). Urine contamination levels were similar between pads (16%) and bags (18%) but lower with clean catch (2%). Parents disliked the clean-catch method (requiring nursing the infant with a bottle ready until they wee, which is both time consuming and messy). Parents found pads and bags easy to use, and preferred them to clean catch. The pad was considered comfortable. However, the bag was distressing, particularly on removal, often leaking and leaving red marks.*
4. Rao S, Bhatt J, Houghton C, Macfarlane P. An improved urine pad collection method: a randomised clinical trial. *Arch Dis Child* 2004;89:773-775. *Febrile children under the age of two were randomized to either the same urine collection pad kept in the nappy until urine was passed, or to urine collection pads to be changed every 30 minutes until a urine was passed. From 80 children enrolled, a satisfactory sample was obtained from 68 of them (12 samples were unusable because of faecal soiling). Heavy mixed growth (indicating contamination) occurred in 3% of the replaced urine collection pad group (1 of 31) compared with 29% (10 of 35) in the single urine collection pad group, p = 0.008.*

Interpretation of culture result children

1. European Urinalysis Guidelines. Eds. Kouri T, Flogazzi G, Gant V, Hallender H, Hofmann W, Guder WG *Scand J Clin Lab Invest* 2000;60:1-96. Laboratory decision-limits for significant bacteriuria: see section 7.2.3, page 29. *The cut-offs for symptomatic urinary tract infection caused by primary pathogens (E. coli and S. saprophyticus) are set by the European Confederation of Laboratory Medicine at $\geq 10^3$ cfu/mL in mid-stream urine specimens. For secondary pathogens (such as Enterobacter species, Enterococcus species, Klebsiella species, P mirabilis, P aeruginosa etc) cuts off are set as $\geq 10^4$ CFU/mL for women and $\geq 10^3$ CFU/mL for men.*
2. HPA. Investigation of Urine. Health Protection Agency. National Standard Method BSOP 41. 2009 <http://www.hpa-standardmethods.org.uk/documents/bsop/pdf/bsop41.pdf> (Accessed 2nd March 2011). White blood cells: significant pyuria is defined by the HPA as $\geq 10^4$ WBC/mL, although higher numbers are often found in healthy, asymptomatic women. A level of $\geq 10^5$ WBC/mL has been suggested to be more appropriate for discriminating infection. Sterile pyuria (i.e. pyuria in the presence of no growth on routine culture media) may be the result of many factors including genital tract infection, infection with C. trachomatis, infection with a fastidious organism, prior treatment with an antibiotic, renal calculi, bladder neoplasm, catheterisation, renal tuberculosis, or lysis of WBC in alkaline urine (as occurs in infections with Proteus species).
3. NICE. Urinary tract infection in children. Diagnosis, treatment and long-term management. Clinical guideline 54. 2007 <http://guidance.nice.org.uk/CG54> (Accessed 2nd March 2011). *Expert opinion is that pyuria may be absent in childhood UTI, and that non E coli organisms are an atypical cause of UTI in children. NICE recommend urgent ultrasound imaging in this situation to exclude structural abnormalities of the genitourinary tract, and to guide management.*

Other general reading on laboratory diagnosis of UTI

Malmström PU. Education and debate: Time to abandon testing for microscopic haematuria in adults? *BMJ* 2003;326:813-15.

Treatment advice can be found on our website:

http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1194947333801 (Accessed 20th February 2012)