The Predictive Value of Strip Method as Early Diagnostic Test for Urinary Tract Infection in Children Attending Kirkuk Pediatric Hospital

Rasha Amer Salman, Department of Pediatric, Al Haweeja Hospital, Kirkuk, Iraq. Email: rashamuthana38@gmail.com; Mobile: 009647701256574,
Alaa H. Alwan, Department of Pediatric, Tikrit University College of Medicine, Tikrit, Iraq; Email: alaa19ssth@tu.edu.iq.
Mobile: 009647701736473; ORCID: 0000-0001-7418-8075

Correspondence author: Alaa Hussain Alwan, Department of Pediatric, Tikrit University College of Medicine, Al-Yarmook street, BO Box 45, Tikrit, Iraq. Email: alaa19ssth@tu.edu.iq; Mobile: 009647701736473

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Abstract
Background: Urinary tract infection (UTI) is a common infection causing illness in children. It is either presented with specific symptoms or may be asymptomatic especially in younger infant. It is most common cause of febrile disease in children affecting about 2% of boys and 8% of girls by the age of 11 years.
Aim: To evaluate the predictive value of strip method as a simple and non-costly method for early diagnosis of urinary tract infection in children.
Materials and methods: A cross sectional hospital based study included children attending the outpatient clinic of Paediatric General Hospital in Kirkuk city. The study conducted during the period from 1st of July to 30th of August 2017. 250 cases selected randomly from those complaining of symptoms suggesting of UTI. Their age ranged from 2 months to 12 years. Culture performed on samples with positive strip test.
Results: Of the 250 samples, 170 (68%) were positive in strip test and 52 (30.5%) were positive in culture. Gram negative bacteria are the most common isolated bacteria from the urine samples of children with uncomplicated UTI.
Conclusion: Urine dipstick test can be used as a screen to determine whether or not urine culture should be performed. This test provides a cheap approach for urine test especially in healthcare centers in rural areas.
Key words: Children, Urinary tract infection, UTI, Strip test.

Introduction

Urinary tract infection is a common infection causing illness in children. It is either presented with specific symptoms or may be asymptomatic especially in younger infant. It is most common cause of febrile disease in children affecting about 2% of boys and 8% of girls by the age of 11 years. UTI is important infection usually occurs due to bacteria although viruses and fungi and parasites can also cause infection. UTI classify according to site of infection, in the bladder (cystitis), in the kidney (pyelonephritis), in urine (bacteriurea). The symptoms may arrange from mild irritative voiding to bacteremia, sepsis or even death .Gram negative are the most common isolated bacteria from urine samples of children for uncomplicated UTI

,with *E. coli* account for 70% to 90% of infection especially in developed countries [1-6].

Urinary tract infection usually occur due to bacteria, although viruses, fungi, and parasites can also cause infection [7,8]. Half of the children with urinary tract infections present to primary health care centers are not diagnosed at their first presentation, establishing the diagnosis is difficult in early childhood owing to nonspecific urinary symptoms like fever, irritability and vomiting. Additionally, difficulty in urine collection, and contamination of the samples, and lack of toilet training mat interfere with the accurate diagnosis [9]. Most children have a single episode and recover promptly, however, UTI in children either symptomatic or asymptomatic, and symptoms ranging from mild irrigative voiding to bacteremia, sepsis, or even death [10-12]. Consequently the information will be combined for UTI identification and management in the first health facilities, will be suggested including the complications. There are multiple important medical and financial inferences associated with UTI, the estimated annual cost of community-acquired UTI is significant [13, 14].

Recently a retrospective population-based study investigated the incidence rate of first time symptomatic UTI in children with <6 years of age. The cumulative incidence rate of UTI was 3 times greater in girls than boys. Acute uncomplicated UTIs are usually considered to be benign condition. However sever infections may require hospitalization, long term consequences of acute UTI are rare ,substantial medical sequelae are more frequently associated with complicated infection, or with infections that occur in specific subpopulations, such as pediatric patients [15].

Uncircumcised boy is with 10-12 fold risk to get UTI than in circumcised one and age of less than 6 months were with 12-30% recurrence rate [16]. Thus younger children, uncircumcision and female gender were a risk factors for the development of UTI in children [17,18]. Urinary tract infection should be considered in any child younger than 2 years of age with unexplained fever [15,16]. Because UTI signs and symptoms in infants are non-specific, urinalysis and urine culture are recommended to determine the source of infection [18,19].

Girls are more prone for recurrence than boys and have more episodes than boys [20,21]. The total number of patients with parenchyma damage is equal in both genders even during childhood [22, 23]. The diagnosis of UTI can be supported by urine culture, biochemical and microscopic examination of clean urine samples [24, 25].

Most first level facilities (primary Health Care Center) do not have urine culture, urine microscopical examination and gram stain. First health facilities can only obtain urine by midstream, or urine bag collection, so urine dipstick can be used to assist the diagnosis of UTI. Dipsticks for nitrite and leukocytes can help in detecting UTI in children which is superior to microscopic analysis for pyuria. Generally negative dipstick urinalysis can exclude UTI in children especially over 2 years of age [26, 27].

Urine culture can be done to patients with UTI when clinical symptoms and dipsticks do not correlate and vesico-ureteric reflux is the most common abnormality associated with UTI with prevalence of 1% in all children and 35% in children following first UTI [28,29]. Leukocytes and nitrite in urine examination alone or in combination had a positive value of 73% when compared to urine culture and allowing early diagnosis of UTI [30]. Dipsticks and urinalysis was recommended to be performed to children with high risk UTI, such as febrile children with age of 2

month to 2 year, very low weight for age and febrile children with previous confirmed UTI or renal problems [31,32].

Aim of the study

To evaluate the predictive value of strip method as a simple and non-costly method for early diagnosis of urinary tract infection in children.

Patients and method

Across sectional hospital based study done on patients who attended the outpatient clinic of pediatric General hospital in Kirkuk city selected randomly, during the period from 1st of July to 30th of August 2017. A total number of 250 cases with age of 2 months to 12 years were included in the study and they were recruited from the outpatient clinics. Urine culture was performed on samples that were positive in strip test. The demographic and clinical characteristics of each patients gathered using pre-designed questionnaire. Urine sample was collected using sterile clean bag in children younger than 2 years. The child mother was instructed about the way of urine collection. Additionally, midstream urine samples were collected from children with age of more than 2 years of age. Urine placed in sterile tube and sent immediately to the laboratory for culture after taking the results of strip method. The strip screen for presence of 8 different items in addition to pus, cell, nitrate, PH, protein, glucose, ketone, bilirubin, erythrocyte, and Hb. The case was recorded as with UT I if 1+ or more pus in strip test compared to matched control. If the test for leukocyte esterase is positive that means there is an infection. Each case that shows positive strip test was sent for culture. Ultrasound performed for cases who diagnosed as UTI looking for signs of acute or chronic infections and renal anomalies. Each patient diagnosed as UTI was sent for hemoglobin (Hb) level to exclude associated anemia. Urine culture was performed on samples that were positive in strip test, the demographic and clinical characteristic of each patients gathered using pre-designed questionnaire.

Fig.1. Strip

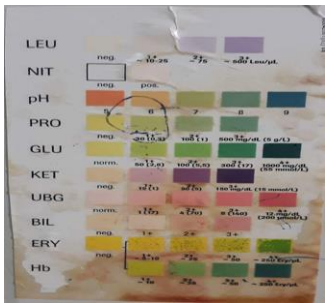

Fig 2. An example of strip test results.

Inclusion criteria

Children with age of 2 months to 12 years and with signs and symptoms of urinary tract infection.

Statistical analysis

The statistical analysis was done using the SSPS version (18), and Chi –squire calculated to determine the significance.

Results

The total number of cases included in the study were 250 cases, of them 170 (68%) were positive by strip for UTI and 52 (30%) of cases were positive by culture of urine, Table 1. Thus strip test was with sensitivity of 100% and specificity of 40.4%, Table 1.

Table (1) Strip method versus culture in diagnosis of urinary tract infection

Culture	Strip test		
	Positive	Negative	Total
Positive	52	0	52
Negative	118	80	198
Total	170	80	250

The present study found that 53.8% (28/52) of UTI in patient with age of 1-5 years, and 5.7% (3/52) with age of 10-11 years. Additionally, 73% of UTI were in children with age of ≤ 5 years. Gender influence urinary tract infection and the infection was more common in female (32/52; 61.5%) than in male (20/52; 38.5%), with significant difference. However, there was no significant differences (X^2 =0.85, P>0.05) between male and female in regards to age groups, Table 2.

Table (2) Distribution of urinary tract infection in relation to age and sex

Age	Male		Female		Total	
	NO.	%	NO.	%	NO.	%
2-11month	4	20	6	8.7	10	19.2
1-5 year	12	60	16	50	28	53.8
6-10 year	3	15	8	25	11	21.2
11-12 year	1	5	2	6.25	3	5.8
Total	20	38.4	32	61.5	52	100

Chi square=0.85; P>0.05

Urinary tract infection was predominant in children from urban area (86%), Fig 3. Unfortunately, 67.3% of mothers of infected cases were illiterate, while 17.3% and 15.3% were graduate of primary and secondary school respectively, Table 3.

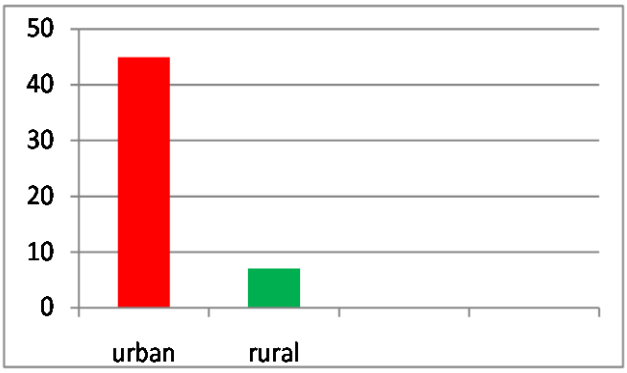

Figure .3. Distribution of urinary tract infection according to residence

Table. 3. Educational level of positive culture patient's mother

Education level	Number	Percent
Illiterate	35	67.3
Primary school	9	17.3
Secondary school	8	15.3
Total	52	100

The most of the cases of UTI were on mixed feeding (breast &bottle) (36.5%), Table 4.

Table. 4. Distribution of urinary tract infection according to feeding type.

Type of feeding	Male		Female		Total	
	NO.	%	NO.	%	NO.	%
Breast only	1	5	1	3.1	2	3.8
Bottle only	4	20	6	18.7	10	19.2
Mixed Breast & bottle	4	70	15	46.8	19	36.5
Milk & solid	5	25	2	6.3	7	13.0
Solid only	6	30	8	25.0	14	26.9
Total	20	38.4	32	61.5	52	100

$X^2 = 5.8$; $P > 0.05$

The Study found that most of cases have family history of UTI, most of male patients circumcised and most of patient's non diabetic as shown in table (5).

Table. 5. Risk factor for occurrence of urinary tract infection

Risk factor	Male		Female		Total	
	Yes NO(%)	No NO (%)	Yes NO (%)	No NO (%)	Yes NO(%)	No NO(%)
Family history of UTI	16(80)	4(20)	24(75)	8(25)	40(76.9)	12(3.1)
History of circumcision	19(95)	1(5)	(0)	32(100)	19(36.5)	33(63.5)
Diabetes	3(15)	17(85)	5(15)	27(84)	8(15.4)	44(84.6)
Total	20(100)		32(100)		52	

$X^2 = 0.017$; P>0.05

The most common symptoms in the infected children were dysurea (100%) and poor feeding (100%), followed by vomiting (92.3%) and frequency (86.5%). While the most common sign was pallor which forms 90.4%. In regard to gender, fever, frequency, vomiting and pallor were more frequent in female than in male and form 78%, 90.6%, 96.9%, and 93.8% respectively. In contrast, incontinence, constipation, and abdominal pain were more frequent in male than in female with a rate of 65%, 70%, and 75% respectively. However, dysurea and poor feeding were with the same frequency (100%) in both genders, Table 6.

Table.6. The sign and symptom of urinary tract infection in patient with positive culture.

Signs and symptoms	Male		Female		Total	
	Yes	No	Yes	No	Yes	No
Fever	4	16	25	8	29	24
Dysurea	20	0	32	0	52	0
Frequency	16	4	29	3	45	7
Nocturia	9	11	15	18	24	29
Incontinence	13	7	15	17	28	24
Constipation	14	6	20	10	24	16
Vomiting	17	3	31	1	48	4
Abdominal pain	15	5	22	10	27	15
Pallor	17	3	30	2	47	5
Poor feeding	20	0	32	0	52	0
Hypertension	All patient have normal blood pressure		All patient have normal blood pressure		All patient have normal blood pressure	

$X^2 = 7.25$; P>0.05

Ultrasound examination indicated presence of cystitis in 92.3% of children with urinary tract infection with same pattern in male (95%) and female (90%). While PCSD was present in 42.3% and it was higher in female (53%) than in male

(25%). However, bladder wall thickening found in all male cases of urinary tract infection and in 96.9% in female cases, Table 7.

Table.7. Manifestation of urinary tract infection detected by ultrasound.

Ultrasound finding	Male		Female			
	Yes	No	Yes	No	Yes	No
	NO.(%)	NO.(%)	NO.(%)	NO.(%)	NO.(%)	NO.(%)
Cystitis	19(95)	1(5)	29(90)	3(10)	48(92.3)	4(7.7)
PCSD	5(25)	15(75)	17(53)	15(46)	22(42.3)	30(57.7)
Bladder thickening	1(5)	19(25)	6(18.7)	26(81)	7 (13.5)	45(86.5)
Hydronephrosis	0(0)	20(100)	1(3)	31(96.9)	1 (1.9)	51(98.1)
Stone	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

$X^2 = 3.12$; P>0.05

Haemoglobin level of less than 10 g/dl was significantly ($X^2 = 2.6$;P=0.01) more frequent (67.3%) in children with urinary tract infection with a more predominance in male (80%) than in female (59%), Table 8.

Table. 8. Hemoglobin level in children with urinary tract infection

Hb level	Male		Female		Total	
	NO.	%	NO.	%	NO.	%
<10	16	80	19	59	35	67.3
>10	4	20	13	40.6	17	32.7
Total	20	38.4	32	61.5	52	100

$X^2 = 2.38$; P>0.05

In the present study cohort strip method detected urinary tract infection in 68% of children presented as suffering from UTI. From a total of 95 male, 75 were positive (78.9%) in strip test and of a total 155 female, 95 (61.2%) were positive in strip test. Thus urinary tract infection was significantly (X^2=8.43; P=0.001) more frequent in male than in female as strip test indicated, Table 9.

Table.9. Distribution of positive strip cases according to gender.

Result	Male		Female		Total	
	NO.	%	NO.	%	NO.	%
Positive	75	78.9	95	61.2	170	68
Negative	20	21	60	38.7	80	32
Total	95	100	155	100	250	100

X^2 = 8.44; P=0.001

Discussion:

The present study findings indicated less than age of children was a significant risk factor for urinary tract infection. The frequency of infection in children with age of less than 5 years was 73% and this indicated that this age group need attention and follow up to prevent permanent sequelae of UTI. Breast feeding was with protective effect from development of urinary tract infection. This study shows a low frequency of UTI in breast feed children, mixed breast and bottle feeding, solid food and bottle feeding were with risk of development of UTI of 9.6, 7 and 5 times respectively. Thus feeding practice influenced development of UTI in children. The risk of UTI was 2.3% times higher in non breast fed children when compared with exclusively breastfed children. The reason why bottle fed babies have more UTI is that bottle milk have more solute than breast milk which leads to increase precipitate of crystals in the urine that increase the incidence of UTI [33]. Still circumcision is protective against UTI, because the fact that circumcision prevents UTI by preventing the bacteria to grow near the urethral meatus and ascend to urinary bladder. This was agreed with that reported by others [34, 35].

UTI presented in many features like fever, dysurea, frequency, abdominal pain, irritability, poor feeding, and vomiting and this goes with symptoms of Feverish illness in children [36]. However, dysurea, poor feeding, vomiting and frequency were the common symptoms for UTI in the present study. Additionally, pallor was the main sign in this study cohort. UTI sign and symptoms without significant differences between male and female children.

Cystitis and pelvicalyceal cyst dilatation (PCSD) were the most common features of UTI detected by U/S. This finding agreed with the study in Royal College of Pediatrics and Child Health [37]. However, there was a non-significant difference between male and female in the detection of renal system abnormality by ultrasound. Urban location, illiterate, haemoglobin level of <10 g/dl and age of < 5 years were a risk factors for the development of urinary tract infection. There was none significant differences in UTI in relation to gender when the cases compared on strata of age groups, educational level, feeding type, signs and symptoms, ultrasound finding and haemoglobin level. However, there was a significant difference in strip test positivity between male and female children.

Regarding the use of strip method to diagnose UTI, this goes with other studies in China, conducted that the urine dipstick test can be used as screen to determine whether or not a urine culture should be performed [38]. Although, strip test was with higher sensitivity, but it was with low specificity in diagnosis of UTI. This is

due to strip method is depended on chemical reaction that may be affected by urine pH or hydration state which may not pick up UTI successfully as well as different microorganisms might have different reaction [39].

There was no significant correlation between strip method and culture as strip test is sensitive in pickup of UTI but it is not specific, and it is useful as diagnostic test for patients with signs and symptoms of UTI. Thus the positive strip test is not specific as diagnosis of UTI and false positive high rate of strip test may be attributed to other causes rather than UTI. One study conducted that no other method like strip method should not substitute culture method in symptomatic children [39].

Conclusion

Strip test was highly sensitive but with low specificity as compared to culture as the standard method. However, it may be of value as screening test or in the primary health care centers with equipment limitation. Urban location, illiterate, haemoglobin level of <10 g/dl and age of < 5 years were a risk factors for the development of urinary tract infection.

References:

1. Baker SS, Alsamarai AGM, Mahmoud MI. Susceptibility of bacterial uropathogens to antimicrobial agents in Basrah. Med J Basrah Univ.1988;7:73-81.
2. Alsamarai AGM, Latif IA, Abdulaziz MM. Antibiotic susceptibility of extended spectrum beta lactamase (ESBL) producing Escherichia coli. WJJPPS. 2016; 5: 195-215.
3. Alsamarai AGM, Ali S. Urinary tract infection in Female in Kirkuk City, Iraq: Causative agents and antibiogram. WJPPS. 2016;5:261-73.
4. Alsamarai AGM, Ali S. Urinary tract infections in female in Kirkuk, Iraq. Risk factors. WJPPS. 2016;5:180-95.
5. Alsamarai AGM. In vitro susceptibility of urinary bacterial isolates to gentamicin: six years study Med J Tikrit University. 1996;2:83-92.
6. Alsamarai AGM, Latif IA, Abdulaziz MM. Urinary tract infection in Iraq: Evaluation of early detection methods and etiology. WJPPS. 2016;5:181-94.
7. American Academy of Pediatrics Committee on Quality Improvement, Subcommittee on UTI. Practice parameter: the diagnosis, treatment, and evaluation of initial urinary tract infection in febrile infants and young children. Pediatrics 1999;103(4 Pt 1):843-52..
8. Armengol C, Hendley J, Schlager TA . Should we abandon standard microscopy when screening for urinary tract infections in young children? The Paed Infect Dis J 2001;20(12): 1176-1177.
9. Asharam K, Bhimma R, Adhikari M. Human immunodeficiency virus and urinary tract infections in children. Ann Trop Paed 2003; 23: 273-277.
10. Babaoye F, Ogala W, Muhammad I. Dysuria in infancy and childhood: an analysis of 42 child representing in the pediatrics outpatients department. East Afr Med J 1991; 68(11): 860-4.
11. Banapurmath C, Jayamony S. Prevalence of urinary tract infection in severely malnourish preschool children. Indian Pediatrics 1994;31(6): 679-82.
12. Kehinde EO, Rotimi VO, Al-Hunayan A, Abdul-Halim H, Boland F, Al-AwadiKA.. Bacteriology of urinary tract infection associated with indwelling ureteral stent. J Endourol 2004; 18(9):891-6.

13. Schlager TA, Clark M, Anderson S. Effect of a single-use sterile catheter for each void on the frequency of bacteriurea in children with neurogenic bladder on intermittent catheterization for bladder emptying. Pediatrics 2011; 108(4):71– 4.
14. Craig J. Urinary tract infection: new perspectives on a common disease. Current Opinion in Infectious Diseases 2001; 3: 309-13.
15. Craig J, Hodson E. Treatment of acute pyelonephritis in children. Br Med J 2004; 328:179-180.
16.Craig J, Irwig L, Knight JF, Roy LP. Does treatment of vesico-ureteric reflux in childhood prevent end-stage renal disease attributable to reflux nephropathy? Pediatrics 2000; 105(6): 1236-1241.
17. Doley A, Nelligan M. Is a negative dipstick analysis good enough to exclude urinary tract infection in paediatric emergency department patients? Paediatric Emergency Medicine 2004; 15: 77-80.
18.Downs S. Technical report: urinary tract infections in febrile infants and young children.Pediatrics1999; 103(4): e54.
19.Gorelick M and Shaw K Screening tests for urinary tract infection in children: a meta-analysis. Pediatrics 1999;104(5): 54.
20.Hari P, Singla I, Mantan M, Kanitkar M, Batra B, Bagga A. Chronic renal failure in children. Indian Pediatrics 2003;40(11): 1035-42.
22. Jeena P, Coovadia H, Adhikari M. Probable association between urinary tract infections (UTI) an common disease of infancy and childhood: a hospital-based study of UTI in Durban, S Afr J Trop Paed 1996;42: 112-115.
24.Kala U, Jacobs W. Evaluation of urinary tract infection in malnourished black children. Ann Trop Paed 2003;12: 75-81.
23.Kassim O. Proteinuria and haematuria as predictors of schistosomiasis in children. Ann Trop Paed 1996;3: 156-160.
25.Keren R, Chan E. A meta-analysis of randomized, controlled trials comparing short- and long course antibiotic therapy for urinary tract infections in children. Pediatrics 2002;109(5):E70-0.
26.Ladhani S, Gransden W. Increasing antibiotic resistance among urinary tract isolates. Arch Dis Childhood 2003;88: 444-445.
27.Liao J, Churchill B. Pediatric urine testing. Pediatric Clinics of North America 2003;48(6): 1425-143.
21.Nuutinen M, Uhari M, Murphy MFG, Hey K. Clinical guidelines and hospital discharges of children with acute urinary tract infections. Pediatric Nephrology 1999;13(1):45–9.
28.Michael M, Hodson E, Craig JC, Martin S, Moyer VA. Short compared with standard duration of antibiotic treatment for urinary tract infection: a systematic review of randomised controlled trials. Arch Dis Childhood 2002;87: 118-123.
29.Bonadio WA, Hennes H, Smith D, Ruffing R, Melzer-Lange M, Lye P, Isaacman D. Reliability of observation variables in distinguishing infectious outcome of febrile young infants. Pediatr Infect Dis J 1993; 12:111–114.
30. Wiggelinkkhuizen J, Maytham D, Hanslo DH. Dipstick screening for urinary tract infection. S Afr Med J 1988;74(5):224-8.
31. Uwaezuoke SN , Ndu IK, Eze KIC. The prevalence and risk of urinary tract infection in malnourished children: a systematic review and meta-analysis BMC Pediatrics 2019;19:261
32.Shaw KN, McGowan KL. Evaluation of a rapid screening filter test for urinary tract infection in children. Pediatr Infect Dis J 1997;16:283–287.

33.Marild S, Hansson S, Jodal U, Odén A, Svedberg K. Protective effect of breastfeeding against urinary tract infection. Acta Paed 2004; 93(2):154-6.
34.Go JMR, Cocjin A and Dee-Chan R. Jaundice as an early diagnostic sign of urinary tract infection in infants less than 8 weeks of age. Santo Tomas Journal of Medicin 2005; 52(4):131-139
35.Hiraoka M, Tsukahara H, Ohshima Y, Mayumi M. Meatus tightly covered by the prepuce is associated with urinary infection. Pediatrics 2002;44(6):658-62.
36.Jodal U. The natural history of bacteriurea in childhood. Infectious Disease Clinics of North America 1987;(4):713–29.
37.Verrier-Jones K, Hockley B, Scrivener R and Pollock JI. Diagnosis and Management of Urinary Tract Infections in Children under Two Years: Assessment of Practice Against Published Guidelines. London: Royal College of Paediatrics and Child Health;2001.
38.Cheng YW and Wong SN. Diagnosing symptomatic urinary tract infections in infants by catheter urine culture. J Paed Child Health 2005;41(8):437–4.
39.Arslan S, Caksen H, Rastgeldi L, Uner A, Oner AF, Odabas D. Use of urinary gram stain for detection of urinary tract infection in childhood. Yale J Bio Med 2005;75(2):73–8.