"ENHANCED URINALYSIS AS A SCREENING TEST FOR URINARY TRACT INFECTION IN CHILDREN AGED ONE MONTH TO TWELVE YEARS"

Dissertation submitted to

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY

CHENNAI

In partial fulfilment of the regulations for the award of degree of

M.D. PAEDIATRICS

(BRANCH VII)

INSTITUTE OF CHILD HEALTH & HOSPITAL FOR CHILDREN

MADRAS MEDICAL COLLEGE

CHENNAI

APRIL – 2017

CERTIFICATE

This is to certify that the dissertation titled "**ENHANCED URINALYSIS AS A SCREENING TEST FOR URINARY TRACT INFECTION IN CHILDREN AGED ONE MONTH TO TWELVE YEARS"** submitted by **Dr.S.KABILAN** to the Faculty of Paediatrics, **THE TAMILNADU DR.MGR MEDICAL UNIVERSITY, CHENNAI,** in partial fulfilment of the requirements for the award of M.D. Degree (Paediatrics) is a bonafide research work carried out by him under our direct supervision and guidance.

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DECLARATION

I **Dr.S.KABILAN,** solemnly declare that the dissertation titled "**ENHANCED URINALYSIS AS A SCREENING TEST FOR URINARY TRACT INFECTION IN CHILDREN AGED ONE MONTH TO TWELVE YEARS"** has been prepared by me.

This is submitted to The Tamil Nadu Dr.M.G.R. Medical University Chennai in partial fulfilment of rules and regulations for the M.D. Degree Examinations in Paediatrics.

DR.S.KABILAN

Place: Chennai

Date: 01-10-2016

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INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI-3

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CERTIFICATE OF APPROVAL

To
Dr. S. Kabilan
Post Graduate in MD (Paediatrics)
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Dear Dr. S. Kabilan,

The Institutional Ethics Committee has considered your request and approved your study titled **"ENHANCED URINALYSIS AS A SCREENING TEST FOR URINARY TRACT INFECTION IN CHILDREN AGED 1 MONTH – 12 YEARS" No. 12092015.**

The following members of Ethics Committee were present in the meeting held on **08.09.2015** conducted at Madras Medical College, Chennai-3.

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2.	Prof.R.Vimala, M.D., Dean, MMC, Ch-3	:Deputy Chairperson
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9.	Thiru S.Govindasamy, B.A., B.L.,	: Lawyer
10.	Tmt.Arnold Saulina, M.A., MSW.,	: Social Scientist

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

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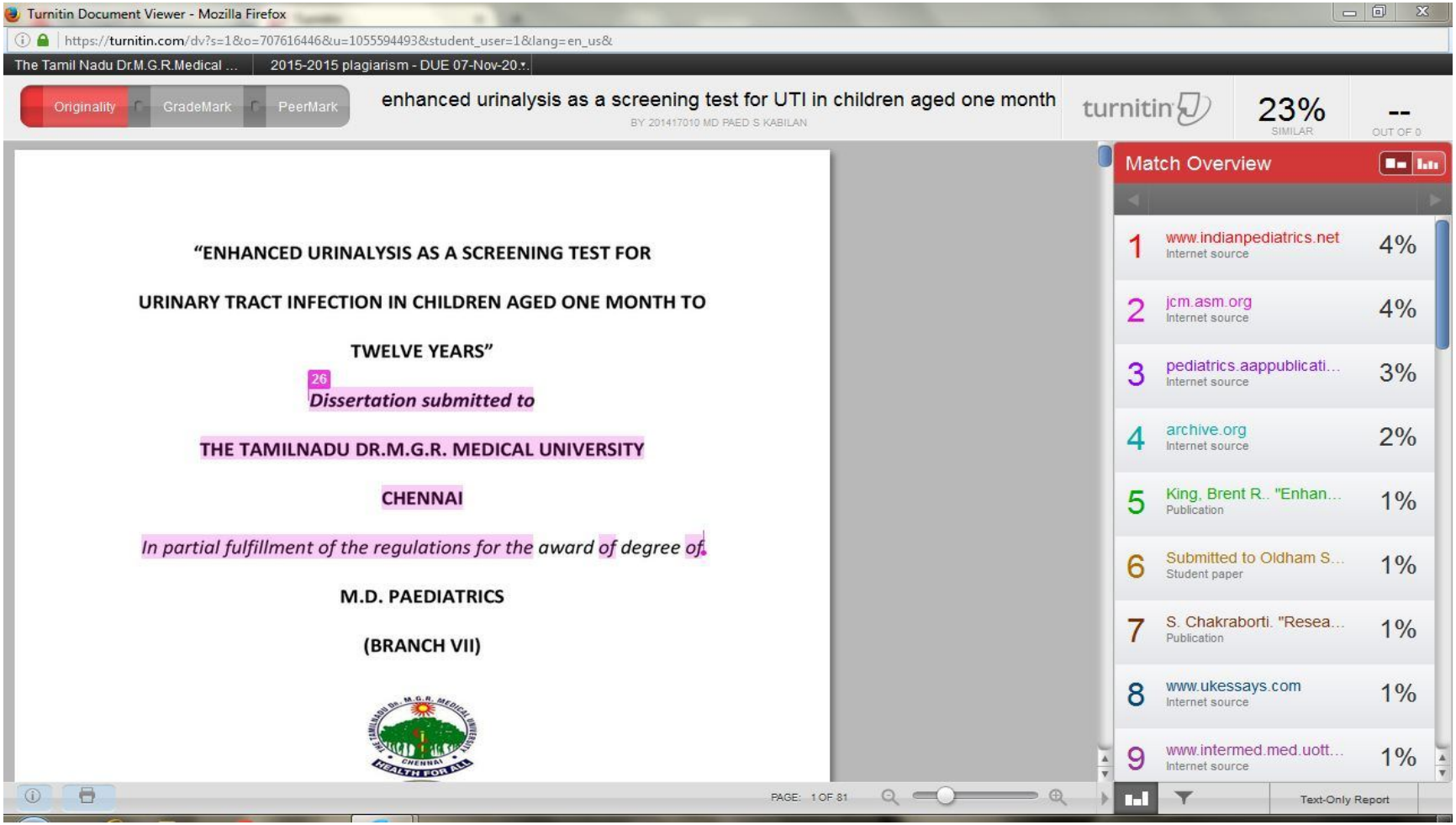
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ABBREVIATIONS

CFU	-	COLONY FORMING UNITS
C.I	-	CONFIDENCE INTERVAL
DMSA	-	DIMERCAPTOSUCCINIC ACID
E.coli	-	ESCHERICHIA COLI
ESR	-	ERYTHROCYTE SEDIMENTATION RATE
FPR	-	FALSE-POSITIVE RATE
hpf	-	HIGH POWER FIELD
LR	-	LIKELIHOOD RATIO
MCU	-	MICTURATING CYSTOURETHROGRAM
MO	-	MONTHS
mg	-	MILLIGRAM
ml	-	MILLILITRE
MSCCU	-	MID STREAM CLEAN CATCH URINE
NPV	-	NEGATIVE PREDICTIVE VALUE
OPD	-	OUTPATIENT DEPARTMENT
PPV	-	POSITIVE PREDICTIVE VALUE
PUV	-	POSTERIOR URETHRAL VALVE
RBC	-	RED BLOOD CELLS
ROC	-	RECEIVER OPERATOR CHARACTERISTIC
rpm	-	ROTATIONS PER MINUTE
TPR	-	TRUE POSITIVE RATE
WBC	-	WHITE BLOOD CELLS
USG	-	ULTRA SONOGRAPHY
UA	-	URINALYSIS
UTI	-	URINARY TRACT INFECTION
VUR	-	VESICO URETHRAL REFLUX
YR	-	YEAR

CONTENTS

INTRODUCTION

Urinary tract infections in paediatric age group are one of the commonest infections next to respiratory tract infections. Early and correct diagnosis of UTI and pyelonephritis is essential for treatment. A swiftly available diagnostic tool for early diagnosis of acute UTI and pyelonephritis helps to decrease the extent of renal scarring and subsequent secondary hypertension, which may land in renal failure later if not treated promptly. By giving proper and complete treatment at the earliest it can be prevented.

All age group children with UTI ,especially associated with fever can have acute pyelonephritis and later develop renal scarring, but the chances are more in those younger than 2 years of age[1].

UTI usually diagnosed based on symptoms or findings on urinalysis or both, to confirm an urine culture is mandatory and also for suitable antibiotic therapy .

URINARY TRACT INFECTIONS

"Urinary Tract Infection is identified by notable growth of urinary microorganism belonging to single species, along with the symptoms'. Urinary tract infection is usually classified based on the site of infection as follows

1. Upper and lower urinary tract infections as follows;
    - Pyelonephritis - upper urinary tract condition involving the renal parenchyma,
    - Cystitis - lower urinary tract condition involving the bladder.

2. Based on the severity it is classified as Complicated UTI and simple UTI.

Epidemiology:

Incidence differs based on age, race and gender of children. UTI occurs in about 1% of boys and 3-5% of girls[1]. In female children the 1st UTI occurs by the age of 5 years showing peak incidence during first year and in Toilet - training period. After the first episode sixty to eighty percent of the female children will develop a second urinary tract infections within 18 months of age. In male children most urinary tract infections occur in the first Year. UTI is much more common in Uncircumcised males. The Prevalence of UTI varies with age. In the first year of life; the male to female ratio is 2.8-5.4:1 . After 1-2 years there is a obvious female dominance, with a male to female ratio of 1:10. 3%-5% of febrile children are found to have UTI.

Symptoms of UTI may be minimal and undetailed in infants and young children. In most cases the 1st episode of urinary tract infection occurs during the 1st year of life and it is believed that young developing kidneys are more at risk for renal parenchymal damage.

In the children the chances for recurrence is more than the adult population. Especially if first episode occurs within < 1 yr of age, around thirty percent of male and forty percent of female children will develop another episode.

Table .1. Prevalance of UTI age wise

AGE IN YEARS	FEMALE	MALE
<1 YEAR	0.7%	2.7%
1-5	0.9-1.4%	0.1-0.2%
6-16	0.7-2.3%	0.04-0.2%

We can anticipate a recurrence rate of 30% after the first episode, This value will multiply by two for each upcoming infection. Anatomic abnormalities (posterior urethral valves, ureteropelvic junction obstruction, ureterovesical obstruction, and ureterocele) as an etiology for UTI is seen in two percent to ten percent and thirty percent to fifty percent will have vesicoureteral reflux.

Aetiology:

The causative agent of urinary tract infection varies based on age and associated co-morbidities. Although urinary tract infection can be caused by any pathogenic microorganism that conquers the urinary tract, most common causative microorganisms are the bacteria which is present in the gut. Escherichia coli is the most common and very frequently documented microorganism.

ORGANISMS CAUSING UTI

GRAM NEGATIVE BACTERIA

- Escherichia Coli
- Klebsiella pneumoniae
- Proteus mirabilis
- Enterobacter aerogenes
- Pseudomonas aeruginosa
- Serratia marcescens

GRAM POSITIVE BACTERIA

- Staphylococcus epidermidis
- Staphylococcus aureus
- Staphylococcus saprophyticus
- Enterococcus sp

OTHERS

- Adenovirus 11 & 12
- Influenza A
- Polyomavirus BK
- Herpes simplex, Herpes zoster
- Candida albicans
- Schistosomiasis,
- Mycobacterium

PATHOGENESIS:

I. Retrograde ascending infection from urethra.

Bacterial clonally studies strongly support that "the entry of organism in to the urinary tract occurs by fecal-perineal-urethral route with subsequent retrograde ascent into the bladder". Because the urethral length is short in female children and for the differences in their anatomy, the female children are more prone for UTI than the male children, after their infancy. In the female children, the presence of the moist peri-urethral and vaginal areas, usually promotes the proliferation and growth of the pathogenic microorganisms.

The mechanism by which, the microbial pathogen enters the urinary bladder and its subsequent entry into the ureters and kidneys remains as, yet undefined mechanism. Normally the 'simple and compound papillae' in the kidney have an anti reflux mechanism by which it usually prevents the urine from flowing back in 'retrograde manner' into the collecting tubule of the kidney. Some 'compound papillae' especially located in the upper and lower poles of the kidney allow intra renal reflux and results in stasis which may encourage bacterial growth leads to urine unsterile. This unsterile urine then causes an immune and inflammatory reactions.

I. **Haematogenous route**

Is an unusual and rarer mode of infection except for neonatal period.

II. **Direct extension of the infection**

It is due to the recto vesical or vagino vesical fistulae.

III. **Nosocomial infection**

It may occurs due to indwelling urinary catheters during hospitalization.

The urinary tract is a “closed, normally sterile space lined with mucosa composed of epithelium known as transitional cells”. There are many defence mechanisms present in the intact urinary tract one of which is the constant ‘ante grade’ movement of the urine from the kidney, then to ureter and to the urinary bladder with total emptying of the bladder through the urethra. This is called as “washout effect of the urinary flow” which always clears the urinary tract of pathogenic microorganisms.

The urine has certain characteristics in addition, that provide anti microbial properties, like acidic pH, presence of polymorph nuclear cells and uromodulin, which prevents the adherence of the pathogenic microorganism to the mucosal layer of the wall of the urinary bladder.

Urinary tract infection occurs with the introduction of the pathogenic microorganism into genitourinary tract, which is a closed space and is associated with the adherence of the microorganism to the mucosal layer of the urinary tract. If the microorganisms are not cleaned adequately by the washout effect and ante grade flow of urinary voiding, then colonization by pathogenic microorganisms usually develops. Colonization of the urinary tract may come next to growth of uropathogens and severe inflammatory reaction associated with it.

The pathogenic bacteria that cause urinary tract infection in normal healthy individuals usually exhibits a distinctive property called as ‘virulence

factor’ to overcome the natural defence mechanism of the renal tract. the adherence of the microorganism to the transitional uroepithelium is increased by adhesions, often ‘fimbriae’ (pili), which are bound to the specific receptors present in the uroepithelium. The interaction of ‘fimbriae’ with the receptor present in the mucosal layer of the urinary tract causes internalization of the microorganism into the epithelial cell, which triggers apoptosis, hyperinfection, and the invasion of the microbe into the surrounding epithelial layer or the establishment of a microbial focus for ‘recurrent UTI’. Uropathogenic strains, especially of E coli, have been identified to release certain ‘toxins’ including cytolytic distending toxin, ‘alpha hemolysin’, ‘cytotoxic necrotizing factor-1’, ‘secreted auto transporter toxin’ that initiates and causes lysis of the cell, promotes cell cycle arrest and changes in their morphology and cellular function. To prolong their survival, various uropathogens possess ‘siderophore systems’ capable of getting iron from heme which is an essential micronutrient for the proliferation and growth of the bacteria.

When several serotypes of E-coli were studied, the disease causing strains of E-coli that are usually isolated in urinary tract infection have a “glycosylated polysaccharide capsule” which interferes with the phagocytosis and complement mediated bacterial lysis.

There are 2 types of pili, I and II. Type I pili are found on almost every strains of E. coli. Because attachment to target cells can be blocked by d-mannose, these pili are referred to as mannose sensitive. They have no role in

pyelonephritis. The attachment of type II pili is not inhibited by mannose, and these are known as mannose resistant.

Between 76% and 94% of pyelonephritogenic strains of E. coli have P pili(it can agglutinate by P blood group RBC, so they are known as P pili) or mannose resistant pili.

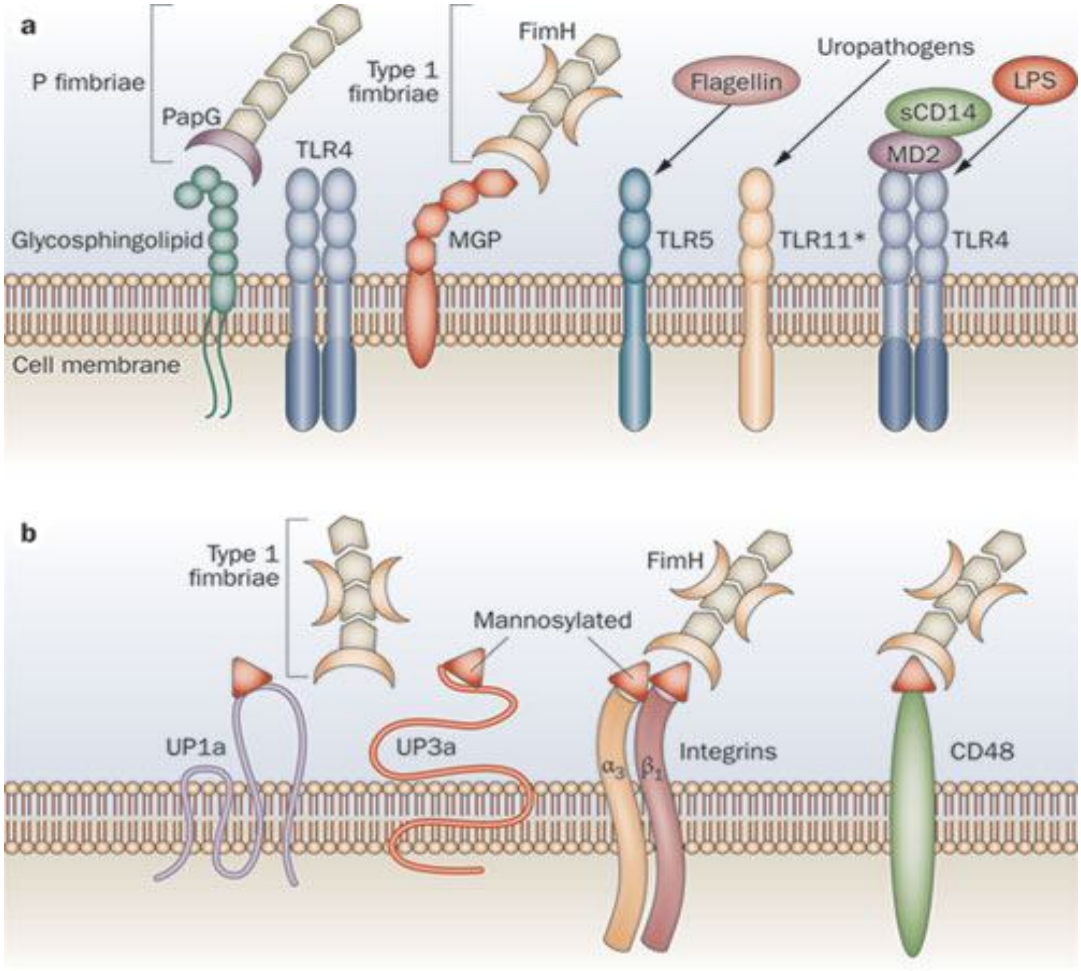

Figure 1-E.COLI FIMBRIAE(pili).

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Risk Factors:

Though all individuals are prone for urinary tract infection, many of them remain free from acquiring infection during the childhood by the presence

of natural and innate ability to resist the attachment of infective urinary pathogen. There are specific sub populations with an increased susceptibility to UTI.

RISK FACTORS FOR UTI IN CHILDREN[1]

- Girl child
- Uncircumcised boy
- VUR
- Trans urethral procedures
- Cleaning from back to front in girls
- Training for Toilet
- Voiding dysfunction
- Obstructive uropathy
- Bath in tub
- Tight under wear
- Infection of the GIT with worms
- Constipation
- p pili bacteria
- Anatomic abnormalities (labial adhesion)
- Neurogenic bladder and
- Sexual activity

CLINICAL FEATURES

Initial presentation of UTI is more of non specific symptoms. Presentation is age dependent, and it usually present with specific symptoms in children >5 yr old. Fever is the one of the common symptom among all age groups.

As we go age group wise,

In newborns, UTI is one of the causes for septicaemia, usually present with extra- uterine growth retardation, fever, lethargy, vomiting and hyperbilirubinemia.

In children aged less than 2 years it usually present as “febrile event without focus”.

In age group of more > 2 yrs and toddlers presentations will be of repeated fever, abdominal pain, vomiting, diarrhoea and inadequate weight gain.

In school going age group it usually presents with specific symptoms such as dysuria, urgency, abdominal or flank pain and increased frequency along with the fever.

Adolescents usually have symptoms of lower urinary tract and fever may be the rare presentation.

Hematuria may present as single manifestation of UTI or may be one of the associated symptoms.

The delineation between upper and lower urinary tract infection is difficult as symptoms are usually nonspecific and it's also unnecessary. So all UTI in paediatric age group is taken as upper urinary tract infection and should undergo treatment immediately, delay in initiating treatment may lead to renal parenchymal damage.

SIGNS SUGGESTIVE OF UTI

- Palpable bladder
- Enlarged and palpable kidneys
- vulval synechiae ,Tight phimosis
- Fecal mass palpable in the colon
- Patulous anus; neurological deficit in lower limbs
- Incontinence
- H/O Previous surgery in the urinary tract and
- Congenital ano rectal malformation.

COMPLICATED UTI:

Children with features of systemic toxicity "Presence of fever >39ºC, systemic toxicity, persistent vomiting, dehydration, renal angle tenderness and raised renal parameters especially creatinine" are considered as having complicated UTI.

SIMPLE UTI:

Children with no features of systemic toxicity are considered as simple UTI. Usually presents with mild fever, burning micturition, increased frequency, and urgency; and with no symptoms suggestive of complicated UTI. The differentiation helps in choice of treatment.

RECURRENT UTI:

Recurrent urinary tract infection is defined the recurrence of symptoms in children who have recovered clinically following treatment ,associated with significant bacteriuria. It usually occurs in female children as 2^{nd} episode.

DIAGNOSIS:

UTI is diagnosed based on culture positivity of a properly collected urine sample. Initial screening of urine enables provisionary diagnosis of UTI; a sample must be obtained for culture before starting antibiotics.

PYURIA:

Significant pyuria is defined as > 10 WBC/mm^3 in a fresh unspun urine, or >5 WBC/hpf in spun urine. Newer dipstick, automated methods are available which is not cost effective and also not accurate in picking up pyuria[17].

Dipstick tests, which identify leukocyte esterase and nitrite, are used in screening for urinary tract infection.

Pyuria also seen in conditions such as fever, glomerulonephritis, renal stones. The identification of leukocyturia (pyuria) in absence of significant

bacteriuria is not enough to diagnose a UTI .This finding is more confirmatory than diagnostic.

The combination of these tests discussed above has average sensitivity and specificity for identifying UTI.

STERILE PYURIA

Sterile pyuria defined as condition of positive pyuria with negative urine culture, may occur in partially treated UTI caused by bacteria, renal mycobacterium tuberculosis infection, abscess, viral infections ,obstructive uropathy.

BACTERIURIA

"Presence of any microorganisms in the urine specimen is called bacteriuria."

Microscopic examination for bacteriuria can be performed in bacteriological practice by four basic procedures[(12)].

i. Uncentrifuged fresh urine with a forty times magnification (40X) dry objective examination,
ii. Centrifuged fresh urinary sediment with a forty times magnification(40 X) dry objective examination,
iii. With an oil immersion objective (100X) examination of a Gram-stained smear of uncentrifuged urine, and
iv. Examination of Gram stained smear of centrifuged urine with an oil immersion objective.

Microscopy for bacteriuria though not done routinely in practice, commonly used two types of methods.

- First method is wet mount examination in microscope after centrifugation of urine sample if >1ml, if <1ml not centrifuged, reported as, trace, mild, plenty.
- Second method, one of the components of our study which is Gram Staining of uncentrifuged sample for bacteriuria by standard method of staining.

Reported as number of bacteria in 10 hpf under oil immersion.

Significant bacteriuria

Commonly defined as CFU $>10^5$/ml of a single microorganisms in a midstream clean catch urine (MSCCU).

Asymptomatic bacteriuria:

It is defined as Significant bacterial growth in the absence of symptoms suggestive of urinary tract infection, common among female children, incidence is <1% in toddlers (toilet training age group) and school age groups.

It is rare in boys. Some children are mistakenly detected as having asymptomatic bacteriuria, they might be actually experiencing incontinence either in day or night or perineal discomfort due to UTI **.**

URINE FOR CULTURE

Quantitative urine culture is considered the gold standard procedure for diagnosis of UTI . In an attempt to reduce the time and cost spent in examining these negative cultures, several rapid methods have been developed for

characterizing bacteriuria, including microscopic examination, chemical tests, and automated systems.

"The urine specimen should be plated on time within one hour of collection. If delay is expected, the specimen should be stored in a refrigerator at 4ºC up to 24 hours, because if the urine specimen kept at room temperature for more than one hour, overgrowth of a minor contaminant can suggest a UTI when the urine might not be infected. Refrigeration is a reliable method of storing the urine until it can be plated[16].

The culture for urine should be repeated in case of suspected contaminants, e.g., growth of two or more uropathogens mixedly, or growth of organisms that are normal flora of the peri urethral region of both the gender (lactobacilli in girls; enterococci in infants and toddlers). Test should be repeated in situations where UTI is strongly possible but colony counts are ambiguous.

The numbers of bacterial growth needed for defining UTI depends on the method of collection as explained below in tabular column.

TABLE-2 : Significant bacteriuria in diagnosing UTI is based on the method of sampling:

SAMPLING METHODS	COLONY COUNT	PROBABILITY OF INFECTION(%)
Suprapubic Aspiration	Any NO; of Pathogens	Ninety nine(99)
Urethral Catheterization	$>5 \times 10^4$ CFU/ml	Ninety five(95)
Midstream clean Catch urine	$>10^5$ CFU/ml	Ninety to ninety five (90-95)

TABLE 3 : Sensitivity and Specificity of Components of Urinalysis, its Combination:

DIAGNOSTIC TOOL	SENSITIVITY(%)	SPECIFICITY(%)
Leukocyte esterase(LE) test	83(67-94)	78 (64-92)
Nitrite test	53 (15-82)	98 (90-100)
Microscopy (WBC)	73 (32-100)	81 (45-98)
Microscopy (Bacteria)	81 (16-99)	83 (11-100)
LE test, nitrite test or microscopy	99.8 (99-100)	70(60-92)

ENHANCED URINALYSIS

Enhanced urinalysis"**(14,19,20)** is a combination of urine cell count described by Dukes in 1927 and the urine Gram stain, which has been proposed as a more sensitive and specific method for identifying children with UTI in previous studies(19,20).

Components of enhanced urinalysis

- Manual Counting of WBC in Neubauer chamber or hemocytometer and expressing the result as number of WBC per cubic millimeter(/mm^3) in uncentrifuged urine sample and
- Gram-stained smear of uncentrifuged urine, for bacteria.

Other nonspecific markers for acute pyelonephritis are leukocytosis, neutrophilia, and elevated serum erythrocyte sedimentation rate, procalcitonin, and C-reactive protein are common. However their elevation does not prove acute pyelonephritis.

Several rapid screening tests have been developed and used commonly(Nitrite, Leucocyte esterase and automated Pyuria analyser) to make diagnosis of UTI presumptively, but because of their poor sensitivity, low positive predictive value against positive urine cultures and also high cost , had made simpler tests still in need.

Some of the bio-chemical tests commercially available enlisted as follows:

- Nitrite test,
- Leucocyte esterase test,
- Glucose oxidase test,
- Catalase test, and
- Triphenyl Tetrazolium Chloride (TTC) test.

TREATMENT:

The initial management is based on the degree of toxicity, dehydration and ability to retain oral intake. Baseline blood pressure should be recorded. Bladder and bowel habits to be noted.

Clinical features of underlying urological or functional abnormalities to be noted. Complete workup of blood along with serum creatinine and a blood culture should be done in children less than one year and those who presenting

with features suggestive of complicated urinary tract infection. Early initiation of therapy reduces the morbidity; reduces the renal damage and further consequences landing in dreadful complications.

Children < 3 mo of age and children with the complicated UTI should be treated with either intramuscular or intravenous antibiotic. The choice of antibiotic should be guided by local sensitivity pattern. A 3rd generation cephalosporin is preferred. Amino glycosides may be used if renal function is normal. Intravenous therapy is given for the first 2-3 days followed by oral medication once the clinical condition improves. Children with simple UTI and those above three months of age are treated with oral antibiotics. With adequate therapy, if symptoms and signs don't improve even after 48-72 hours of culture sensitive antibiotics, indicates the presence of resistant pathogens.

Table 4 : Choice and dosages of antibiotics[(4)]

ANTIBIOTICS	DOSAGES
PARENTRAL	
Ceftriaxone	75mg-100mg/kg, in one to two divided doses IV
Cefotaxime	100mg-150mg/kg, in two to three divided doses IV
Amikacin	10mg-15mg/kg, single dose IV or IM
Gentamicin	5mg-6mg/kg, single dose IV or IM
Coamoxiclav	30mg-35mg/kg of amoxicillin, in two divided doses IV
ORAL	
Cefixime	8mg-10mg/kg, in two divided doses

Coamoxiclav	30mg-35mg/kg of amoxicillin, in two divided doses
Ciprofloxacin	10mg-20mg/kg, in two divided doses
Ofloxacin	15mg-20mg/kg, in two divided doses
Cephalexin	50mg-70mg/kg, in two to three divided doses
PROPHYLACTICS*	
Cotrimoxazole	1mg-2mg/kg -Avoid in infants <3 months, G6PD deficiency
Nitrofurantoin	1mg-2 mg/kg- avoid in infants <3 months, G6PD deficiency, renal insufficiency
Cephalexin	10mg/kg - Drug of choice in first 3-6 mo of life
Cefadroxil	5mg -An alternative agent in early infancy

*prophylaxis antibiotic is recommended for patients with *(i)* UTI in less than one year of age**,** while awaiting imaging studies, (*ii*) vesicourethral reflux, (*iii*) frequent UTI with fever (three or more episodes in a year) even if the urinary tract is normal [(4).].

Duration of therapy[(4)]:

Children less than one year and those with complicated UTI to be treated for ten to fourteen days, in uncomplicated UTI for seven to ten days and three days for cystitis in adolescents' age group. Prophylaxis may needed in less than one year age group until appropriate imaging of the urinary tract is in process and specific children with abnormal genitourinary tract, neuropathic bladder etc.

It is mandatory to maintain adequate hydration during the course of illness. Sick child may require intravenous fluids. Routine alkalization is still under debate, may not necessary. A repeat urine culture is unnecessary unless there is no improvement even after adequate treatment for three days .

Evaluation after first UTI with fever is to pick individual at high risk for renal parenchymal damage ,specifically those below <1 year and those with vesicourethral reflux or urinary tract obstruction. Evaluations includes USG, DMSA and MCU, each having its own indications and complications. Detailed evaluations to be done for first UTI with fever and recurrent UTI in all age groups with age specific investigation shown in fig.2. and fig.3.

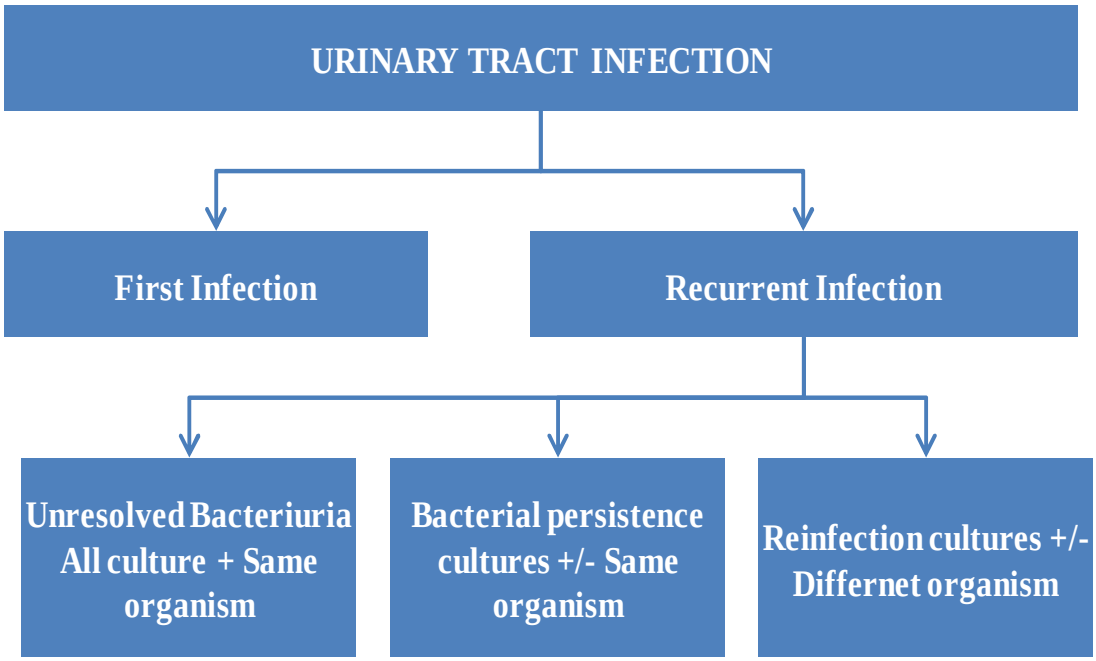


Figure 2

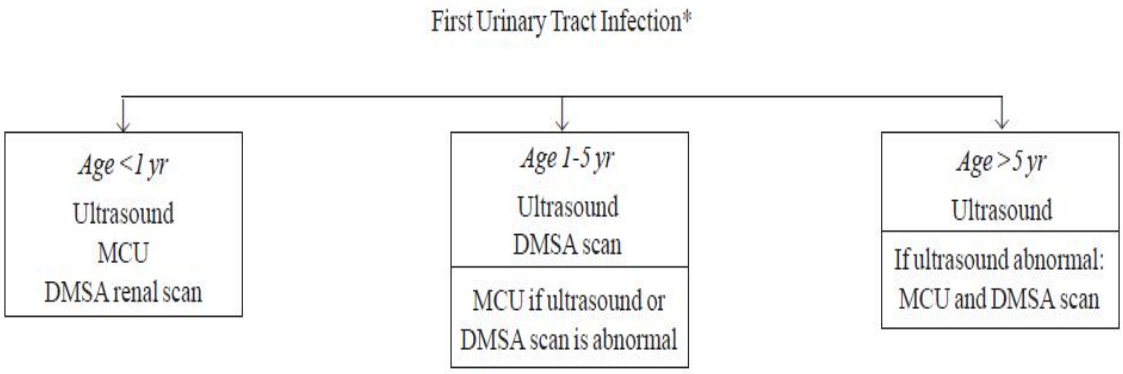


Figure 3 - Approach to first UTI age wise[(4).]

It is mandatory that individual with recurrent UTI at any age should be evaluated in detail by imaging with ultrasonography, MCU and DMSA scintigraphy. The main aim is to diagnose children at high risk of renal damage, especially those <1 year of age, and those with VUR or urinary tract obstruction. Evaluation includes USG,,DMSA and MCU performed judiciously as shown in Fig. 2[(4).]

An USG(ultrasonography) provides information on size of the kidney, number and location, hydronephrosis, bladder anomalies and post-void residual urine. DMSA (dimercapto succinic acid)scan is a sensitive technique for detecting renal parenchymal infection in acute event(pyelonephritis) and cortical scarring. MCU(micturating cysturethrogram) detects vesicourethral reflux and provides anatomical details regarding the bladder and the urethra.

USG should be done soon after the diagnosis of UTI. The MCU is recommended two to three weeks later, while the DMSA scan is carried out two to three months after completion of treatment[4].

REVIEW OF LITERATURE

- Hoberman et al :

698 children were screened for UTI, by both the enhanced urine analysis and routine analysis. All samples are obtained by catheterization. Concluded by saying that enhanced urinalysis is simple and results are readily available. The greater sensitivity and the positive predictive value of the enhanced UA seen when compared with the routine urinalysis, substantially improve its accuracy in diagnosing urinary tract infection[14].

- Shah AP et al:

A sum 703 catheterized urine sample of children screened for by both the enhanced urine analysis and automated analysis concluded by saying, "Automated urinalysis was comparable to the manual method detection of pyuria in subjects with suspected urinary tract infection, but bacteriuria detected by automated urinalysis was less sensitive and specific for confirming urinary tract infection than a Gram -stain smear. They recommended by saying either manual or automated measurement of pyuria in combination with Gram-stained smear was the preferred technique for urine analysis[17].

- Satish. S.P. et al.

A sum of 98 samples of mid stream clean catch was evaluated for by Gram stain and urine culture was done. The reported by saying that Gram stain of urine specimen sensitivity was calculated to be

89.1%, specificity 86%, positive predictive value 85.4% and negative predictive value 89.6%. Gram stain of uncentrifuged urine was very sensitive and specific screening test for diagnosis of urinary tract infection[8].

- Arslan et al;

  Urinary culture, urinary Gram stain, and 4 tests within the urinalysis(LE, nitrite, microscopy for bacteria, and microscopy for pyuria), were examined in hundred children with symptoms suggesting UTI. In conclusion, they revealed that a combination of Gram stain plus pyuria showed the highest (90 percent) specificity, but the lowest (42 percent) sensitivity; urinary Gram stain demonstrated the highest (90 percent) specificity; and overall urinalysis displayed the lowest (3.5 percent) specificity. With these findings they suggested that neither of the methods substitute urine culture in the symptomatic child[9].

- MJ Rodríguez. et al:

  This study had retrospectively reviewed medical records of children, who got admitted to the paediatric emergency department over a period of five years. They included children aged up to 2 years with complaints suggestive of urinary tract infection, in which a urine specimen was obtained by catheterizing bladder and urine -dipstick, sediment, gram stain and urine culture were performed. They concluded by stating that Gram stain of centrifuged urine sample provided a higher sensitivity and specificity applicable not only to children under three

months but extendable up to 2 years, and was thus a reliable guide for initial antibiotic treatment based on local antibiotic sensitivity pattern. Their results show that gram stain of urine specimen was the tests of choice for diagnosis and deciding factor for initiating treatment in infants with suspicious urinary tract infections until the results of urine culture are awaited[22].

- Hoberman A & Wald et al:

  Pyuria or bacteriuria positivity or both (Enhanced urinalysis)positive have the highest sensitivity and positive predictive value for identifying culture positivity. they concluded by saying, that analysis for pyuria(>10 WBC/mm^3) can be used to decide upon need for urine culture in pediatric age group.

- Kathy N. Shaw et al:

  This study conducted among children of less than 2 years of age, urine specimen obtained by urethral catheterization and screened for UTI by dipstick, enhanced urinalysis (pyuria and Gram stain) and by their various combination ,compared against urine culture which was the gold standard method of diagnosing UTI. This study concluded by saying “no test can screen for urinary tract infection in young children”. The urine dipstick + culture tests appear to be the most economic method of screening and helps in initiating presumptive treatment for UTI in febrile children in the Emergency department. In children who were particularly at high risk for UTI or its complication, they suggest to

consider us for the enhanced urinalysis to identify more infants with possible UTI and to begin early presumptive treatment [19].

- Marc H.G. et al:

In this meta- analysis after reviewing twenty six articles ,which are all reporting the efficiency of urine dipstick analysis (leukocyte esterase and/or nitrite), Gram stain, or microscopic analysis of centrifuged or un centrifuged urine in the diagnosis of UTI in children <12 years of age concluded by saying both Gram stain and dipstick tests for nitrite and LE perform equally in identifying urinary tract infection in children and are higher in prediction than microscopic urinalysis for pyuria [10].

- Hiraoka M.H. et al:

For identifying of urinary tract infection several quantitative methods bacteriological examination of urine for bacteriuria and pyuria on a cell counting-chamber had been found useful. However, no one technique has become popular or commonly used because of laborious procedures associated with the concerned method.

This study has investigated the effectiveness of microscopic examination of unspun urine on single use and throw cell counting-chambers in eighty nine samples. The cell counting-chamber method diagnosed bacteriuria rightly in 21/ 23 urine samples diagnosed as significant bacteriuria (sensitivity = 91%) and also gave us correct diagnosis of 64/ 66 urine samples with non-significant bacteriuria

(specificity = 98%). Nineteen of the twenty three urine specimens with significant bacteriuria also had pyuria. Concluded by saying that urine microscopy by using single use and throw cell counting -chambers was economic and reliable and had hundred percent positive predictive value in diagnosing culture positive UTI [24].

STUDY JUSTIFICATION

UTI, though it is a common cause for fever in young children, clinical findings suggestive of UTI are often subtle and non specific, with fever often the only manifestation. it is important to identify low risk and high risk group among the UTI suspects, which is a difficult task and this delineation helps in stopping us from doing unnecessary urine cultures.

Several rapid screening tools were used commonly to make a provisionary diagnosis of UTI, among those studies many were conducted in adult patients. Studies done in the paediatric age group shows varying results. Therefore we were left with little information regarding the right choice of diagnostic tool for identifying UTI in children.

Coming to our study, from previous experience Gram stain of unspun urine for bacteria proved to be better predictor of culture positive UTI. Combination of cell count in unspun urine in neubauer chamber and Gram stain for bacteria, named as “Enhanced urinalysis” had been studied mostly in children aged less than two years and also not much of Indian studies. So we decided upon doing a screening tests including enhanced and routine (standard) urine analysis along with the urine culture in children aged more than one month up to twelve years presenting with manifestations suggestive of urinary tract infections in our hospital.

The enhanced urinalysis differs from the standard test in two significant ways. While the standard urinalysis depends on centrifuged urine, the enhanced urinalysis uses uncentrifuged urine.

Secondly, When an pyuria for enhanced urinalysis was performed, the urine was placed into a neubauer chamber or hemocytometer without centrifugation, and the results are reported as the number of cells and in gram staining by standard method of staining ,bacteria is identified as per fields of oil immersion.

This method appreciably higher to the routine urinalysis , the answer is “centrifuge”. The standard urinalysis results can in literature be affected by the process of preparing it for analysis.

Both the amount of time that the sample centrifuged and the amount of liquid added to re-suspend the urine can influence the results theoretically. Because the enhanced urinalysis does not require any centrifugation, this variability is removed.

Comparing Standard UA and Enhanced UA

STANDARD URINALYSIS	ENHANCED URINALYSIS
Pyuria: Unstained specimens screened for pus cells on the centrifuged samples ,counting may be inaccurate due to the concentration and resuspension of solid elements attained by centrifugation.	The neubauer chamber or hemocytometer allows counting of a fixed volume of uncentrifuged urine and facilitates accurate counting by providing a small, marked visual field and uniform illumination.
Bacteriuria by microscopy: Unstained centrifuged samples are looked for bacteria under microscope, where reported as none, trace, moderate and plenty of bacteria per high power field (hpf).	Greater accuracy of microscopic urinalysis for predicting positive urine cultures has been achieved by standardizing gram staining method. Reports will be available on the same day.

OBJECTIVES OF THE STUDY

The main objective of my study is to compare enhanced urinalysis versus routine urinalysis with the positive urine culture which is the gold standard for diagnosing UTI.

The positive predictive value of the enhanced urinalysis is assessed in diagnosing urinary tract infection by comparing against positive urine culture.

To assess the usefulness of this urinalysis either as a separate test or in combination with other tests in screening urinary tract infection, as a best predictor of culture positive urinary tract infection.

MATERIALS AND METHODS

STUDY DESIGN

Type of study:

Descriptive study

Setting :

Outpatient department and medical wards of Institute of child health and hospital for children.

Study Period:

6 months (September 2015 to February 2016).

Study Population:

Children in the age group of 1 month to 12 years in the above mentioned study period who met the following inclusion criteria.

Sample size

Since the test was proposed to be used as a screening tool considering the sensitivity of the test reported in previous representative study as 85%[14] with the allowable error of 5% at 95% confidence interval, sample size of 204 was arrived at using the formula

$$\frac{Z\left(1-\frac{\alpha}{2}\right)pq}{d^2}$$

Where

Z - Denotes confidence interval

p - sensitivity in previous study

q - (1-p)

d - Allowable error

INCLUSION CRITERIA

All children presented with symptoms and signs suggestive of UTI (as enumerated in case proforma) between the age group more than one month to 12 years attending OPD and admitted in the ward were enrolled, especially Infants and young children attending OPD or hospitalized in ICH with 'fever without focus" for more than three days and in older children with features suggestive of UTI such as urgency , dysuria , increased frequency, with or without fever were included.

EXCLUSION CRITERIA:

1. Children aged below one month and above 12 years were excluded.
2. Immunosuppressed children.
3. Children already on treatment either in the form of oral or IV antibiotics.

Data collection

Clinical and biological data were prospectively reported based on the proforma designed for the study. This was used as the primary data for further analysis and interpretation of results. The proforma used for data collection is enclosed in annexure.

Statistical analysis.

Sensitivity, specificity, and positive and negative predictive values were calculated by following formulae:

i. sensitivity = TP/(TP + FN), the probability that the enhanced urinalysis will be positive in patients with urinary infections (positive culture),

ii. specificity = TN/(TN +FP), the probability that the enhanced urinalysis will be negative in patients without urinary infections (negative culture),

iii. PPV(positive predictive value)= TP/(TP + FP), the probability that a urinary infection is present when the enhanced urinalysis is positive, and

iv. NPV(negative predictive value) =TN/(TN + FN), the probability that a urinary infection is not Present when the enhanced urinalysis is negative,

Where TP stands for true positive (enhanced and cultures both positive),FP for false positive (positive enhanced urinalysis and negative culture), TN for true negative (enhanced urinalysis and culture both negative), and FN for false negative (enhanced urinalysis negative and culture positive).

Sample collection methods:

In toilet untrained, by catheterization (<2 years)

In toilet trained, by MSCC urine

The samples were sent for analysis immediately. Urinalysis and cultures were done within one hour duration. Else the samples were stored in refrigerator for analysis for upto 24 hours. It was demonstrated that the cellularity (pyuria) and bacteriuria of urine specimens stored under refrigeration of 4^0C did not change (except erythrocytes), confirming the importance of this method in preserving urine specimen[16].

CATHETERIZATION:

In subjects aged <2 years and those who were not toilet trained (both the sexes) were catheterized for sampling under aseptic precaution after obtaining written consent from the parents.

The procedure was done with age appropriate catheters size, after ruling out any anatomical abnormalities contraindicated for catheterization and bleeding manifestations. The catheter was removed immediately after sampling**.**

MIDSTREAM CLEAN CATCH URINE (MSCCU)

Collection instruction given to parents in their own language for MSCCU.

For male children;

1. Hands wash with soap and water.
2. Pull back foreskin (Forced retraction of the prepuce was not adviced)
3. Completely wash the genitalia with soap and water. No need for antiseptic washes.
4. Start to urinate directly into the toilet.
5. Stop and position the container then begin urinating into the container. Do not touch the container to the genital area.
6. Fill the container until half of the volume is reached.

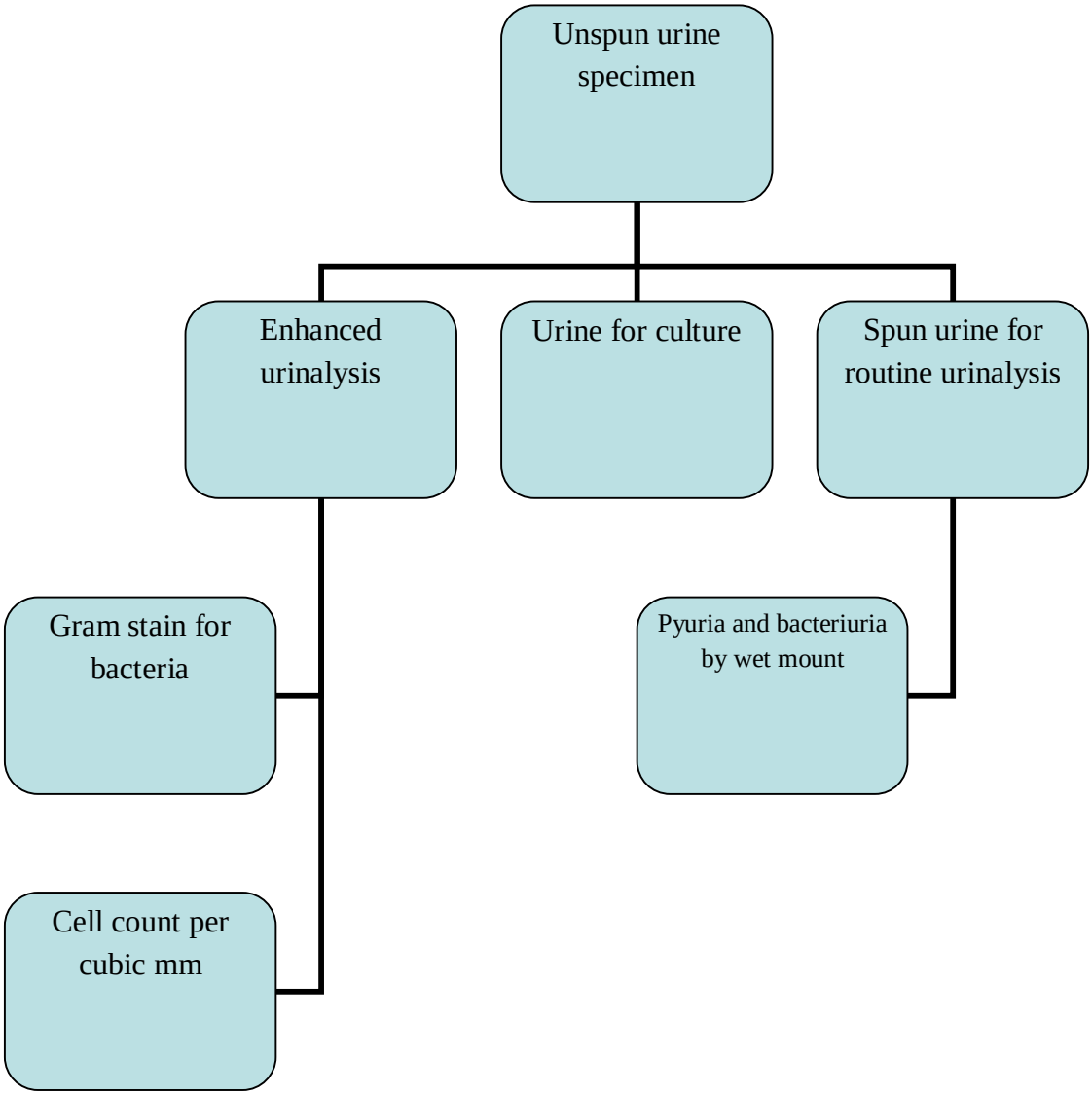
For female children;

1. Hands wash with soap and water.
2. Holding the labia apart wash the entire area with soap and water. Wipe from front to back.
3. Continue to spread the labia and start to urinate directly into the toilet.
4. Stop and position the container then begin urinating into the container. Do not touch the container to the genital area.
5. Fill the container until half of the volume is reached.

STUDY MANOEUVRE

According to the study protocol 205 subjects were recruited into this study as per inclusion criteria. Out of 205 subjects 89 were males and 116 were females.

The urine samples were collected and analysed as shown in the flowchart



Gram staining in Enhanced Urinalysis

Gram stains were prepared by using micropipette one drop (50µl) of uncentrifuged urine specimen on a sterile glass slide within a marked area of approximately 15mm in diameter, dried in air .After air drying, the smears were heat fixed passing slides two or three times through the flame. Then smear was placed on the staining tray. Then the slide was gently flooded with crystal violet and allowed to stand for 1 minute. The slide was slightly tilted and washed with tap water using wash bottle. Again the slide was poured with Gram's iodine and allowed to stand for one minute. The slide was slightly tilted and washed with tap water using wash bottle.

When the smear appeared as a purple round, the slide was decolorized using 95% ethyl alcohol or acetone by applying the alcohol drop by drop for 5 to 10 seconds. Then the slide was washed with tap water. The slide was then gently poured with safranin and allowed to stand for 45 seconds. The slide was slightly tilted and rinsed with tap water using wash bottle. The the slide was dried with bibulous paper. The smear was studied using a light-microscope under oil immersion.

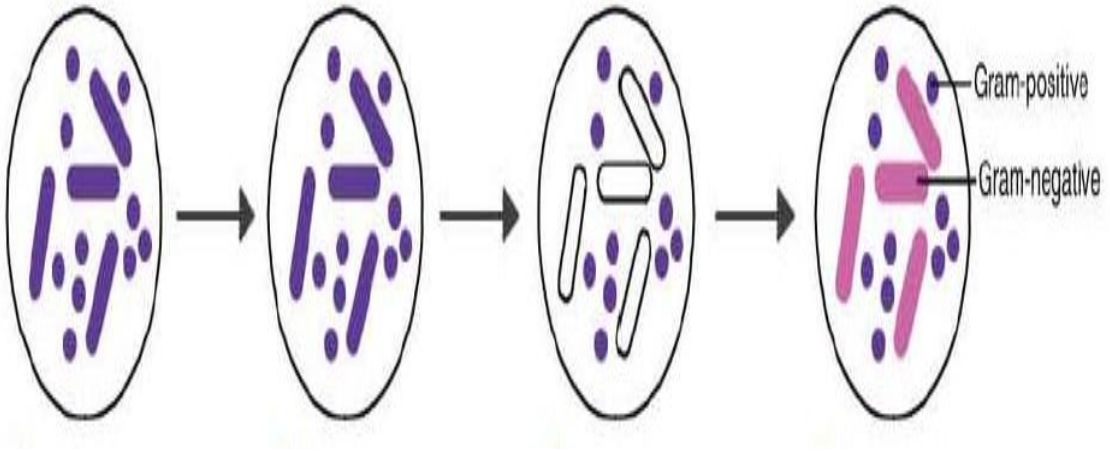


Figure 4-Gram stain stages

In enhanced urinalysis, bacteriuria was noted as positive ,when any bacteria was seen per 10 oil immersion fields [21,19,14]on a Gram stained smear. Gram staining was done by technicians in microbiology lab.

Pyuria in Enhanced Urinalysis.

This was done in neubauer or blood cell counting hemocytometer reusuable done in pathology laboratory. The rectangular shaped thickened glass slide had two chambers in the middle upper and lower each will have multiple squares along with the loading channel adjacently.The procedure was performed by loading uncentrifuged urine specimen by using micropipette(10µl) to the Neubauer chamber or haemocytometer, with the cover slip placed over the counting chamber.

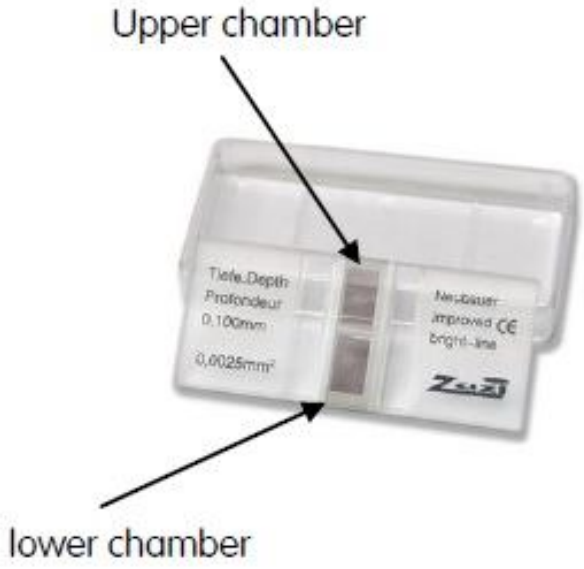


Figure 5 : Neubauer chamber

The micropipette must always kept held in vertical position keeping tip close to the glass cover edge ,which allows uniform filling of the chamber through capillary action[21].

Figure 6 : Loading method

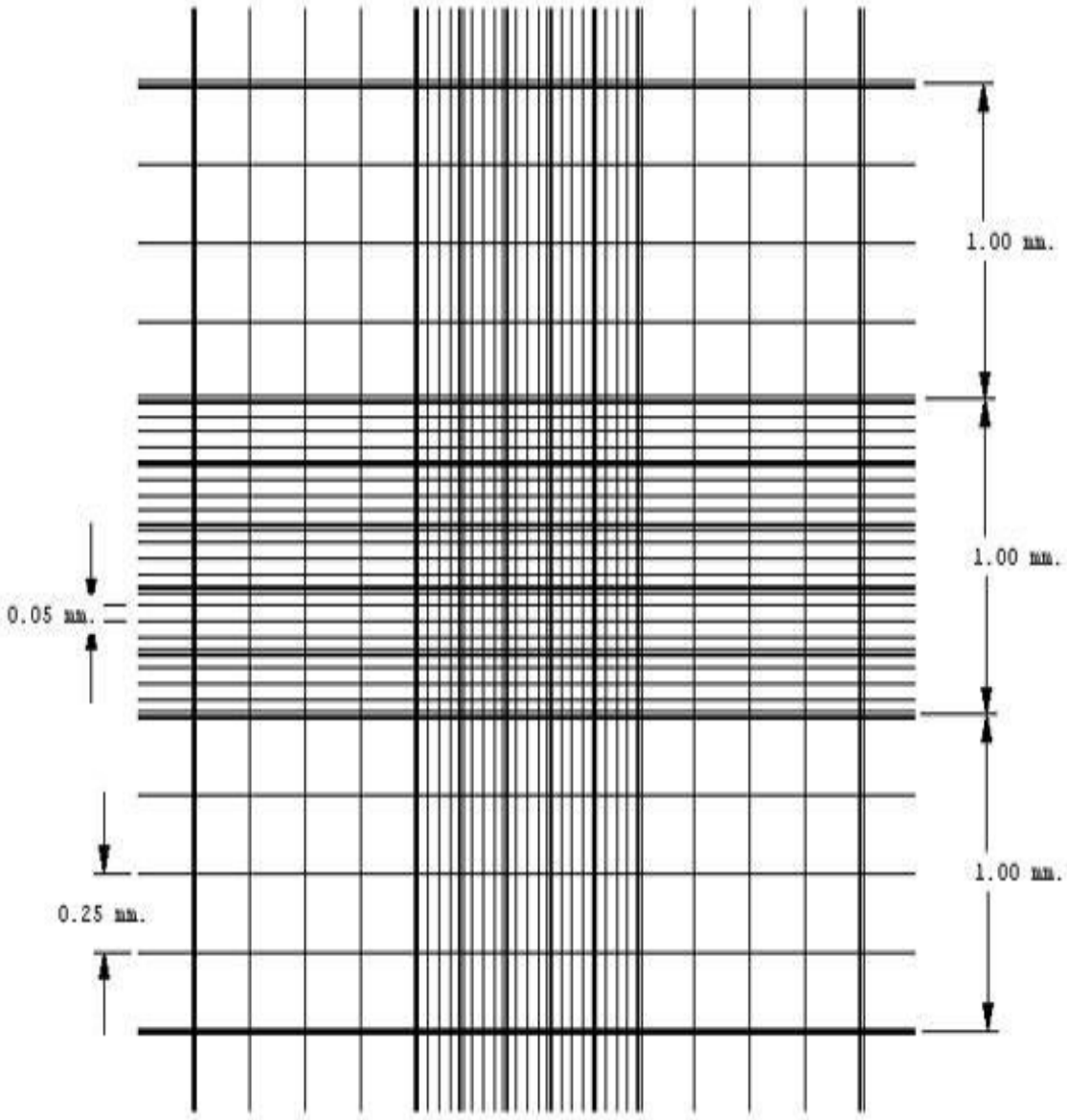


Figure 7 : Neubauer-improved chamber counting grid detail

By placing the neubauer chamber on the microscope stage ,under magnification five squares from the chamber were counted . Squares placed at the corners were commonly used for WBC counting, since their concentration was lower than RBC.

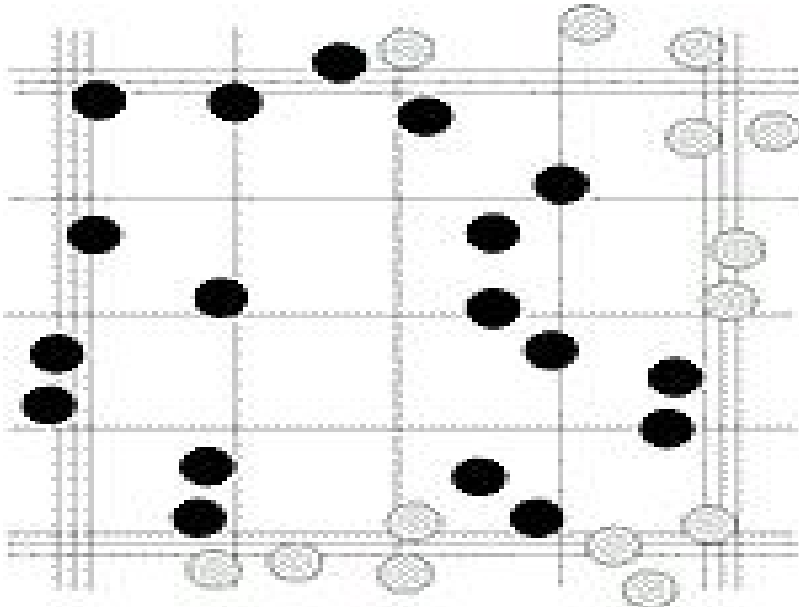


Figure 8 Method of counting in Neubauer chamber big square.

"Cells touching the upper and left limits are counted, unlike cells touching the lower and right limits which are not taken into account" as in depicted by shaded dots in fig.4 we followed this protocols for counting the cells in the each square.

In our study pyuria was taken as positive when = or >10 WBC'S per cubic millimetre are noted.

Enhanced urinalysis was documented as positive when both the pyuria and bacteriuria was found to be positive.

STANDARD (ROUTINE) URINALYSIS:

Pyuria

For the pyuria in routine(standard) urinalysis, specimens greater than 1 ml were centrifuged at 2000 rpm for 10 minutes, and those with less than 1 ml were analyzed without centrifugation. Unstained specimens were examined microscopically for pyuria (reported as number of WBCs per hpf).Pyuria was defined as at least 5 WBCs per hpf.

Bacteriuria by microscopy

In routine urinalysis for bacteriuria after centrifugation sample was placed over plain glass slide diluted in certain cases and observed for organisms under high power, reported as none, trace, light, moderate, or heavy amounts of bacteria per hpf. Bacteriuria defined as positive when the presence of any bacteria per hpf. At least ten hpf was examined before reporting it as negative. Both the pyuria and bacteriuria are positive samples are documented as routine urinalysis positive.

URINE FOR CULTURE:

Urine cultures by quantitative methods and Gram stain were performed in the hospital microbiology laboratory. Urine received in sterile container was inoculated onto blood and MacConkey agar plates with a 0.01 mL calibrated loop, incubated at 35°C, and examined daily for growth for 2 days. Then enhanced urinalysis and routine urinalysis were compared with the culture, the gold standard method for confirmation of UTI[(14)].

OBSERVATIONS

Table-5 : GENDER WISE FREQUENCY DISTRIBUTION

SEX	NO OF PATIENTS	PERCENTAGE (%)
MALE	89	43.4
FEMALE	116	56.6
TOTAL	205	100.0

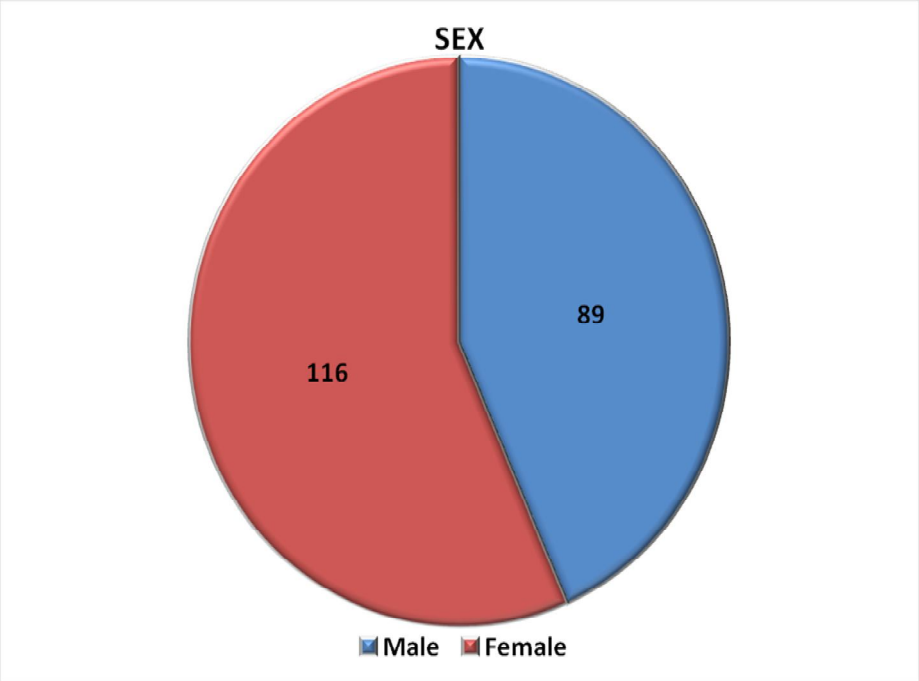


Figure 9

This above diagrams shows frequency of gender distribution among the 205 subjects male children -89, and female children-116

Table 6 : AGE WISE DISTRIBUTION

AGE	NO OF PATIENTS	PERCENTAGE (%)
≤1 YR	26	12.7
1 - 5 YRS	90	43.9
>5 YRS	89	43.4
TOTAL	205	100.0

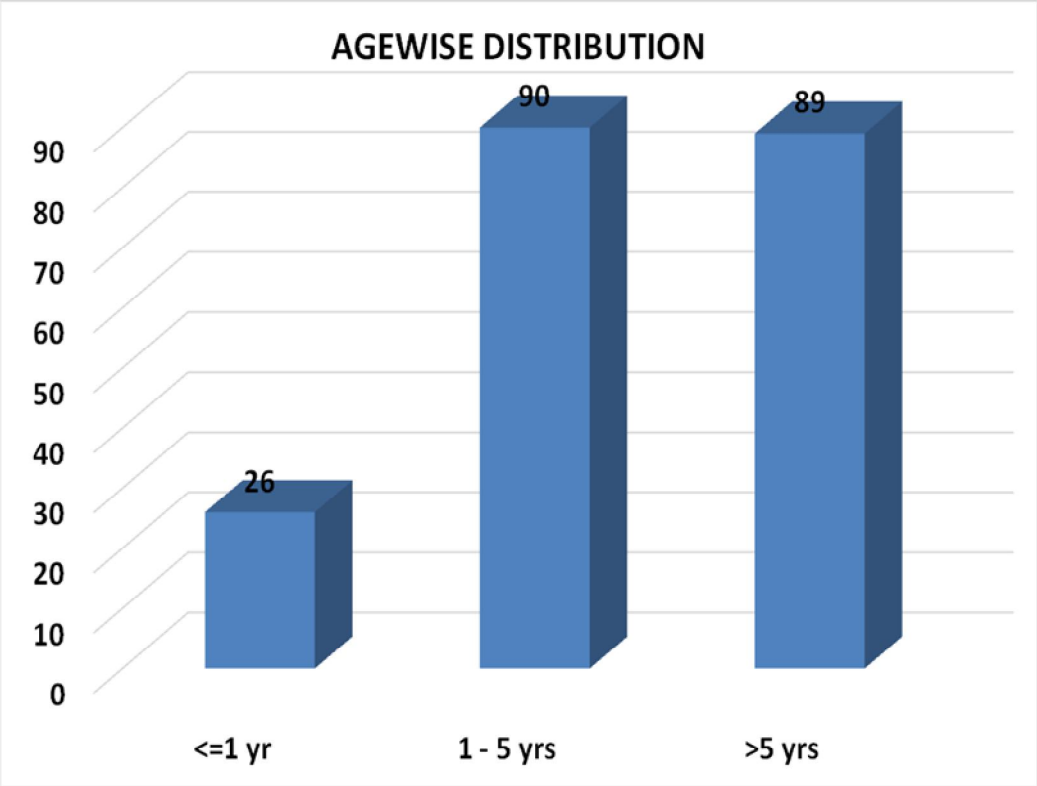


Figure 10

This table and graph shows the age wise distribution 205 subjects. The children were grouped into three categories such as <1 year(26),1-5 years (90) and >5 years (89). Age groups of 1 to 5 yrs and above 5 years were observed almost equal in frequency distribution.

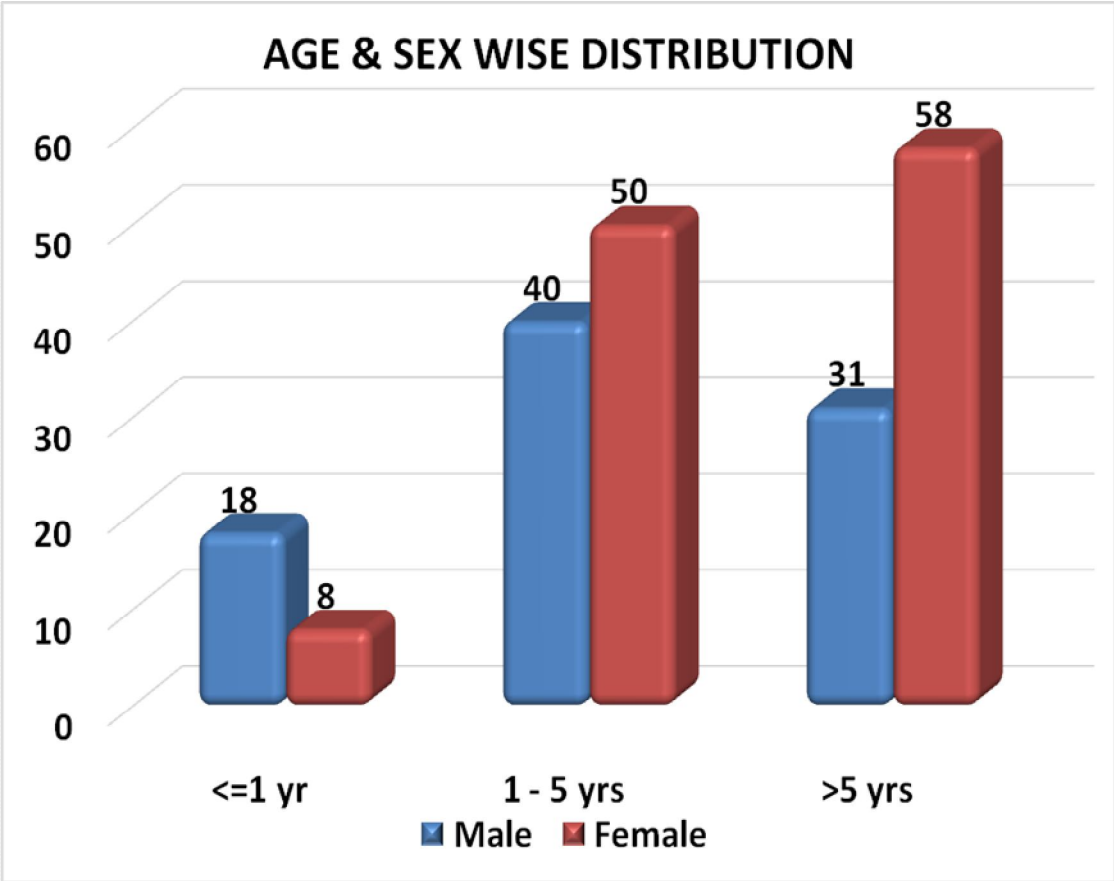


Figure 11

This graph shows age wise gender distribution in enrolled subjects ,showed female preponderance among 1-5 yr and >5 yrs age groups with 50/90 and 58/89 respectively with male dominance seen in less than one year age group. The mean age of presentation for both the gender was three year four months.

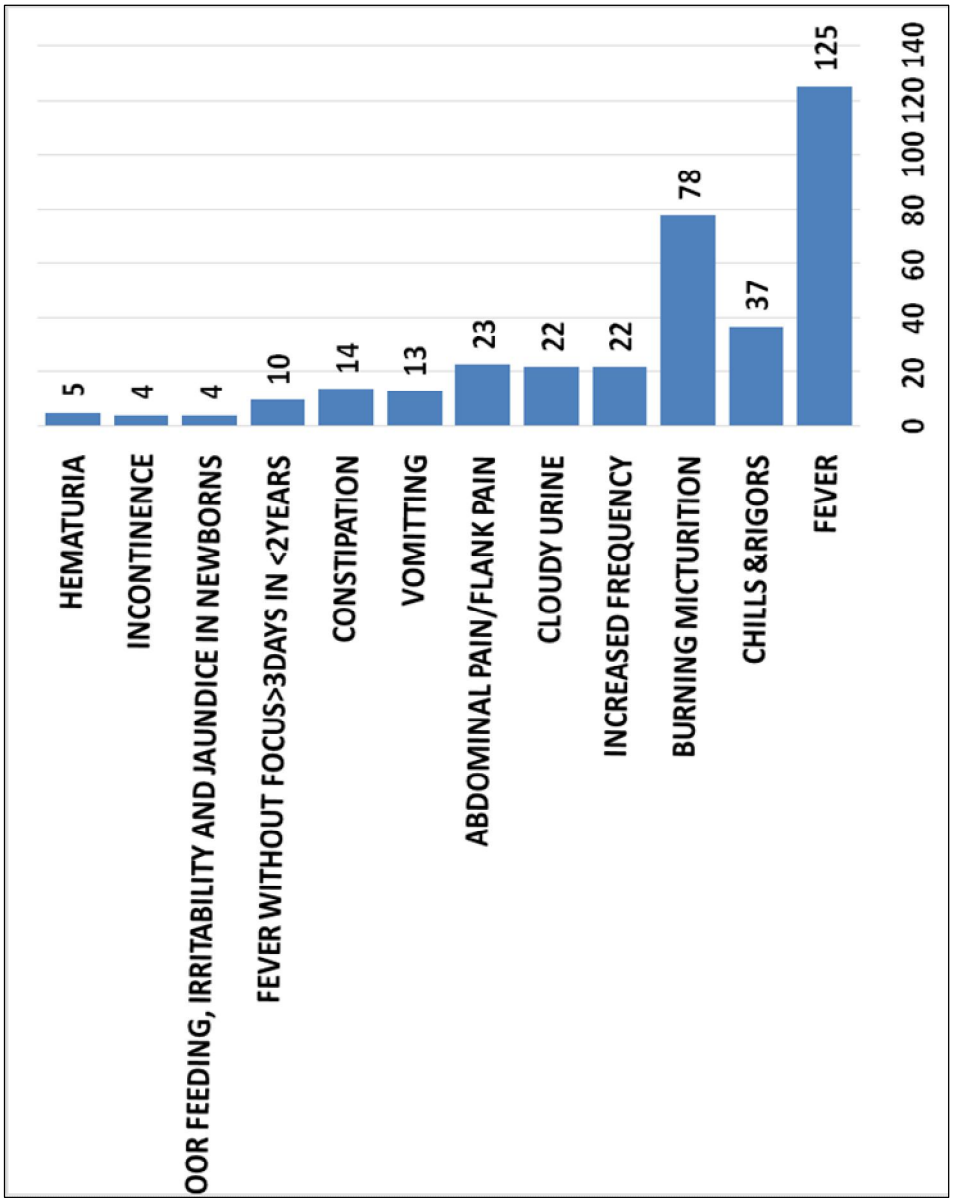


Figure 12

This picture shows the frequency distribution of symptoms among the enrolled children. Fever had been reported commonly in most of the patients, followed by burning micturition, chills & rigor, and complaints increased frequency, cloudy urine equally reported.

Table 7 : Tabular column showing the symptoms of UTI and their percentage reported among the included children in our study

SYMPTOMS	NO OF PATIENTS	PERCENTAGE (%)
FEVER	125	61.0
CHILLS &RIGORS	37	18.0
BURNING MICTURITION	78	38.0
INCREASED FREQUENCY	22	10.7
CLOUDY URINE	22	10.7
ABDOMINAL PAIN/FLANK PAIN	23	11.2
VOMITTING	13	6.3
CONSTIPATION	14	6.8
FEVER WITHOUT FOCUS>3DAYS IN <2YRS	10	4.9

Table 8

SIGNS	NO OF PATIENTS	PERCENTAGE (%)
PHIMOSIS	18	8.8
ANATOMICAL ABNORMALITIES IN GENITOURINARY TRACT	8	3.9
RENAL ANGLE TENDERNESS	6	2.9
SUPRA PUBIC TENDERNESS	14	6.8
NIL	159	77.6
TOTAL	205	100.0

This Tabular column shows the distribution of signs suggestive of UTI in 205 subjects. Commonly observed associated sign was phimosis in 18 male children, supra pubic tenderness in 14 cases, anatomical abnormality in 8, and renal angle tenderness in 6 in both the gender.

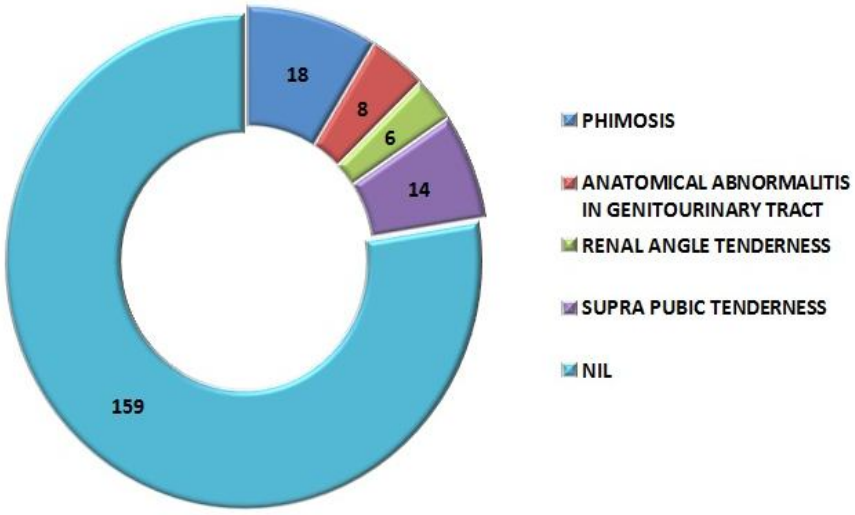


Figure 13

This pie chart shows the signs presented in enrolled 205 children our study.

Table 9

URINE SAMPLE	NO OF PATIENTS	PERCENTAGE (%)
CATHETERIZED	56	27.3
MID STREAM CLEAN CATCH URINE	149	72.7
TOTAL	**205**	**100.0**

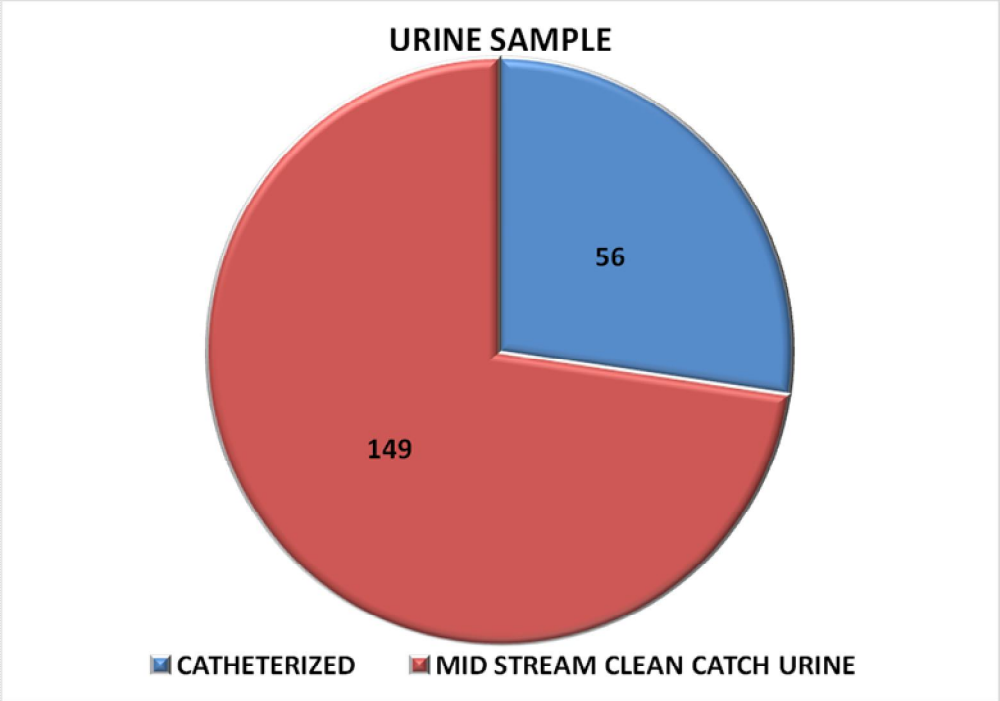


Figure 14

The tabular column and pie chart shows that sampling was done predominantly by MSCCU technique which in turn shows that more children in this study were above 2 years of age.

Table 10

CULTURE	NO OF PATIENTS	PERCENTAGE (%)
GROWTH	57	27.8
NO GROWTH	148	72.2
TOTAL	205	100.0

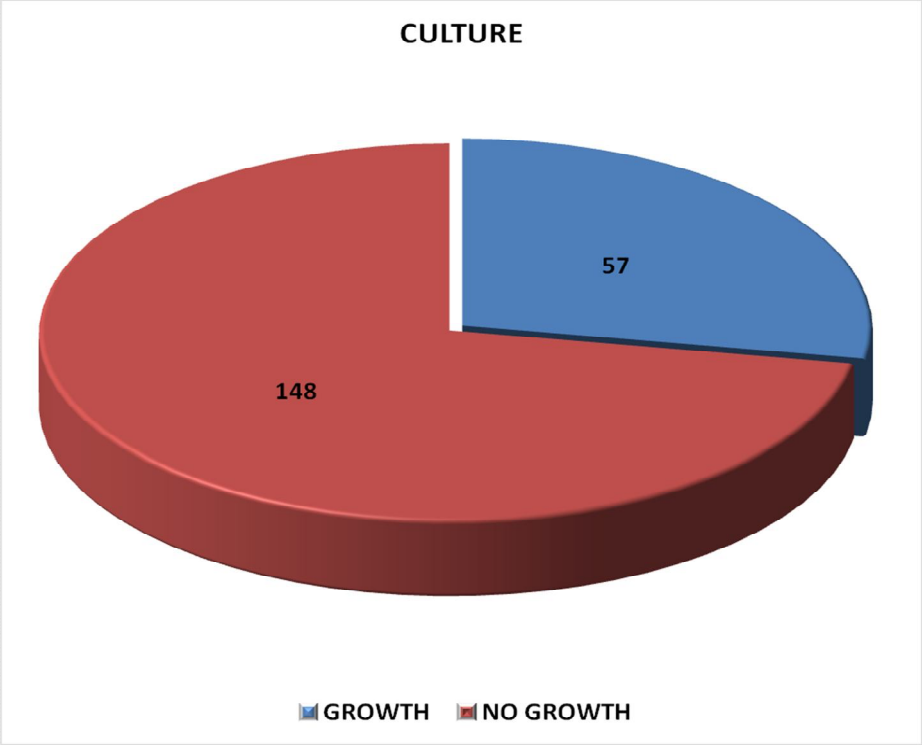


Figure 15

Above data observed in our study ,out of 205 subjects 57 showed significant culture positivity, 148 no-growth(this includes insignificant growth and contaminant growth).

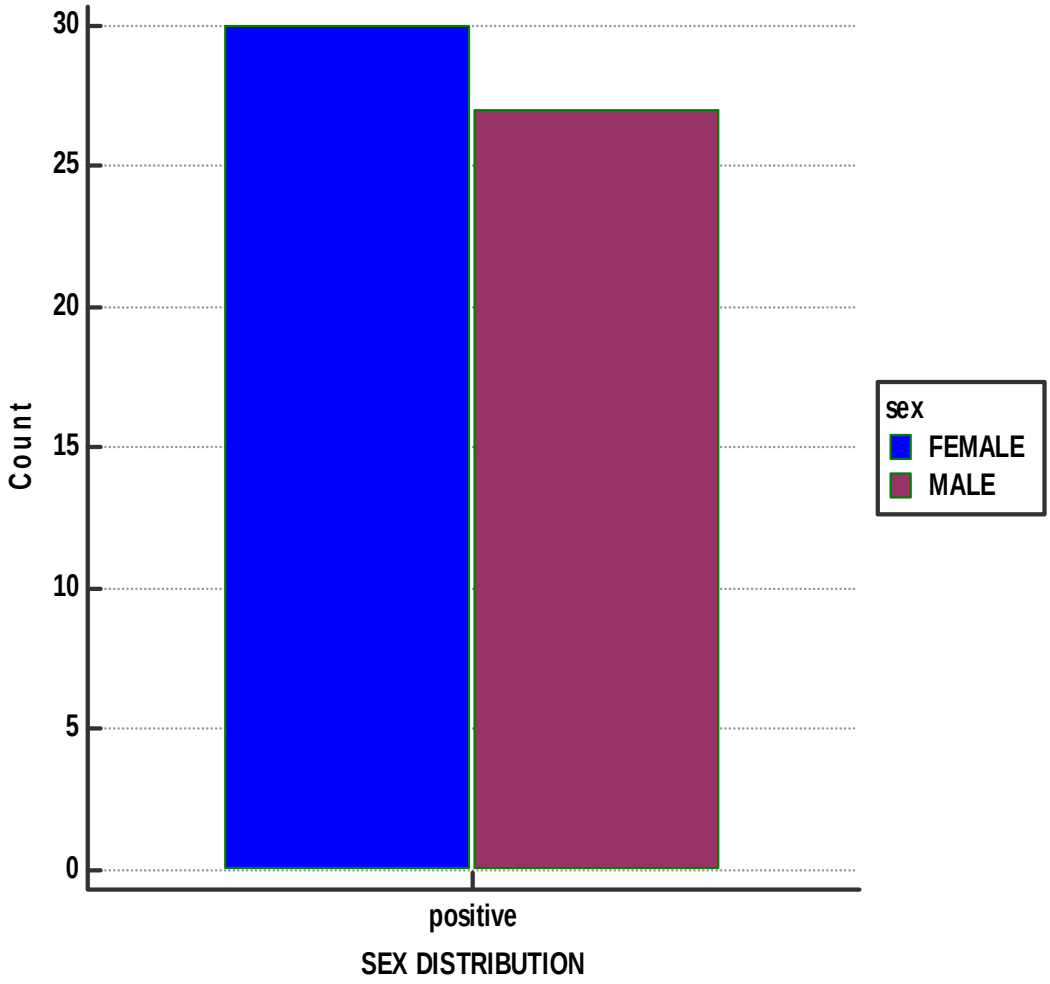


Figure 16

Sex distribution among the culture positive cases which are 30/116 female children and 27/89 male children.

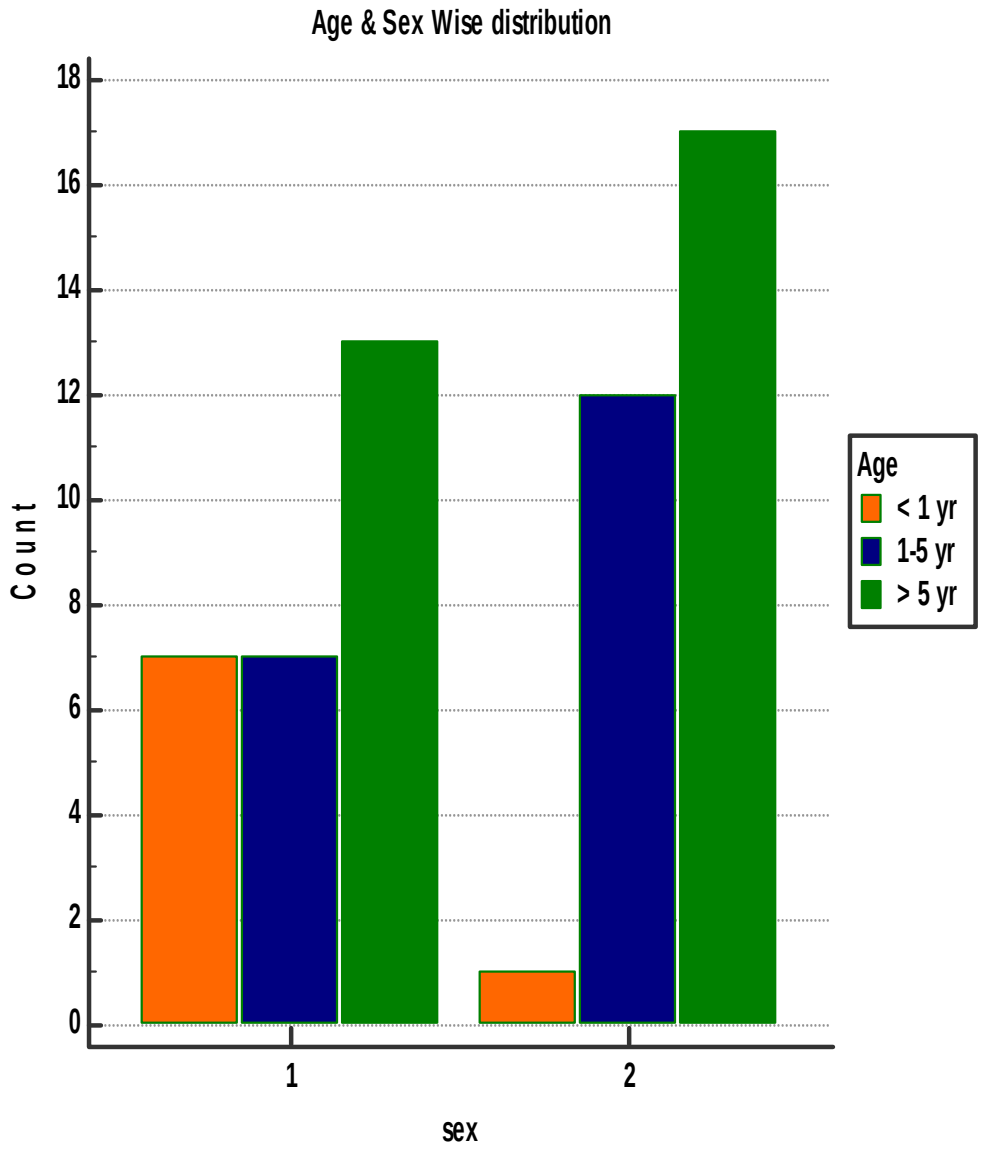


Figure 17

This bar diagram shows the age and sex wise distribution of 57 culture positive children of both male and female children respectively (male=1 and female=2).

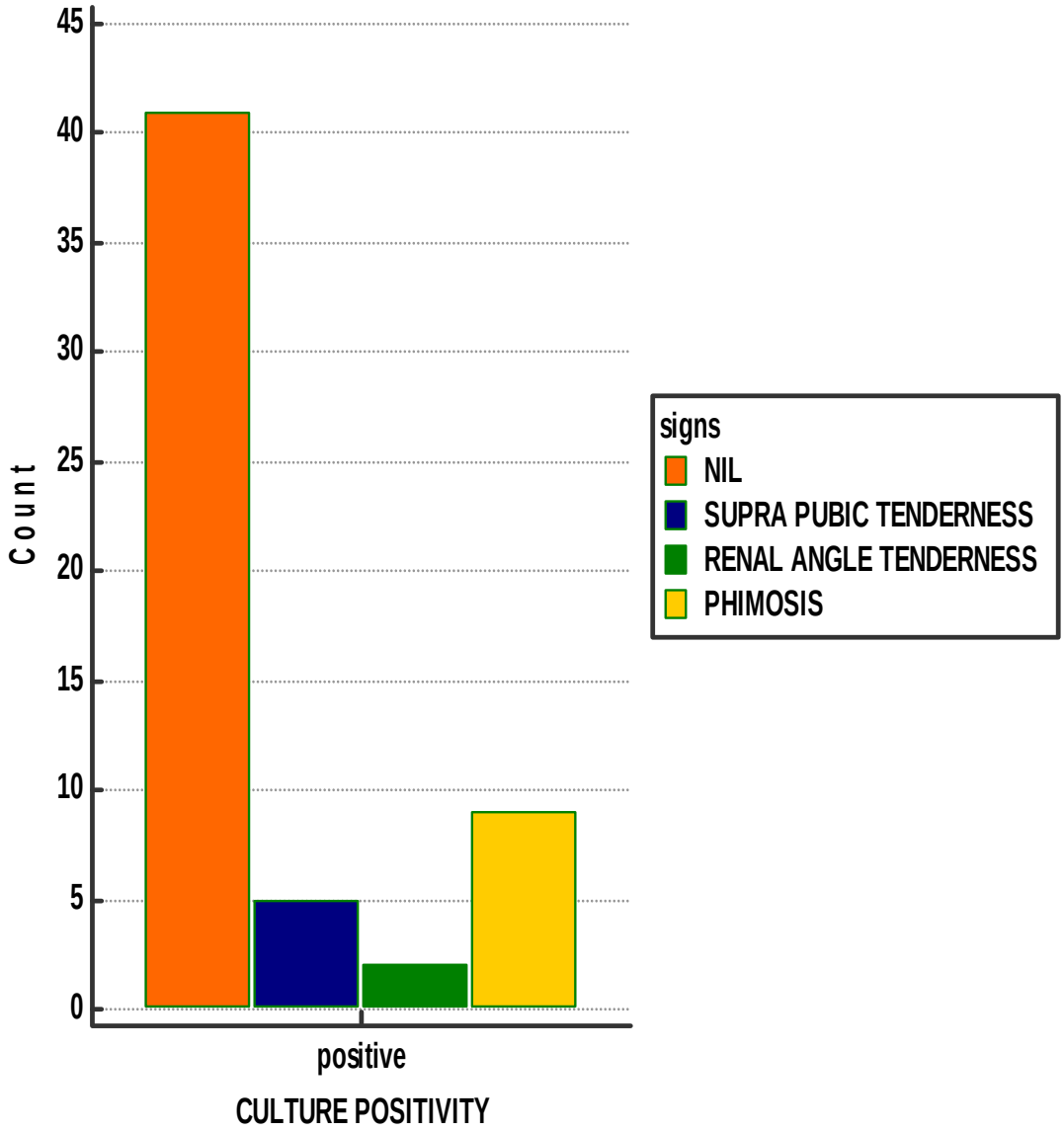


Figure 18

This bar diagram shows the frequency distribution of commonest three(phimosis, supra pubic tenderness and renal angle tenderness) signs associated with the positive urine culture.

Table 11

ORGANISMS	NO OF PATIENTS	PERCENTAGE (%)
E.COLI	24	42.1
KLEBSIELLA	10	17.5
PROTEUS	7	12.3
PSEUDOMONAS	8	14.0
STAPH AUREUS	3	5.3
ENTEROCOCCUS	3	5.3
CITROBACTER	2	3.5
TOTAL	**57**	**100.0**

This tabular column shows the prevalence of single type of organisms grown significantly in culture medium , observed in this study after culture reports.

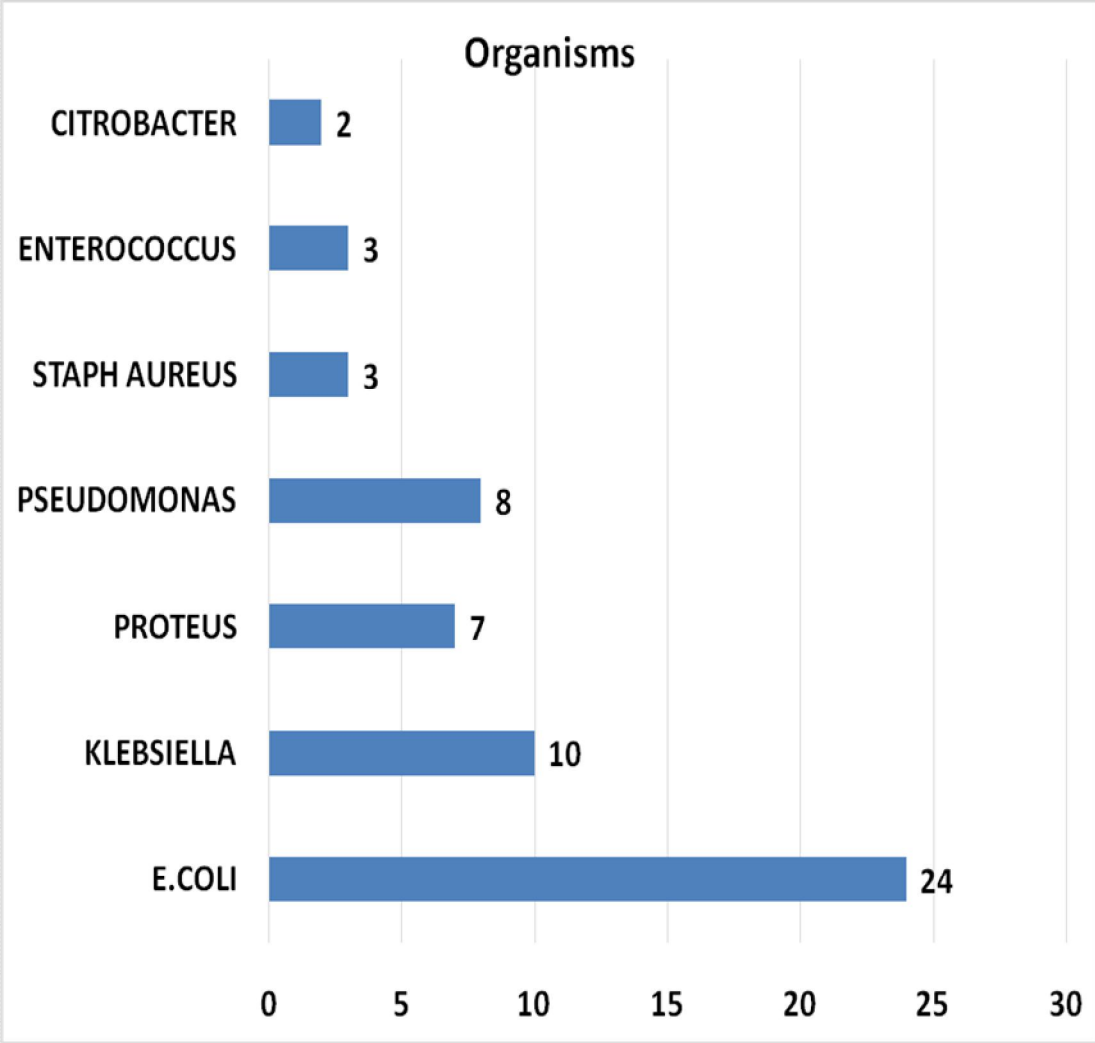


Figure 19

Picture depicting the frequency of each organisms among the culture positive children. With E.coli was reported the commonest among the grown organisms.

Table 12

CULTURE	ENHANCED URINALYSIS		TOTAL
	POSITIVE	NEGATIVE	
GROWTH	48	9	57
NO GROWTH	2	146	148
TOTAL	**50**	**155**	**205**

This tabular column shows the total enhanced urinalysis positivity(48) and negative(9) against the positive urine culture. It shows 2 cases shows positive for enhanced UA but no growth in culture.

Table 13

CULTURE	ENHANCED-PYURIA		TOTAL
	POSITIVE	NEGATIVE	
GROWTH	49	8	57
NO GROWTH	9	139	148
TOTAL	**58**	**147**	**205**

The pyuria by cell count chamber ,one of the component of enhanced UA reported to positive in 49/57 culture positive cases and 9/148 in negative culture cases.

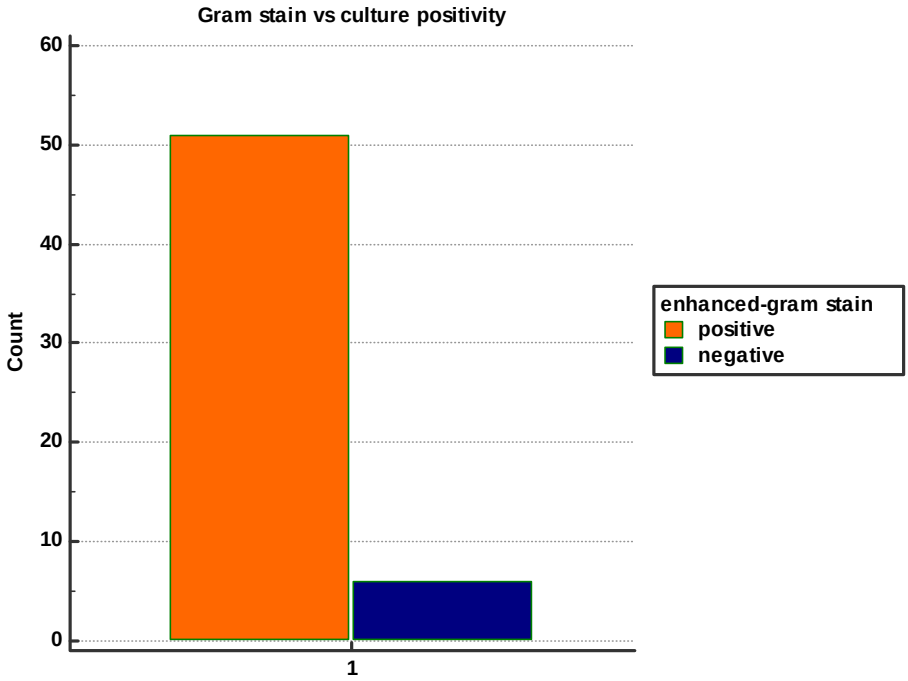


Figure 20

Table -14

CULTURE	ENHANCED-GRAM STAIN		TOTAL
	POSITIVE	NEGATIVE	
GROWTH	51	6	57
NO GROWTH	10	138	148
TOTAL	**61**	**144**	**205**

This bar diagram and tabular column shows the Gram stain positivity against culture positive was (51/57) and false negative for 6 cases .false positive for 10 cases with insignificant growth/ no-growth.

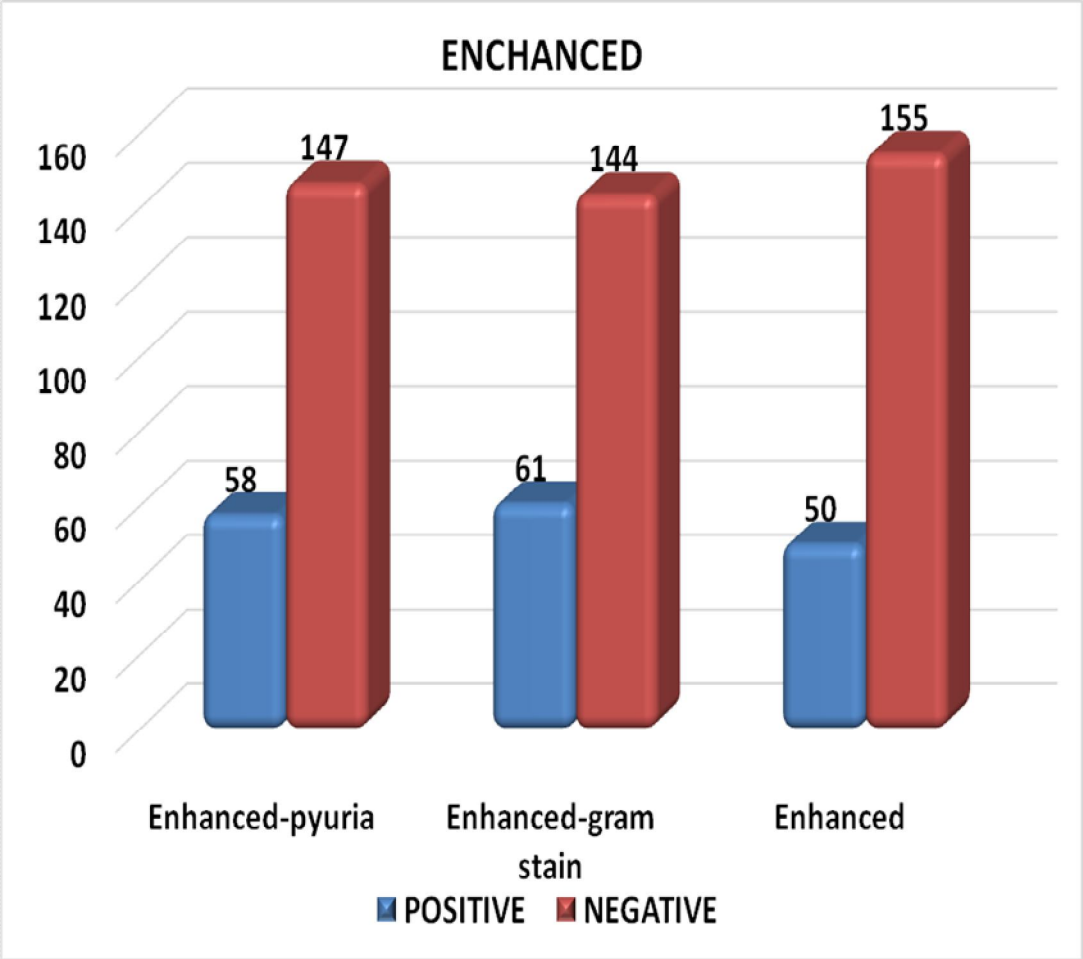


Figure 21

This bar diagram shows overall positive cases of enhanced urinalysis observed in this study(including growth and no-growth cases) with pyuria(58/147) ,gram stain (61/144)and combined(50/155).

Table 15

CULTURE	ROUTINE		TOTAL
	POSITIVE	NEGATIVE	
GROWTH	31	26	57
NO GROWTH	4	144	148
TOTAL	**35**	**170**	**205**

This table shows the observed values of positive routine urine analysis against the culture positive(31/57),and also 4 false positives cases.

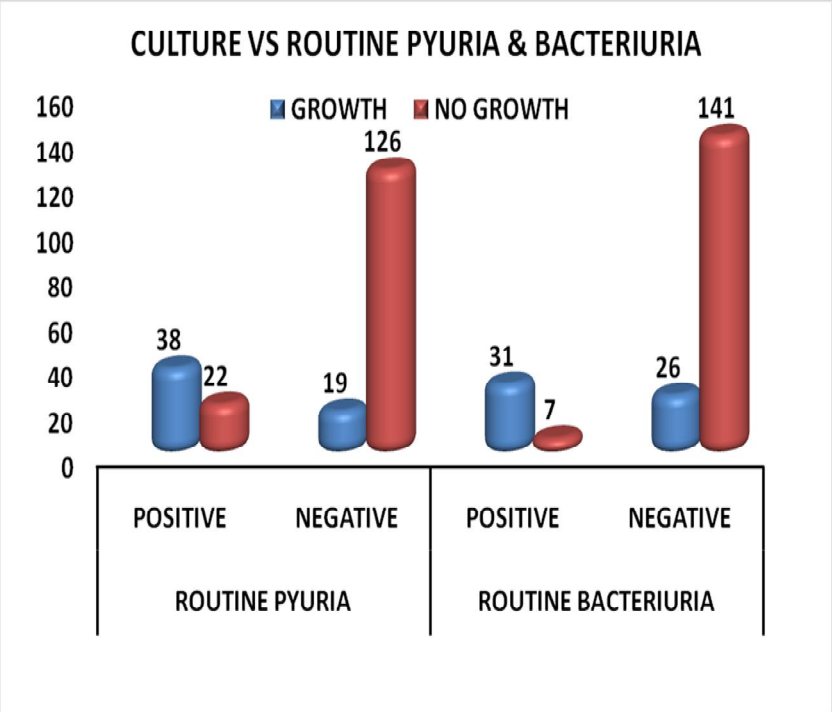


Figure 22

This pictures shows the positivity and negativity of routine urinalysis (pyuria and bacteriuria respectively among the study population with culture growth and no growth.

Table 16

DIAGNOSTICS£	ENCHANCED UA	ROUTINE UA
Sensitivity	84.2%(72.1%,92.5%)	54.4%(40.7%,67.6%)
Specificity	98.6%(95.2%,99.8%)	97.3%(93.2%,99.3%)
Roc Area	0.914(0.866,0.963)	0.758(0.692,0.825)
Likelihood Ratio (+)	62.3(15.7,248)	20.1(7.44,54.5)
Likelihood Ratio (-)	0.16(0.0879,0.292)	0.469(0.353,0.623)
Positive Predictive Value	96%(86.3%,99.5%)	88.6%(73.3%,96.8%)
Negative Predictive Value	94.2%(89.3%,97.3%)	84.7%(78.4%,89.8%)

£95% C.I given in parenthesis

RESULTS

We analyzed data using SPSS software and calculated senstivity, specificity, PPV(positive predictive value) and NPV(negative predictive value).we also generated ROC(receiver operating charesteric) curves for the both enhanced urinalysis and routine urine analysis**.**

In our study intially 212 subjects were included. Among them 7 were excluded due to non compliance with the method of urine sampling . Rest of the 205 were enrolled as study subjects, among those 116 were female children and 89 were male children**.** Demogragphic information of the study population showed (more than one month to twelve years) a median age of three years four months and the study population includes

<1 year -12.7 %, 69.2% were male infant.

1-5 year -43.9%, 55.5% were female children.

>5 years- 43.4%, among them 65.1 % were female children.

Two methods of sampling were done accordingly to age and toilet - training, catheterized (27.3%) and MSCCU (72.7%)collected among study population. Accordingly, 205 samples were lab processed for enhanced urinalysis, routine analysis and for culture as per study protocol.

Fever (61%) was the most common complaint among the subjects in all age groups followed by burning micturition (dysuria), chills & rigor and the rest. Commonest signs among male children noted were phimosis (18/89). Next to this was suprapubic tenderness and renal angle tenderness observed in both the gender.

From the data analysis prevalence of UTI in study population was 27.8% that was out of 205 subjects 57 were culture positive with single micro organism as per expected CFU /ml in both type of collections(catheterized sample->$5X10^4$CFU/ml and MSCC urine->10^5CFU/ml). 5 samples which showed organisms less than the expected level(<10^2CFU/ml) in both catheterized(3) and MSCCU(2), and 4 cases showing more than one organisms in view of contaminants(4) were taken as “no- growth”. Among the 57 positive cultures 30 female children and 27 male children were reported, if we go age wise prevalence in study population, it was 8(<1 year age), 19(1-5 year) and 30(>5 year age).

MICROBIOLOGICAL PROFILE:

The profile of micro organisms among the culture positive samples are shown below

I. Gram negative- bacilli including E.coli(24), klebsiella -pnemoniae(10), pseudomonas aeruginosa(8), proteus mirabilis(7), and citrobacter(2).
II. Gram positive- cocci including staphylococcus aureus(3), and enterococcus sp(3).

Here the sensitivity, specificity, PPV and NPV derived with 95% C.I., using Receiver-operating characteristic (ROC) plots, (see the table 16), “which provide a pure index of accuracy by demonstrating the limits of a test's ability to discriminate between alternative states of health over the complete spectrum of operating conditions”. The observed values showed that enhanced urinalysis (84.2%) was highly sensitive than the routine urine analysis(54.4%).the

specificity was more or less equal for both the enhanced urinalysis(98.6%) and routine urine analysis(97.3%).observed positive predictive value (96%)and negative predictive value(94.2%) for enhanced urinalysis was high among the study population when compared to routine urinalysis (88.6% and 84.7% respectively).

In our study when Gram stain of uncentrifuged alone was compared with positive urine culture showed 51/57 culture positivity, 10 false positives and 6 false negatives ,seeking its statistical values which were sensitivity 89.5%, specificity 93.2%, PPV 83.6% and NPV 95.8%. all were significantly higher than the enhanced urinalysis(combined pyuria and Gram stain) and routine urine analysis.

When pyuria in cell – counting chamber was considered for positivity against positive urine culture showed senstivity ,specificity,PPV and NPV as 86%,93.9%,84.5% and94.6% respectively.

DISCUSSION

UTI (cystitis, pyelonephritis, asymptomatic bacteriuria, and acute urethral syndrome), is one of the most common causes of illness in children. Most such infections were caused by a few genera of bacteria, and the presence of these microorganisms in the urine was known as bacteriuria. Quantitative urine culture was considered the standard procedure for adequate diagnosis of UTI. Urine cultures represent 40 %to 70% of the samples sent for examination to clinical-microbiology laboratories. Although the prevalence of urinary infections may vary in different patient populations, approximately 75% of urine cultures were negative .In an attempt to reduce the time expended in examining these negative cultures, several rapid methods have been developed for characterizing bacteriuria, including microscopic examination, chemical tests, and automated systems.

Microscopic examination of an uncentrifuged Gram-stained urine drop and pyuria by cell count chamber constitutes one of the best diagnostic methods for detecting significant bacteriuria, i.e., the presence of 10^5 or more microorganisms per ml of urine . Observation of one or more bacteria per oil immersion field correlates with 90% of cases of significant bacteriuria, thus indicating UTI. So we did a study combined of gram stain and pyuria by cell count chamber in uncentrifuged urine in children.

SYMPTOMS

Fever was common complaint among all the study population, noted to be the initial manifestation of UTI in younger children reported in Ami.P.Shah & Hoberman et al. A separate entity was created as 'fever without focus" with fever for >3 days to suspect UTI in less than 2 yrs age group as literature[1] shows it was the common presentation among them. From the data among the subjects of <2 years age , 10 showed the symptoms of 'fever without focus" with culture positivity in 6 cases. Among the commonly encountered combination of symptoms fever with dysuria and fever with chills & rigors were the common presentation turnred to be culture positives.

SIGNS:

Signs in suspect of UTI in children were sex and age specific. It also depends on the extent of the disease either involving lower urinary tract or upper urinary tract, or systemic involvement occurred. From the observation made in this study commonly appreciated signs in suspected UTI and culture positive UTI cases. Though signs enlisted were not specific for UTI or its presentation. Though phimosis was not the manifestation of the UTI, common association as per literature and was considered physiological till one and half years of age in male children certain groups were more prone for UTI. Next to this supra pubic tenderness was commonest(14) recorded in 10 female children and 4 male children. At last renal angle tenderness (6) noted, which might be the sign of pyelonephritis.

CULTURE POSITIVITY:

According to our study the prevalence of UTI was 27.8%, which was high among all our reference studies which had been done in children presenting to ED for any illness. In our study, this might be due to the fact that enrolment of study population made by symptoms /signs suggested of UTI. Age wise prevalence of culture positivity <1 yr-8/26(30.7%),1-5 yr - 19/90(21.1%) and, >5 yr 30/89(33.7%) this is consistent with the age wise prevalence among <2 year old children but for the rest of them ,not much of reference as many studies had been done in <2 year age groups [14,17,] except Arslan et al.

In female children prevalence is 30/116 (25.8%), <1 yr-1/8(12.5%), 1-5 yr-12/50(24%), and >5 yr -17/58(29.3%) if we go age wise in female children.

In male children overall prevalence was 27/89(30.3%),age wise shows <1 yr- 7/18(38.8%),1-5 yr-7/40(17.5%) and, >5 yr – 13/31(41.1%).

Among the positive cultures (57),if we split according to method of sampling, catheterized 16/57 and MSCCU 41/57, though the cut off value to label as culture positive varies for the above two methods of collection. In our study out 56 catheterized samples 16 was culture positive with values of $>5*10^4$ CFU/ml, here three samples showed less than this value excluded ($<4*10^4$CFU/ml). Coming to MSCCU samples 41 shows positive urine cultures with single urinary pathogens of significant values against 149 MSCCU samples. Two samples excluded showing the growth of contaminants. Many of

the insignificant bacteriuria cases might be due to partial treatment with short duration oral medication and poor compliance for continuation of antibiotics before hospitalisation. In approximately 96% of the positive cultures , the etiological infective agent was isolated in pure culture ,at a concentration of above guidance value.

ENHANCED UA VS CULTURE:

SENSITIVITY:

In our study the prevalence of UTI was 27.8 %.Out of the 205 children recruited into the study the sensitivity of enhanced UA to detect UTI is 84.2%, ranging between 72.1%-92.5%, with 95% confidence interval, this was similar to the range observed in many previous studies Alejandro Hoberman et al , shah et al and , especially those using enhanced urinalysis in detecting UTI .

About five studies so far reviewed[19,14,12,10], that too in age group of < 2 years predominantly among children presented in emergency department ,showed sensitivity ranging from 75%-95% except for Arslan et al where it shows sensitivity of only 42%, but it used centrifuged samples for enhanced urinalysis, and also comparable especially with the study Hoberman et al with sampling size of 212 culture positive among 4235 specimen shows 95% sensitivity, because our study have used the same definitions for Gram stain in finding bacteriuria and cell count for pyuria. In the study Kathy .N. shaw et al had showed varying two values of sensitivity 75% and 94% by keeping two different definitions (most sensitive and most specific) for pyuria and

bacteriuria. Above discussion shows significance of enhanced UA sensitivity(true positive) observed in our study.

TABLE 17

LITERATURES ON ENHANCED UA	SENSTIVITY	SPECIFICITY	PPV
Alejandro Hoberman et al, 1993 (698)	84.5%	99.7%	93.1%
Arslan et al ,2001(100)	42%	90%	90%
Hoberman et al ,1996(4253)	95%		85%
Kathy N. shaw et al *, 1998(3873)	75%,94%	84%,99%	13-80%
Shah et al ,2013(703)	83.6%		52.5%

***Used two definitions for UA**

SPECIFICITY:

In our study the Enhanced urinalysis showed specificity of 98.6%, in range of 95.2%-99.8%, with 95 % C.I, with false positivity seen in 2/148 samples. This was significant with all similar previous studies showing specificity of 84%- 99.7% given in the table above, showing this enhanced UA as a better in giving fewer false positives. Comparing with Hoberman & Reynolds et al and Hoberman et al using the same definitions showing specificity of 99.7%, shows our results were satistically significant.

PPV:

The positive predictive value(PPV) observed here in our study was 96%, ranging between 86.3%-99.5% ,with 95% C.I., was within the range observed

in all of the reviewed literatures, shows significance of the enhanced urinalysis in predicting the actual UTI(culture positivity).

NPV:

The negative predictive value (NPV) observed in our study for enhanced UA was 94.2% ,ranging from 89.3%-97.3% shows its better in keeping screening and prevent the unwanted urine culture. Kathy N. Shaw et al showed 99.3% NPV.

ROUTINE UA vs CULTURE:

From our study ,using routine urinalysis in screening UTI commonly used in practice shows reports of 31/57 in culture positivity, 4 false positivity, deriving sensitivity of 54.4% (40.7%-67.6%),specificity 97.3%(93.2%-99.3%),PPV of 88.6%(73.3%-96.8%) and, NPV of 84.7%(78.4%-89.8%), which was done in centrifuged urine specimen with 95%C.I., comparing with Kathy N, Shaw et al showed sensitivity ,specificity, and PPV as 83%, 97% and 16%, but it clubbed dipstick along with the routine urinalysis ,all cases have been initially screened for LE /nitrite positivity then subjected to routine urinalysis. In Hoberman et al values were as follows sensitivity- 65.6%, specificity-99.2%, PPV-80.8% and NPV-98.4%, more or less similar as observed in our study except for NPV which was low here.

Use of the enhanced UA to decide when to send a urine culture, or to start presumptive treatment would definitely eliminate the culturing of many samples, but it would be more tedious and may miss 8%-10% of children with UTI.

This study was done at tertiary care hospital, therefore, prevalence, predictive values of the tests cannot be generalized to other settings.

By keeping in mind that characteristics of a Good screening test should be Inexpensive, Easy to administer, Minimal discomfort, Reliable (consistent),and Valid (distinguishes diseased & non-diseased people)[2].,when enhanced UA considered ,it was little bit tedious , time consuming and performance oriented test with high specificity and better sensitivity than routine urinalysis in practice now.

GRAM STAIN vs CULTURE:

We chose to use uncentrifuged Gram –stained urine for examination, because from reviewing various literature ,this was considered the most easily performed ,least expensive and probably the most sensitive and reliable method for bacteriuria. As we go through similar studies in past, lack of standardization was evidenced ,in keeping different criteria for positivity, in relation to volume of urine used and, the number of microscopic fields to be examined. The choice of criteria here we chose from the representative study Alejandro Hoberman et al 1993.

Table 18

Reviewed literatures	Sensitivity%	Specificity%	PPV%	NPV%
Celso Luis et al	96	99.2	97.6	98.7
Kathy n Shaw et al*	79,82	87,98	15,49	
Geogry r Lockhart et al	94	92	53	
Shah et al	83.6		59.4	
Sathish et al	89	86	85.4	89.6
IN CENTRIFUGED SAMPLE				
Arslan et al	80	83	91	64
Mj Rodriguez et al	83	97	97	82

*used two different definitions.

Though our study did not examine the use of the Gram stain alone, many studies have extensively studied about the Gram stain of urine alone in predicting positive culture both in centrifuged and uncentrifuged urine.

Our study observation was consistent and comparable with reviewed literatures[8,9,12,22], which have used similar methods of Gram staining in children with sensitivity ranging 83.6%-96%, specificity 86%-99.2%, PPV ranging from 15%-99% and, NPV 64%-98.7%, with the exception of Arslan et al and

Mj Rodriguez et al which showed low sensitivity and specificity which used centrifuged specimens ranging from 80%-83% and 93%-97%. Many of the previous studies discussed about the major limitations of the microscopic methods ,its decreased sensitivity for detecting bacteriuria in urine specimens containing less than 10^5 CFU/ml, a level that defined as positive for catheterized samples($>5*10^4$CFU/ml). This was not much of our concern in our study showed 14 /16 catheterized sample above the reference value but $<10^5$ CFU/ml. Considering 6 false negatives, 2 only belongs to catheterized sample, might be due improper fixation. The 10 false-positive results, the evidence might be possible infections of the urinary tract caused by fastidious or anaerobic bacteria , there was a positive smear and the specimens failed to grow on aerobic culture.

PYURIA (ENHANCED) vs CULTURE:

Comparing cell count for WBC in hemocytometer with the positive culture the reports were 49/57 culture positive, best observed values of Sensitivity 86%, specificity 93.9%, PPV 84.5% and NPV 94.6% for pyuria (cell count in hemocytometer), showed sensitivity and specificity more or less equal to Gram stain for bacteria , another component of Enhanced UA.

Table 19 : RESULTS OF OUR STUDY

TEST	SENSITIVITY	SPECIFICITY	PPV
ENHANCED UA	84.2%	98.6%	96%
ROUTINE UA	54.4%	97.3%	86%
GRAM STAIN	89.5%	93.2%	83.6%
PYURIA	86%	93.9%	84.5%

In Hiraoka M et al, had screened for UTI using single use and throw hemocytometer chamber for both bacteriuria and cell count, concluded saying procedure was very easy, inexpensive, quick and reliable and thus an extremely useful method for diagnosing urinary tract infection.

In Hoberman et al, the presence of either pyuria or bacteriuria and the presence of both pyuria and bacteriuria have the highest sensitivity and positive predictive value, respectively, for picking up positive urine cultures. Concluded by saying the analysis of urine samples obtained by catheter for the presence of pyuria (> 10 WBC/mm^3) can be used to guide decisions regarding the need for urine culture in young febrile children.

From our study, the main advantage of performing microscopic examination of uncentrifuged Gram-stained urine as part of the bacteriological routine of urine cultures, the presumptive rapid diagnosis of urinary infection can be made. Helps in guidance for initial patient treatment based on the morphology and staining properties of the probable etiological infective agent available within 2-4 hours of specimen collection, while awaiting for the results

of the urine culture and antibiotic sensitivity tests, which were generally available within 24 to 48 h.

When comes to screening for UTI in children, it is still under debate by which of the rapid diagnosing method, we will pick the culture positive UTI. ,so far no test can screen accurately for UTI. The urine dipstick plus culture tests appear to be the most cost-effective strategy for screening and beginning presumptive treatment for UTI so far ,but certain disadvantages were seen in paediatric age group with dipstick tests, especially in younger children due to more frequent voiding in toilet untrained leads to decreased time for production of nitrites by nitrate –reducing organisms, such children have a less vigorous inflammatory response to infection, showing lower sensitivity of the dipstick tests. In recent study by Shah et al 2014, compared Enhanced vs automated urinalysis for screening of UTI children concluded saying there was no much of difference in diagnosing pyuria either by auto analyser or cell count on chamber, but bacteriuria detected by analyser was less sensitive and specific than Gram stained smear[17].

From our study, it shows that Gram stain of urine and cell count on hemocytometer was more sensitive and comparably specific, with better PPV when compared to commonly done routine urinalysis as stated in many of the previous studies[14,12,10], because of its laborious procedure and difficulty of performance greater than for routine urine analyisis and dipstick test commonly in use now, made enhanced UA less attractive.

In certain group of children who were particularly at high risk for UTI or its complications, one should consider performing the enhanced UA to identify more children with possible UTI and to begin early presumptive treatment. However, additional economic strategy was needed to determine the best predictor in screening UTI.

CONCLUSION

- Prevalence of UTI was high in the age group of more than five year old children.
- Prevalence of UTI showed female preponderance in one to five years and male preponderance in less than one year age group.
- Fever with dysuria was the commonest combination of symptom seen in one to twelve years of age.
- Commonest organism causing UTI was E.coli followed by Klebsiella pneumoniae.
- Enhanced urinalysis was more sensitive and of equivocal specificity when compared to the routine urinalysis in detecting culture positive UTI.
- When Gram stain of urine was alone considered, it was more specific and sensitive test in predicting positive urine culture.

LIMITATIONS

- The study was done in a small sample size over a limited period of time
- In this study only symptomatic children were enrolled, Ideally sampling should have been done in general paediatric population.
- The enhanced urinalysis may offer a better combination of test performance, but it warrant further studies in our setup regarding standardisation.

RECOMMENDATIONS

- Enhanced urinalysis can be used instead of routine urinalysis in screening for UTI before obtaining the sample for culture because it reduces the time and cost spent for unwanted culture.
- Gram stain of uncentrifuged urine showed best sensitive and specificity in finding positive UTI. It may help in early initiation of treatment.
- Gram stain can be used in combination or alone , where culture may not be immediately accessible by using standardized method of staining.

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தகவல் படிவம்

ஆய்விடம்: அரசு குழந்தைகள் நல மருத்துவமனை மற்றும் ஆராய்ச்சி நிலையம், புற நோயாளிகள் பகுதி.

ஆய்வாளர்:

பங்குபெறுபவரின் பெயர்: வயது:
பாலினம்:

மருத்துவமனை எண் சிறுநீர் மாதிரியின் எண்:

ஆய்வு தலைப்பு: குழந்தைகளுக்கு சிறுநீர் பாதையில் கிருமி தொற்று இருப்பதை விரைவாக கண்டறிய உதவும் வழிமுறைகள் எவை?

தங்கள் குழந்தையும் இந்த ஆய்வில் பங்குபெற கேட்டுகொள்கின்றோம்.

1. வழக்கமாக செய்யப்படும் சிறுநீர் கிருமி வளர்ப்பு முறையையும், புதிதாக கண்டுபிடிக்கப்பட்டுள்ள உடனடி பரிசோதனை முறையையும் ஒப்பிடுவதே இந்த ஆய்வின் நோக்கமாகும்.

2. உங்கள் குழந்தையைப் பற்றிய தனிப்பட்ட விவரங்கள் யாருக்கும் தெரிவிக்காமல் பாதுகாக்கப்படும்.

3. இந்த ஆய்வில் பங்கு பெறுவது உங்கள் தனிப்பட்ட விருப்பமே. ஆய்வு ஆரம்பித்தபின் விருப்பம் இல்லை என்றால் தாங்கள் விலகிக்கொள்ளலாம். அவ்வாறு விலகுவதானது தங்கள் குழந்தையின் சிகிச்சைக்கு எவ்வித பாதிப்பையும் உருவாக்காது.

4. ஆய்வின் முடிவுகள் ஆய்வு நடக்கும்போதோ(தேவை ஏற்படின்) அல்லது ஆய்வு முடிந்த பின்னரோ தங்களுக்கு தெரிவிக்கப்படும். அந்த முடிவுகள் தங்கள் குழந்தையின் சிகிச்சைக்கு பேருதவியாக இருக்கக்கூடும்.

ஆய்வாளரின் கையொப்பம் பெற்றோரின் கையொப்பம்

நாள்

இடம்

ஒப்புதல் படிவம்

1. இந்த ஆய்வைப்பற்றிய அனைத்து தகவல்களும் எனக்கு தெரிவிக்கப்பட்டது.
2. இதில் பங்குபெறுவதற்கான ஒப்பந்த படிவமும் எனக்கு விவரிக்கப்பட்டது.
3. ஆராய்ச்சியின் தன்மையும், எனது உரிமைகளும் எடுத்துரைக்கப்பட்டது .
4. இந்த ஆய்வினால் எனது குழந்தையின் நலனுக்கு எந்த தீங்கும் இல்லை என்பதை தெரிந்து கொண்டேன்.
5. இந்த ஆய்வில் எனது குழந்தை பங்குபெற எனது மனமார்ந்த ஒப்புதலை தருகிறேன்.

பெற்றோரின் கையொப்பம்: சாட்சியின் கையொப்பம்.

ஆய்வாளரின் கையொப்பம்

தேதி

இடம்

INFORMATION SHEET

Place of study: INSTITUTE OF CHILD HEALTH AND HOSPITAL FOR CHILDREN, GENERAL OPD

Name of Investigator :

Name of Participant age: sex:

Hospital No: Urine sample No:

Study title : Comparision of enhanced urinalysis vs routine urinalysis and culture method

for diagnosing urinary tract infections in children

We are conducting a **ENHANCED URINALYSIS AS A SCREENING TEST FOR URINARY TRACT INFECTION IN CHILDREN AGED BETWEEN 1 MONTH - 12 YEARS.**

We request you to participate in the study

The purpose of this study is to compare rapid screening tests with gold standard urine culture test for diagnosing urinary tract infection.

The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.

The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of investigator Signature of participant

Date:

INFORMED CONSENT FORM

Study place: ICH&HC, GENERAL OPD/WARD..PRINCIPAL INVESTIGATOR:

Title of the study**: ENHANCED URINALYSIS AS ASCREENING TEST FOR URINARY TRACT INFECTION IN 1 MONTH -12 YEARS CHILDREN**

Name of the Participant: Age: Sex: Hospital number:

Urine sample no:

1. I have read and understood this consent form and the information provided to me regarding the participation in the study.
2. I have had the consent document explained to me.
3. I have been explained about the nature of the study.
4. I have been explained about my rights and responsibilities by the investigator.
5. I have informed the investigator of all the treatments I am taking or have taken in the past including any native (alternative) treatment.
6. I have been advised about the risks associated with my participation in this study.*
7. I agree to cooperate with the investigator and I will inform him/her immediately if I suffer unusual symptoms. *
8. I have not participated in any research study in the past.
9. I am aware of the fact that I can opt out of the study at any time without having to give any reason and this will not affect my future treatment in this hospital. *
10. I am also aware that the investigator may terminate my participation in the study at any time, for any reason, without my consent. *
11. I hereby give permission to the investigators to release the information obtained from me as result of participation in this study to the sponsors, regulatory authorities, Govt. agencies, and IEC. I understand that they are publicly presented.

12. I have understand that my identity will be kept confidential if my data are publicly presented

13. I have had my questions answered to my satisfaction.

14. I have decided to be in the research study.

I am aware that if I have any question during this study, I should contact the investigator. By signing this consent form I attest that the information given in this document has been clearly explained to me and understood by me, I will be given a copy of this consent document. For adult participants:

Name and signature / thumb impression of the participant /parents/guardian

Name_____ Signature_____

Date_____

Name and Signature of impartial witness:

Name_____ Signature_____

Date_____

Name and Signature of the investigator or his representative obtaining consent:

ENHANCED URINALYSIS AS A SCREENING TEST FOR URINARY TRACT INFECTION IN CHILDREN AGED ONE MONTH TO TWELVE YEARS

CASE PROFORMA

NAME: AGE/SEX: IP NO: S NO:

WARD NO: DATE OF ADMISSION:

SYMPTOMS

1-FEVER

2-CHILLS &RIGORS

3-BURNING MICTURITION

4-INCREASED FREQUENCY

5-CLOUDY URINE

6-ABDOMINAL PAIN/FLANK PAIN

7-VOMITTING

8- CONSTIPATION

9-FEVER WITHOUT FOCUS>3DAYS IN <2YEARS

10-POOR FEEDING, IRRITABILITY AND JAUNDICE IN NEWBORNS

11-INCONTINENCE

12-HEMATURIA

others specify here.....

SIGNS:

- **PHIMOSIS:**
- **ANATOMICAL ABNORMALITIES OF GENITOURINARY SYSTEM**
- **RENAL ANGLE TENDERNESS:**
- **SUPRA PUBIC TENDERNESS**

INVESTIGATIONS

URINE SAMPLE TYPE: Mid Stream Clean Catch Urine/CATHETERIZED SAMPLE

SAMPLES	REPORTS
Complete Blood Count	
URINE	
URINE CULTURE AND SENSTIVITY	
ROUTINE URINALYSIS PYURIA BACTERIURIA	
ENHANCED URINALYSIS • GRAM STAINING • PYURIA	

MASTER CHART

s.no	sex	age	symptoms	signs	sampling	enhanced-pyurla	enhanced-gram stain	enhanced	routine -pyuria	ine -bacteri	routine	culture	organisms
1	2	3	2	5	2	2	2	2	2	2	2	2	NA
2	2	3	4	4	2	2	2	2	2	2	2	2	NA
3	2	3	4	5	2	2	1	2	2	2	2	2	NA
4	2	3	4,6	5	2	2	2	2	2	2	2	2	NA
5	2	3	3	5	2	2	2	2	2	2	2	2	NA
6	2	3	3	5	2	2	2	2	2	2	2	2	NA
7	2	3	3	5	2	2	2	2	2	1	2	2	NA
8	2	3	1,3	5	2	2	2	2	2	2	2	2	NA
9	2	3	11	5	2	2	2	2	2	2	2	2	NA
10	2	3	1,2	3	2	1	1	1	1	2	2	2	NA
11	2	3	1,4	5	2	2	2	2	2	2	2	2	NA
12	2	3	4	5	2	2	2	2	1	2	2	2	NA
13	2	3	8,1,7	5	2	2	2	2	1	2	2	2	NA
14	2	3	4	5	2	2	2	2	2	2	2	2	NA
15	2	3	1,7,5	5	2	2	1	2	2	2	2	2	NA
16	2	3	3	5	2	2	2	2	2	2	2	2	NA
17	2	3	4	5	2	1	2	2	1	1	1	2	NA
18	2	3	1,4	5	2	2	1	2	2	2	2	2	NA
19	2	3	1,5	2	2	2	2	2	2	2	2	2	NA
20	2	3	12,5	5	2	2	2	2	2	2	2	2	NA
21	2	3	1,3	5	2	1	1	1	1	2	2	2	NA
22	2	3	11	3	2	2	2	2	2	2	2	2	na
23	2	3	4	5	2	2	2	2	2	2	2	2	na
24	2	3	2,4	5	2	2	2	2	2	2	2	2	na
25	2	3	1,3	4	2	2	2	2	2	2	2	2	na
26	2	3	1,2	4	2	2	2	2	2	2	2	2	na
27	2	3	1,3	5	2	2	2	2	2	2	2	2	na
28	2	3	2,5,6	5	2	2	2	2	2	2	2	2	na
29	2	3	12	4	2	2	2	2	2	2	2	2	NA
30	2	3	1,3	5	2	2	2	2	2	2	2	2	NA
31	2	3	2	5	2	2	2	2	2	2	2	2	NA
32	2	3	1,3	3	2	2	2	2	2	2	2	2	NA
33	2	3	1,3,6	4	2	2	2	2	1	2	2	2	NA
34	2	3	1,3,6	3	2	1	2	2	1	2	2	2	NA
35	2	3	1,3	5	2	2	2	2	2	2	2	2	NA
36	2	3	3,11	5	2	2	2	2	2	2	2	2	NA
37	2	3	1,2,12	5	2	2	1	2	2	2	2	2	NA
38	2	2	1,5	5	2	2	2	2	1	2	2	2	NA
39	2	2	11	5	1	2	2	2	2	2	2	2	NA
40	2	2	1,6,7	5	1	2	2	2	2	2	2	2	NA
41	2	2	4	5	2	2	2	2	1	2	2	2	NA
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43	2	2	1,3	5	1	2	2	2	2	2	2	2	NA
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45	2	2	10	5	1	2	2	2	1	1	1	2	NA
46	2	2	1,3	5	2	2	1	2	2	2	2	2	NA
47	2	2	10,5	5	1	2	2	2	2	2	2	2	NA
48	2	2	1,4	5	2	2	2	2	1	2	2	2	NA
49	2	2	1,7	5	1	2	2	2	2	2	2	2	NA
50	2	2	1,3	5	1	2	2	2	2	2	2	2	NA
51	2	2	11	5	2	2	2	2	2	2	2	2	NA
52	2	2	5,1	5	2	2	2	2	2	2	2	2	NA
53	2	2	3,1	5	2	2	2	2	2	2	2	2	NA
54	2	2	6,7	5	1	2	2	2	2	2	2	2	na
55	2	2	1,3	5	2	2	2	2	2	2	2	2	na
56	2	2	1,4,6	5	2	2	2	2	2	2	2	2	na
57	2	2	3	5	1	2	2	2	2	2	2	2	NA
58	2	2	1,5	4	2	2	2	2	2	2	2	2	na
59	2	2	2,8	2	2	2	2	2	2	2	2	2	na
60	2	2	1,3	5	2	2	2	2	2	2	2	2	na
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62	2	2	1	2	1	2	2	2	2	2	2	2	NA
63	2	2	1,3	5	2	2	2	2	2	2	2	2	na
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65	2	2	1,3	5	2	2	2	2	2	2	2	2	NA
66	2	2	1,2,3	2	1	2	2	2	2	2	2	2	NA
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68	2	2	1,3,5	5	2	2	2	2	1	2	2	2	NA
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70	2	2	1,3	5	1	2	2	2	2	2	2	2	NA
71	2	2	1,3	5	2	2	2	2	2	2	2	2	NA
72	2	1	9	5	1	2	2	2	2	2	2	2	NA
73	2	1	1,5,6	5	1	2	2	2	2	2	2	2	NA
74	2	1	1,5	5	1	2	2	2	2	2	2	2	NA
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76	2	1	10	2	1	2	2	2	2	2	2	2	NA
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79	2	3	1,7	1	2	2	2	2	2	2	2	2	NA
80	2	3	8,6	5	2	2	2	2	2	2	2	2	NA
81	2	3	1,8	5	2	2	2	2	2	2	2	2	NA
82	2	3	1,11	5	2	2	2	2	1	2	2	2	NA
83	1	3	1,3,8	5	2	2	2	2	2	2	2	2	NA
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86	1	3	11	5	2	2	2	2	1	2	2	2	NA
87	1	3	3,1	5	2	2	2	2	2	2	2	2	NA
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123	1	2	1,3	5	1	2	2	2	2	2	2	2	NA
124	1	2	12	5	2	2	2	2	2	2	2	2	NA
125	1	2	1,9	1	1	2	2	2	2	2	2	2	na
126	1	2	1,3	5	2	2	2	2	2	2	2	2	na
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131	1	2	1,3	5	1	2	2	2	2	2	2	2	NA
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139	1	1	1,3	5	1	2	2	2	2	2	2	2	NA
140	1	1	9,5	5	1	2	1	2	2	2	2	2	NA
141	1	1	9,7	5	1	2	2	2	2	2	2	2	NA
142	1	1	9	5	1	2	1	2	1	2	2	2	NA
143	1	1	9,8	5	1	2	2	2	2	2	2	2	NA
144	1	1	1,3	5	1	2	2	2	2	2	2	2	NA
145	1	1	10	5	1	2	2	2	2	2	2	2	NA
146	1	1	10	5	1	2	2	2	1	1	2	2	NA
147	1	1	9	5	1	2	2	2	2	2	2	2	NA
148	1	1	9	5	1	2	2	2	2	2	2	2	NA
149	2	3	1	5	2	1	1	1	1	1	1	1	1
150	2	3	1,6,8	5	2	2	2	2	1	1	1	1	1
151	2	3	3	5	2	1	1	1	1	1	1	1	2
152	2	3	2	5	2	2	1	2	2	2	2	1	2
153	2	3	1,3,4	5	2	1	1	1	1	1	1	1	1
154	2	3	2,8	4	2	1	1	1	2	2	2	1	6
155	2	3	1,3	5	2	1	1	1	2	2	2	1	4
156	2	3	1,3	1	2	1	1	1	1	1	1	1	1
157	2	3	12,6,1	5	2	1	2	2	2	2	2	1	4
158	2	3	2,5,6	5	2	1	1	1	1	1	1	1	1

159	2	3	2,3,4	5	2	2	1	2	2	2	2	1	1
160	2	3	1,3,4,6	5	2	1	1	1	1	2	2	1	5
161	2	3	1	4	2	1	1	1	2	2	2	1	1
162	2	3	3	5	2	1	1	1	1	2	2	1	2
163	2	3	1,3,5	4	2	1	1	1	1	1	1	1	2
164	2	2	4	5	2	1	1	1	1	1	1	1	4
165	2	2	10	5	1	1	1	1	1	1	1	1	5
166	2	2	1,2	5	2	1	1	1	2	2	2	1	3
167	2	2	1,3	5	1	1	1	1	1	2	2	1	5
168	2	2	1,2,3	5	2	1	1	1	1	2	2	1	4
169	2	2	1,8,2	1	1	2	2	2	1	1	1	1	2
170	2	2	2,5,8	5	2	2	2	2	2	2	2	1	7
171	2	2	1,9	1	1	1	1	1	1	1	1	1	6
172	2	2	1,3	5	2	1	1	1	2	2	2	1	2
173	2	2	2,3	5	2	1	1	1	1	1	1	1	1
174	2	2	2,3,4	5	2	1	1	1	1	1	1	1	4
175	2	1	10	5	1	1	1	1	1	1	1	1	1
176	1	3	1,6,3	5	2	2	2	2	2	2	2	1	2
177	1	3	1,2	5	2	2	1	2	1	1	1	1	1
178	1	3	1,2,8	5	2	1	1	1	1	1	1	1	1
179	1	3	1,2	3	2	1	1	1	1	1	1	1	1
180	2	3	1,3	5	2	1	1	1	2	2	2	1	1
181	2	3	1,3,5	5	2	1	1	1	1	1	1	1	4
182	1	3	1,3	5	2	1	1	1	2	2	2	1	2
183	1	3	1,2,3	5	2	1	1	1	1	1	1	1	3
184	1	3	2,11	5	2	1	1	1	1	1	1	1	1
185	1	3	1,2	5	2	1	1	1	1	1	1	1	3
186	1	3	1,2,3	3	2	1	1	1	1	1	1	1	3
187	1	3	4	5	2	1	1	1	2	2	2	1	1
188	1	3	1,3,2	5	2	1	1	1	1	1	1	1	4
189	1	3	1,3,5	4	2	1	1	1	2	2	2	1	2
190	1	3	4,2	5	2	1	1	1	2	2	2	1	3
191	1	2	1,3	1	1	2	2	2	1	1	1	1	7
192	1	2	1,3,4	5	2	1	1	1	2	2	2	1	1
193	2	2	3,8	5	2	1	1	1	1	2	2	1	1
194	1	2	1,3	5	2	1	1	1	1	2	2	1	1
195	1	1	1,9	5	1	1	1	1	1	1	1	1	1
196	1	1	1,9	5	1	1	1	1	2	2	2	1	2
197	1	2	1,3	5	1	1	1	1	1	1	1	1	3
198	1	1	1,10	1	1	1	1	1	1	1	1	1	1
199	1	2	1,3,7	4	2	1	1	1	2	2	2	1	4
200	1	2	1,11	1	1	1	1	1	2	2	2	1	6
201	1	2	1,4	1	1	1	1	1	1	1	1	1	1
202	1	1	1,10	5	1	1	1	1	1	2	2	1	1
203	1	1	10	1	1	1	1	1	1	1	1	1	1
204	1	1	9	5	1	1	1	1	1	1	1	1	1
205	1	1	9,10	1	1	1	1	1	1	1	1	1	3

KEY TO MASTER CHART

A-CODE

B-SEX

MALE-1

FEMALE-2

C-AGE

1-<=1 YEAR

2->1-FIVE YEARS

3->5 YEARS

D-SYMPTOMS SUGGESTIVE OF UTI

1-FEVER

2-CHILLS &RIGORS

3-BURNING MICTURITION

4-INCREASED FREQUENCY

5-CLOUDY URINE

6-ABDOMINAL PAIN/FLANK PAIN

7-VOMITTING

8- CONSTIPATION

9-FEVER WITHOUT FOCUS>3DAYS IN <2YEARS

10-POOR FEEDING, IRRITABILITY AND JAUNDICE IN NEWBORNS

11-INCONTINENCE

12-HEMATURIA

E-SIGNS

1-PHIMOSIS

2-ANATOMICAL ABNORMALITIS IN GENITOURINARY TRACT

3-RENAL ANGLE TENDERNESS

4-SUPRA PUBIC TENDERNESS

5-NIL

F-URINE SAMPLE

1-CATHETERIZED

2-MID STREAM CLEAN CATCH URINE

ENHANCED URINALYSIS

G-PYURIA

1-POSITIVE

2-NEGATIVE

H-BACTERIURIA

1-POSTIVE

2-NEGATIVE

I-ENHANCED URINALYSIS

1-POSITIVE

2- NEGATIVE

ROUTINE URINALYSIS

J-PYURIA

1-POSITIVE

2-NEGATIVE

K-BACTERIURIA

1-POSITIVE

2-NEGATIVE

L-ROUTINE URINALYSIS

1-POSITIVE

2-NEGATIVE

M-URINE CULTURE

1-GROWTH

2- NO GROWTH

N-ORGANISMS

1-E.COLI

2-KLEBSIELLA

3-PROTEUS

4-PSEUDOMONAS

5-STAPH AUREUS

6-ENTEROCOCCUS

7-CITROBACTER