"STUDY OF CLINICAL PROFILE OF URINARY TRACT INFECTION IN NEONATES WITH SUSPECTED SEPSIS AND UTILITY OF DIPSTICK AS A DIAGNOSTIC TOOL"

BY

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Dissertation submitted to

B.L.D.E (DEEMED TO BE UNIVERSITY) VIJAYAPURA

KARNATAKA

In partial fulfilment of the requirements for the degree of

DOCTOR IN MEDICINE IN PEDIATRICS

UNDER THE GUIDANCE OF
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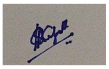

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GLOSSARY OF ABBREVIATIONS

UTI	Urinary Tract Infection
NICU	Neonatal Intensive Care Unit
E. coli	Escherichia coli
UPEC	Uro-pathogenic Escherichia coli
ASB	Asymptomatic Bacteruria
VUR	Vesicoureteral reflux
TGF	Transforming Growth Factor
VEGF	Vascular Endothelial Growth Factor
ACE	Angiotensin Converting Enzyme
TLR	Toll-Like Receptor
ICU	Intensive Care Unit
MSU	Mid-Stream Urine
SPA	Supra Pubic Aspiration
NT/NIT	Nitrite
LE	Leucocyte Esterase
NICE	National Institute for health and Clinical Excellence (UK)
AAP	American Academy of Pediatrics
USG	Ultrasonography
VCUG	Voiding Cysto-urethrography
DMSA	Dimercapto Succinic Acid
KUB	Kidney Ureters and Bladder
WBC	White Blood Cells
HTN	Hypertension

PROM	Pre-Mature Rupture of Membranes
NVD	Normal Vaginal Delivery
LSCS	Lower Segment Caesarean Section
RDS	Respiratory Distress Syndrome
NNHB	Neonatal Hyperbilirubinemia
PPV	Positive Predictive Value
NPV	Negative predictive Value

INTRODUCTION

Children frequently suffer from urinary tract infections (UTIs), which present a substantial diagnostic and treatment challenge, especially in the susceptible neonatal group. While UTIs often present with clear symptoms in older children, the clinical picture in neonates can be considerably more subtle and enigmatic. This complexity is further compounded when UTIs occur in neonates suspected of sepsis, a potentially life-threatening condition characterized by systemic inflammation due to a presumed infection[1,2].

As the symptoms are ambiguous and the clinical presentation of neonatal UTIs and sepsis overlap, diagnosing these infections can be difficult. Similar to many other neonatal illnesses, fever, irritability, poor feeding, vomiting, jaundice, and failure to thrive are common symptoms in newborns with UTIs. Due to the high degree of suspicion needed for a diagnosis, lengthy and occasionally intrusive investigations are frequently conducted[3].

Although there is considerable variation in the prevalence of UTIs in newborns with suspected sepsis, it is generally acknowledged as a major cause of morbidity. Gram-negative bacteria are the main culprits behind UTIs in newborns, with Escherichia coli being the most frequent offender[4]. Proteus mirabilis, Enterococcus, and Klebsiella species are among the other pathogens. The therapy of neonatal UTIs is further complicated by the evolving trend of antibiotic resistance among these bacteria.

Prompt detection and intervention are essential to avoid consequences including hypertension, chronic kidney disease, and renal scarring. Numerous factors, including as age, sex, underlying congenital defects, and predisposing circumstances like immunodeficiency and preterm, affect the clinical picture of UTIs in newborns[5].

A newborn with suspected sepsis, can be diagnosed using a combination of imaging scans, laboratory testing, and clinical evaluations to detect UTIs. Urine culture is still the gold standard for identifying urinary tract infections (UTIs), although it has drawbacks such as long turnaround times and contamination risks. As a result, quick, trustworthy, and non-invasive diagnostic instruments are required in order to support early diagnosis and therapy[6].

The dipstick test has become an important screening technique because it may identify leukocyte esterase and nitrites in urine. Dip sticks make it possible to quickly identify newborns who are at risk, allowing for the fast start of empirical antibiotic therapy while waiting for confirming urine culture findings. By stopping the illness from spreading, this strategy may shorten hospital stays, save healthcare expenses, and enhance clinical results. Additionally, dipstick tests can help reduce discomfort and hazards for newborns by assisting in the decision-making process on the necessity of additional invasive investigations, such as suprapubic aspiration or bladder catheterization. It is a desirable choice for preliminary assessment due to its affordability, speed of processing, and ease of use[7].

The accuracy of dipstick testing in neonates has been a topic of discussion due to the undeveloped immunological response in this age range. Additionally, false-negative results for nitrites may arise from neonates having a lower urine bacterial burden and frequent voiding than older children[8].

There have been conflicting results from recent studies assessing the usefulness of dipstick tests in the diagnosis of UTIs in newborns with suspected sepsis. The inconsistent results highlight the need for more investigation to create standardized procedures and confirm the test's applicability in various clinical contexts[9,10].

In order to better understand the clinical profile of urinary tract infections in neonates with suspected sepsis and the use of dipsticks as a diagnostic tool, the current study was designed.

AIM & OBJECTIVES

AIM:

- **To study the clinical profile of urinary tract infection in neonates with suspected sepsis and utility of dipstick as a diagnostic tool.**

OBJECTIVES:

- To study the Prevalence of Urinary tract infections (UTI) amongst Neonates admitted in NICU with suspected sepsis
- To test the efficacy of dipstick in diagnosing/predicting (screening) UTI
- To study the etiological pathogens causing the infection
- To identify the susceptible anti-microbial agents (sensitivity pattern) in the current study setting place

REVIEW OF LITERATURE

Urinary tract infections (UTIs) are the most common bacterial infection in febrile newborns. As most of the newborns do not show with fever, especially in the neonatal period, studies that focus on febrile infants probably underestimate the true prevalence of UTIs in infants[11].

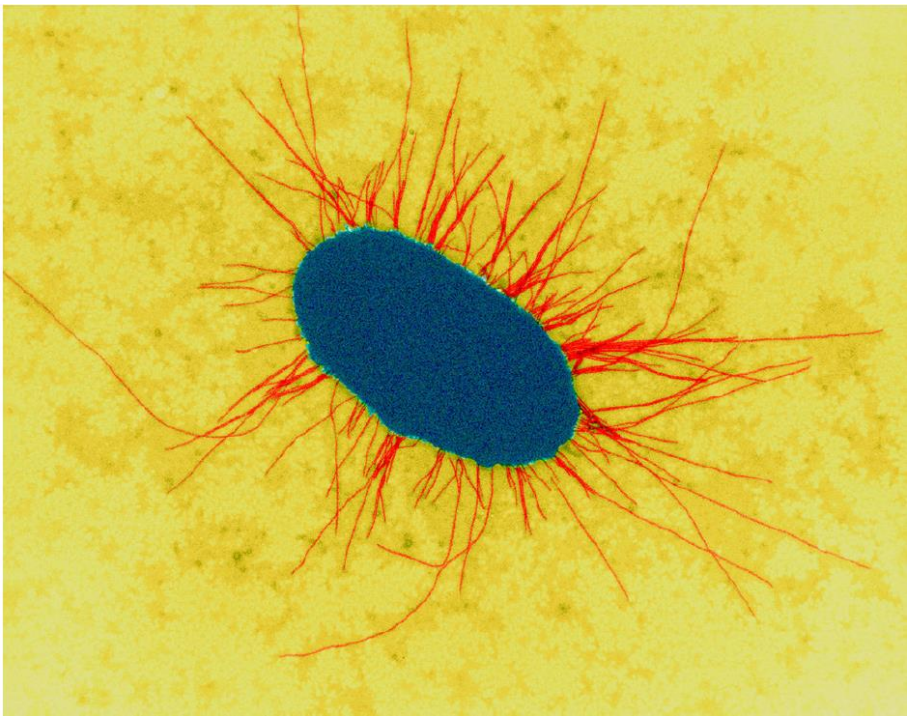
ETIOLOGY

Eighty to ninety percent of pediatric UTIs are caused by Escherichia coli, one of the most frequent intestinal flora pathogenic organism. Enterobacter aerogenes, Proteus mirabilis, Klebsiella pneumoniae, Citrobacter, Pseudomonas aeruginosa, Enterococcus spp., and Serratia spp. are some of the other species. Males are more likely than females to have Proteus mirabilis. Newborn babies are comparatively more likely to contract Streptococcus agalactiae. Staphylococcus saprophyticus is responsible for around 15% of urinary tract infections in teenage girls who are sexually active. Hemophilus influenzae, Streptococcus pneumoniae, Streptococcus viridians, Streptococcus agalactiae, Staphylococcus aureus, and Staphylococcus epidermidis may be the cause of urinary tract anomalies in children with impaired immune systems or anatomic, neurological, or functional abnormalities. Staphylococcus aureus, Streptococcus agalactiae, Proteus mirabilis, Pseudomonas aeruginosa, and nontyphoidal Salmonella are some of the bacteria that can cause hematogenous dissemination of infection, an unusual cause of urinary tract infection. Mycobacterium TB and Streptococcus pneumoniae are two uncommon bacterial

causes of urinary tract infections. UTIs can be brought on by viruses such coxsackieviruses, echoviruses, adenoviruses, and enteroviruses. Usually, the lower urinary tract is the only area affected by the accompanying infection. In this context, hemorrhagic cystitis is known to be caused by adenoviruses. Fungi, such as Aspergillus spp., Cryptococcus neoformans, and Candida spp., are rare causes of urinary tract infections (UTTIs) that mostly affect preterm neonates, children who have an indwelling urinary catheter, urinary tract abnormalities, have used broad-spectrum antibiotics for an extended period of time, or have weakened immune-systems[12].

PATHOGENESIS

It is believed that the chain of events resulting in an ascending urinary tract infection starts when E. coli derived from the gastro-intestinal tract which colonize the periurethral mucosa. Then, by an unclear method, the periurethral E. coli ascend into the kidneys, ureters, and bladder, creating a risk of renal parenchymal infection or bladder urine infection. An infection is not always the result of bacteria on the periurethral mucosa. Even while newborns under a year old have a high colonization of the periurethral mucosa, the majority of them do not get UTIs. Weekly periurethral cultures following a first UTI in a group of healthy, potty-trained girls (3–6 years old) showed a significant diversity of E. Coli clones invading the area around the urethra. The presence of E. coli in the periurethral region does not predict a subsequent UTI [13].



Escherichia coli with Fimbriae

The pathogenicity of UPEC in contrast to commensal E. coli results from specific virulence genes, which are frequently encoded on different pathogenicity islands on the bacterial genome. The production of bacterial-adherence factors is made possible by the proteins that these virulence genes encode. The adherence factors Afa/Dr, S/F1c, pap (P), M hemagglutinin, and type-1 pili adhesins are expressed by UPEC strains. These adherence-promoting elements encourage E.coli's attachment to bladder epithelial cells, which in turn signals inflammatory mediators in the host cell and causes exfoliation and the evacuation of contaminated bladder cells by urination. The pathogenicity profiles of E. coli causing asymptomatic bacteriuria (ASB)-causing are not the same as isolates that cause symptomatic UTIs. In vitro adhesion capacity of ASB strains from females was found to be lower in classic early research conducted in Sweden when compared to isolates obtained from girls who had symptomatic infections. These findings were supported by a more recent study that examined UPEC virulence determinants in

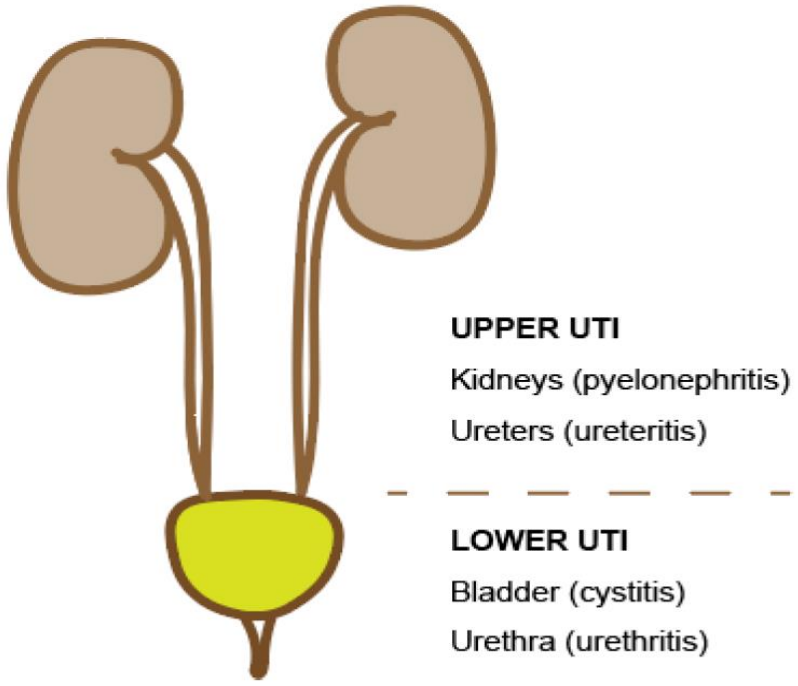
isolates of children from Korea that were both UTI and ASB. The study found that while fimH was equally common in both isolates, UTI strains had a significantly higher prevalence of papEF (adherence determinant) and fyuA (siderophore) than ASB isolates[14].

Since the urinary tract lacks mucosal surfaces, it is believed that host defense may rely heavily on mediators derived from epithelial cells. These mediators include lipocalin, lactoferrin, THP, soluble IgA, and bactericidal antimicrobial peptides like cathelicidin and betadefensins, which have evolved to fight urinary tract pathogens. Numerous host defense mechanisms may serve more than one purpose, including stimulating the removal of germs, immune cell recruitment, and activation. The main host defense against infection is the ability to routinely and fully empty the bladder[15]. A broad term that replaces "voiding dysfunction" is "lower urinary-tract dysfunction," which includes a variety of disruptions to lower urinary-tract function in children who are neurologically normal. In school-aged children, lower urinary tract dysfunction is linked to a higher incidence of UTI. UTI risk is also higher in children with neurogenic bladder, anatomic anomalies, and extrinsic tumor or constipation compression. During the first year of life, 10 out of 1,000 male infants who are not circumcised (1%) are expected to get a UTI, while 1 out of 1,000 male infants who are circumcised (0.1%) will experience this problem[15].

The American Academy of Pediatrics (AAP) Task Force on Circumcision advises against performing a circumcision on infants who have severe reflux or hydronephrosis during the first trimester of life. The task group highlighted the risks and possible medical benefits of circumcision for newborns, but it did not propose routine circumcision[15].

Comparing lower and upper tract UTIs

Anatomically, UTIs can be divided into upper and lower tract infections. An upper tract infection involves inflammation and infection in the ureters and kidneys (pyelonephritis). This usually results in fever, anorexia, vomiting, lethargy, malaise, and stomach pain along with tenderness in the loins. Lower abdomen or suprapubic pain, dysuria, frequent and urgent urination, and other localized symptoms are indicative of a lower tract UTI, which is an infection of the bladder (cystitis) and urethra. Children who are older may have indications and symptoms that point to the infection site. These traditional indicators are frequently missing in younger individuals, making it more difficult to distinguish between upper and lower UTIs[16].



Urogenital system: upper versus lower tract UTI

Pathogen Virulence Factors[17]

The possibility that a particular bacterial strain would colonise and then invade the urinary system is increased by pathogen virulence factors. Aerobactin, which chelates iron to promote growth, α-hemolysin, M hemagglutinin, endotoxin, cytotoxic necrotizing factor 1, K capsular antigen, a stiff cell wall, serum resistance ability because of the outer membrane protein TraT, and sticky capacity are some of these factors. The three distinct adhesin types found on uropathogenic E. coli include Pfimbriae, X-adhesins, and type 1 pili (or fimbriae). Despite the flushing effect of urine flow, these adhesins help the bacteria stick to mucosal receptors in the uroepithelium. Once the uroepithelium is invaded, an intracellular biofilm forms. The uropathogenic E. Coli can be shielded by the biofilm from the immune system of the host.

Urinary Tract Infection Pathogen Frequencies in Infant Studies

REFERENCE	ZORC ET AL, 2005 (4)	ISMAILI ET AL, 2011 (6)	BONADIO AND MAIDA, 2014 (9)	GREENHOW ET AL, 2014 (13)
Age of patients	≤60 days (febrile)	0–3 months	≤ 30 days (febrile)	1 week–3 months
No. of urine cultures	1,025	46	670	823
Organisms				
Escherichia coli	80%	88%	71%	60%
Klebsiella spp	9%	7%	10%	2%
Enterobacter spp	5%	2%	3%	0%
Enterococcus	–	–	10%	2%
Citrobacter spp	4%	–	–	–
Pseudomonas spp	1%	–	1%	–
Other (gram-positive organisms, fungal, etc)	–	2%	5%	26%

Mechanisms of Host Defence[18]

While germs often enter the bladder, urinary tract infections are not always the result. Bacterial adhesion to uroepithelial cells is inhibited by local bladder-wall defence mechanisms, such as mucus formation and antimicrobial peptide secretion by the uroepithelium. Furthermore, toll-like receptors that can identify patterns associated with pathogen-related molecules are expressed by the uroepithelium. By activating uroepithelial cells and producing inflammatory mediators like cytokines, Toll-like receptor engagement can cause a local inflammatory response that aids in the removal of the invasive germs. Furthermore, full bladder emptying reduces the likelihood of adhesion. Anaerobic bacteria are part of the urethral flora; however, low urine pH, soluble IgA, polymorphonuclear cells, lactoferrin, lipocalin, Tamm-Horsfall glycoprotein, and high urine organic acid or urea concentrations all prevent these microorganisms from growing.

Host Compromising Factors

Urinary tract infections are more likely to occur in situations where the unidirectional flow of urine is impeded. Vesicoureteral reflux and blockage cause this.

VESICOURETERAL REFLUX

Via the VUR, infected bladder urine may ascend to the renal parenchyma and upper urinary tract. The most prevalent urologic anomaly in children, VUR is linked to a higher risk of developing pyelonephritis following a urinary tract infection. While VUR usually goes away on its own, some kids get reflux nephropathy, high blood pressure, and insufficient adrenal glands. When there are no further urinary tract anomalies and a congenital anatomic malformation of the ureterovesical junction, reflux results in primary VUR. Prenatal ultrasound is routinely used to identify fetal urinary tract abnormalities, and hydronephrosis is the most frequently found anomaly[19].

Even in the absence of a UTI, VUR with hydronephrosis is associated with renal impairment and is more common in men. In particular, primary VUR is caused by a shortening of the intramural segment of the ureter as it passes through the wall of the bladder and a deficit of the longitudinal muscle of the submucosal ureter. Urine can more easily return from the bladder into the ureter and pelvicalyceal system when the ureter's closure during bladder filling and micturition is limited. Age-related declines in VUR incidence are indicative of the condition's spontaneous remission. Detrusor activity and voiding pressures are two urodynamic measures that are directly linked to the resolution of VUR. In a prospective follow-up study spanning five years, 82% of children under five years old with primary VUR and radiographically normal kidneys experienced resolution of grade I VUR, 80% of grade II VUR, and 46% of grade III VUR. Over a five-year period, the rates of resolution for grades IV and V were roughly 30% and 13%, respectively. The term "secondary VUR" describes reflux that is brought on by

elevated bladder pressure (posterior urethral valves), an ectopic ureter, or related urinary tract disorders (prune-belly syndrome) that affect the ureter's implantation. Correction of the underlying cause is necessary for the resolution of secondary VUR[20].

38 to 57% of kids with renal-cortical scintigraphy-diagnosed pyelonephritis or upper urinary tract infections will experience renal scarring. Younger children (less than 1 year old), those with reflux in grades III–V, those with an abnormal renal ultrasonography, and those who have recurrent UTIs are the children most at risk for scarring. An aberrant renal-ultrasonographic result or the combination of a high fever and a UTI caused by bacteria other than E. coli are among the risk factors that place children and adolescents at high risk for the development of renal scarring, according to a recent comprehensive study on risk factors following a first UTI.[21].

Merely a few numbers of putative candidate genes have been examined for potential correlations with renal scarring. Children's post-UTI renal scar formation was linked to gene polymorphisms in the promoters of the transforming-growth factor-beta-1 (TGF beta-1) and vascular endothelial growth factor (VEGF) genes; however, more studies involving larger populations will be necessary to confirm the involvement of these genes in renal scarring[22].

By creating an environment that encourages bacterial growth, foreign bodies like stones or catheters increase the risk of UTI. Post-void residual urine is linked to both urge syndrome and dysfunctional voiding, increasing the risk of urinary tract infection. Other risk factors include delaying voiding and voiding infrequently. Adverse host factors encompass parenchymal renal abnormalities, ineffective bladder emptying, instability of the detrusor muscle, constipation, diabetes

mellitus, insufficient immune system, obesity, and insufficient vitamin D.

Due to their immature immune systems, infants, particularly neonates, are more susceptible to UTIs. Having sex is a significant risk factor for teenage girls. UTI risk is higher in children and adolescents with psychosis, according to recent research[23].

Genetic Factors:

Renal scarring and recurrent UTIs are genetically predisposed. Angiotensin-Converting Enzyme Insertion/Deletion (ACE I/D) gene, Interleukin (IL)-8 receptor CXCR1 and CXCR2 gene, IL-10-1082 A/G gene, heat shock protein 72 (HSPA1B) gene, Transforming Growth Factor (TGF)-β1 gene, Toll-Like Receptor (TLR) pathway genes, and Vascular Endothelial Growth Factor (VEGF) gene have been demonstrated to predispose patients to recurrent UTI and renal scarring[23].

Neonates/Infants- risk factors for UTI

NEONATAL OR INFANT CHARACTERISTICS
Male (< 3 months)
Uncircumcised
Prematurity
Renal and urinary tract malformation
High temperature (≥102.2°F [≥39°C])
MATERNAL CHARACTERISTICS
History of urinary tract infection
Premature rupture of membranes
Exposure to antibiotics

Clinical Presentation:

Due to neurologic immaturity and vague concomitant symptoms, the clinical presentation in the infant can frequently be difficult to distinguish from neonatal sepsis. A infant with a UTI may show with poor feeding, lethargy, vomiting, diarrhea, irritability, feeding intolerance, hypothermia, hypoglycemia, abdominal distention, bradycardic episodes, and persistent jaundice. Both term and preterm newborns may exhibit with prolonged jaundice. While there is a specific correlation between UTI and jaundice that appears after 8 days of age, the American Academy of Pediatrics advises screening for UTI in all newborns with an increased direct bilirubin concentration. Compared to viral illnesses, fever with a high temperature is linked to an increased risk of spontaneous bacterial infection. But up to half of newborns with UTIs may only have a low-grade fever or be afebrile, which makes diagnosis more challenging and necessitates a high index of suspicion in these cases[23].

UTI Clinical Features

Age group	Common	Less common
Neonate (birth–2 months)	Fever	Poor feeding, vomiting
Infancy (2 months–2 years)	Irritability	Hematuria Foul smelling urine, cloudy urine
Children (>2 years)	Pyelonephritis: High fever Vomiting Loin pain	Abdominal pain Malaise
	Cystitis: Dysuria Lower urinary symptoms	Hematuria Foul smelling urine, cloudy urine

Age has an inverse relationship with the likelihood of bacteremia linked to a UTI in babies. A positive blood culture had a 5.7% connection with a confirmed UTI, according to one study. Elevated serum band count (as a proportion of total white blood cell [WBC] count) and microscopic Urine analysis with more than 10 WBCs per high-power field (HPF) were more common in the bacteremic UTI group when age-matched controls with bacteremic UTI were compared to nonbacteremic UTI. A retrospective research involving 20 centers examined older infants (29–60 days) who came to the emergency room with a temperature over 100.4°F (38°C) and a UTI. Of these, 2.8% experienced adverse outcomes (such as shock, bacterial meningitis, ICU hospitalization, etc.), and 6.5% had bacteremia. A clinical prediction model with a peripheral band count of less than 1,250 cells/mL and an absolute neutrophil count of greater than or equal to 1,500 cells/mL found a group at "low risk for adverse events" (not clinically unwell and no medical history of high risk). 28 of the 862 (3.2%) bacteremic individuals among these low-risk patients experienced no adverse events. This may also apply to low-risk preterm newborns, even though the model's focus was on an older, lower-risk sample. Since the risk of meningitis is modest (0%–6%), it may be possible to forego lumbar punctures in newborns who appear healthy and have a suspected or confirmed UTI in a lab[24].

Diagnosis[25]:

Pediatric UTIs have notably non-specific clinical characteristics, particularly in younger children. While making a diagnosis can be difficult, it is crucial to take into account, particularly for infants who have fever without attention.

HISTORY

Younger preverbal children are unable to communicate symptoms like abdominal pain or dysuria. Non-specific symptoms like fatigue, irritability, poor feeding, and vomiting are frequently noticed by parents. Both severe bacterial illnesses and numerous ordinary, benign viral infections are overlapped by them. The youngster may be afebrile, have a fever frequently, or just have one characteristic. When children use diapers, malodorous or discolored pee may not be noticeable. Elderly kids may complain of localizing symptoms like flank pain or dysuria.

Examination:

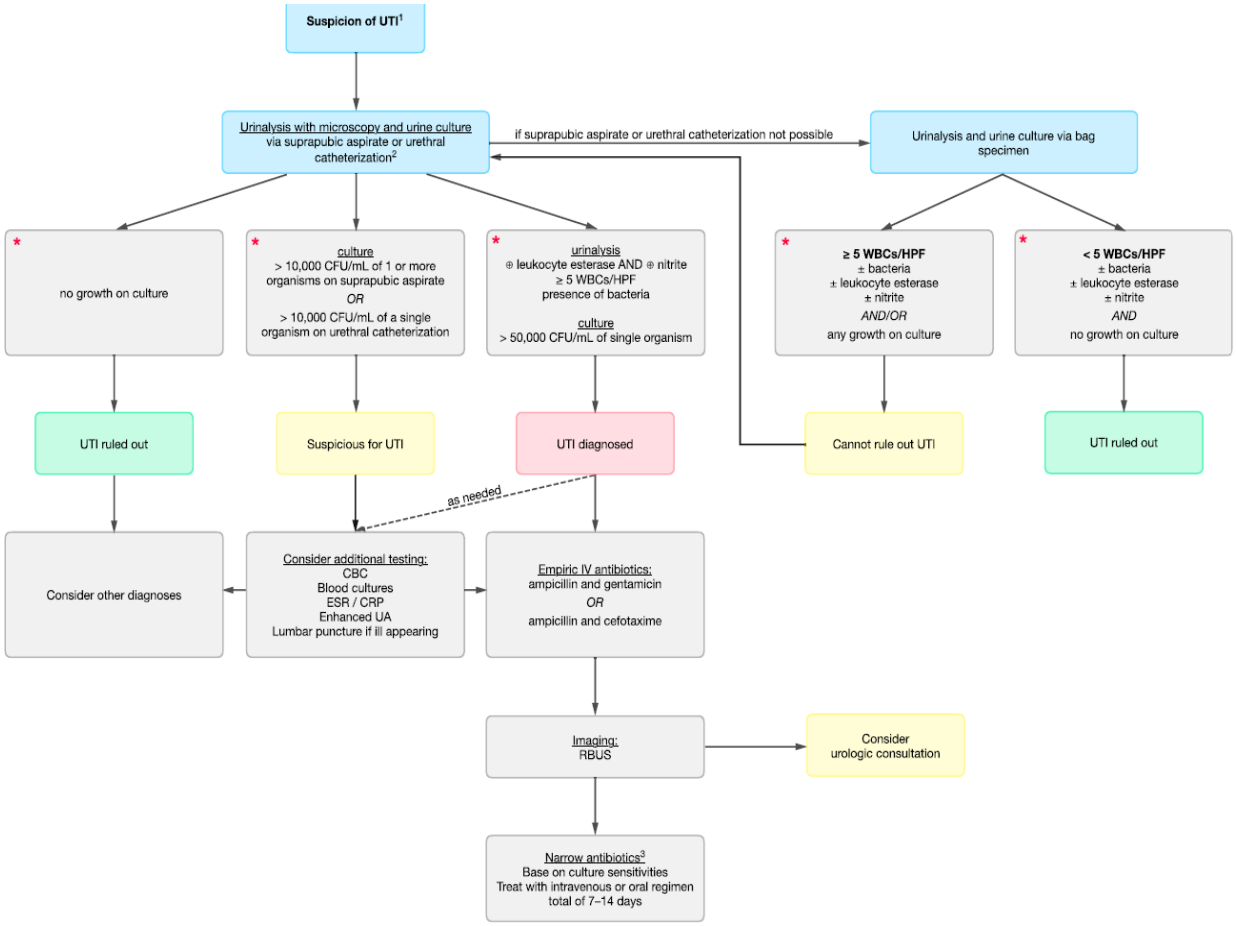
Youngsters with UTIs can seem quite well or extremely ill. It is possible to diagnose dehydration, fever, and stomach pain. Older children are more prone to exhibit localizing indications. For additional assessment, a urine sample is needed because clinical diagnosis is not always accurate.

Urine sample collection: continent children[26]

Children who are confined to a bed can urinate upon request to collect a sample of midstream urine (MSU) in a sterile container. Before collecting a sample from the middle of the urinary stream, the first voided urine washes skin bacteria away from the urethral orifice. Urine sample collection: precontinent children Young children in Western society typically do not establish urine continence until 2–3 years old, hence different collection procedures are required for precontinent children. Cleaning with soap and water before MSU further lowers contamination. Waiting for spontaneous voiding of the urine and then collecting it as soon as

possible using a diaper pad, bag, or "clean catch" of the urine stream are non-invasive approaches.

Diagram showing approach to a newborn suspected of having a UTI



These techniques are sensible and easy to use. Nonetheless, considering their intimate touch with the skin beneath the diaper area, pads and bags have significant rates of contamination of up to 50%–60%, which is reasonable. While pad and bag samples are unreliable for culture, they can be helpful for dipstick screening. In particular, collecting cotton wool balls is discouraged. Of all non-invasive techniques, clean catch has the least contamination—roughly 25%—but implementation might be laborious or unproductive. Easy techniques to stimulate

voiding, including the Quick-Wee approach, can speed up and improve clean catch rates. Through suprapubic needle aspiration (SPA) or urethral catheterization, intrusive techniques remove pee directly from the bladder. These techniques work well, but they hurt and upset the youngster and need special training and tools to be used. Catheter and SPA contamination are rather minimal (10% and 1%, respectively), making these techniques more trustworthy for diagnosis and culture[27].

The best way to collect data is still up for debate. Every approach has benefits and drawbacks, and recommendations vary among guidelines. Guidelines in the UK, where primary care is provided by general practitioners, include using a catheter or SPA only in cases when non-invasive procedures are impractical or impossible, and clean catch or other non-invasive methods in the event that clean catch is not possible. Although urine bags can be used for screening, recommendations in the USA, where pediatricians frequently offer primary care, recommend that a catheter or SPA be necessary to confirm a UTI. The majority of international recommendations clearly forbid the use of bag samples for culture and advocate catheter or SPA as the gold standard. They also list clean catch as an acceptable technique of collection. The frequency of invasive operations can be decreased with a two-step technique that uses initial bag screening and catheter confirmation of positive screens[27].

	Non-invasive methods			Invasive methods	
	Nappy pad	Urine bag	Clean catch	Catheter	SPA
Procedure	Pad placed inside nappy.	Bag affixed over genitalia.	Wait until child voids spontaneously, catch sample opportunistically.	Catheter inserted into bladder via urethra, removed once urine sample obtained.	Needle inserted into bladder through skin of lower abdomen above pubic symphisis.
Advantages	Convenient. Useful for dipstick screening.	Convenient. Useful for dipstick screening.	Least contamination of non-invasive methods. Voiding stimulation methods can increase success.	Low contamination. High success rate.	Ultra-low contamination. Ultrasound to confirm adequate bladder filling can increase success.
Limitations	High contamination. Unreliable for culture.	High contamination. Unreliable for culture.	Moderate contamination. Can be time-consuming.	Invasive and painful. Requires equipment and expertise.	Invasive and painful. Requires equipment and expertise.
Contamination rate	>60%[2]	≈50%[15 17]	25%[17]	10%[17]	1%[17]

Screening – dipstick and microscopy[28]

Dipsticks for urine are a rapid and affordable screening tool for the bedside. The presence of nitrites, which can result from a UTI, and leucocyte esterase, an enzyme found in leucocytes, causes chemical reagent strips to change color. Generally speaking, leucocytes show up in the urine when a UTI occurs. Sterile pyuria, however, can also be brought on by other infections. In children with symptomatic UTIs, Enterococcus, Klebsiella, and Pseudomonas species are also less likely than E. coli to cause pyuria. Dietary nitrates are converted to urine nitrites by the majority of uropathogens. Some, including the Enterococcus and Klebsiella species, don't, though. Due to the fact that frequent voiding flushes substrates out of the bladder, dipsticks are also less accurate in early newborns. Leucocytes and nitrites are not completely sensitive or specific for urinary tract infections, but they can be a helpful screening tool, especially when combined. Dipsticks offer a good negative predictive value to rule out UTI if the diagnosis is deemed doubtful. Urine microscopy also reveals leucocytes and bacteria,

enhancing dipstick screening. Empirical antibiotics are required while awaiting culture in the case of suggestive symptoms and either leucocytes or nitrites.

Sensitivity and specificity of components of urinalysis, alone and in combination

Test	Sensitivity	Specificity
LE	83 (67–94)	78 (64–92)
NT	53 (15–82)	98 (90–100)
Either LE or NT positive	93 (90–100)	72 (58–91)
Microscopy, WBCs	73 (32–100)	81 (45–98)
Microscopy, bacteria	81 (16–99)	83 (11–100)
LE, NT or microscopy positive	99.8 (99–100)	70 (60–92)

Data presented as % (range). LE Leukocyte esterase; NT Nitrite; WBCs White

Diagnosis: culture[29]

When diagnosing a UTI, laboratory culture is the gold standard. Since urine is sterile, a UTI is suggested by the presence of bacteria in a significant enough quantity along with contemporaneous signs of an active infection. A growth medium containing urine is added, allowing microorganisms and antibiotic sensitivity to be detected. After about a day for the culture, the tentative diagnosis can be examined. According to all main UTI standards, a culture is necessary in order to diagnose a UTI. What is the bacterial count required to diagnose pediatric UTIs? Guidelines and collection techniques have different thresholds. The widely cited threshold of 100,000 CFU/mL for a single organism is derived from a groundbreaking study conducted in 1956 on adult women by Kass. Does this cutoff apply to kids? American recommendations recommend a threshold of 50,000 CFU/mL for SPA and catheter specimens, together with concomitant

pyuria. An even lower threshold of 10,000 CFU/mL, according to more recent data, would marginally improve sensitivity without compromising diagnostic specificity. Many recommendations state that because SPA is very lightly contaminated, any growth on it is odd.

The presence of bacteria in the urine without an active infection is known as asymptomatic bacteriuria (ASB). The prevalence of ASB in children is estimated to be 1.4%–1.9%. A UTI is not suggested by bacterial growth in the absence of signs of an active infection, such as pyuria. These diagnostic cutoff points are not binary in actuality.

Low colony counts on culture media could be an indication of ASB, contamination, or early infection. On rare occasions, early infection or immunocompromise may not present with pyuria. Results from screening and culture must always be interpreted within a clinical setting[30].

Minimum colony counts that are indicative of a urinary tract infection

	CFU/mL	CFU/L	Comments
Clean catch (midstream)	$\geq 10^5$	$\geq 10^8$	Mixed growth is usually indicative of contamination. Sitting a girl backward on the toilet is a good way to spread the labia when collecting midstream urine
In and out catheter specimen*	$\geq 5\times10^4$	$\geq 5\times10^7$	Mixed growth is usually indicative of contamination. Specimens from indwelling catheters are less reliable
Suprapubic aspiration	Any growth	Any growth	

Contamination:

Evaluation of UTI is complicated by contamination. If one uropathogen is the source of the UTI, the presence of numerous organisms indicates sample contamination. When you void, incidental flora that colonises your perigenital skin may wash into your urine sample. Misdiagnosis can happen if a single contaminant predominates in the culture or if a genuine uropathogen is hidden in the mixture. Cleaning the perigenital skin before sample collection and avoiding contacting the specimen jar or pressing the jar up against the child's skin will help minimize contamination[30].

Imaging:

In the past, recommendations called for a rigorous imaging surveillance to spot renal damage and UTI-related consequences. It is widely recognized that structural abnormalities detectable on ultrasonography or recurrent UTIs account for the majority of children at risk of problems. Therefore, several new guidelines recommend less extensive imaging for recurrent UTIs and none at all after an older child's first uncomplicated UTI.

National Institute for Health and Clinical Excellence (NICE) UK[16]	
Age 0–6 months	
Uncomplicated first UTI	Outpatient ultrasound.
Atypical UTI	Inpatient ultrasound, outpatient DMSA scan and VCUG.
Recurrent UTI	Inpatient ultrasound, outpatient DMSA scan and VCUG.
Age 6 months–3 years	
Uncomplicated first UTI	No imaging.
Atypical UTI	Inpatient ultrasound, outpatient DMSA scan.
Recurrent UTI	Outpatient ultrasound, outpatient DMSA scan.
Age >3 years	
Uncomplicated first UTI	No imaging.
Atypical UTI	Inpatient ultrasound.
Recurrent UTI	Outpatient ultrasound, outpatient DMSA scan.
American Academy of Pediatrics (AAP)[21]	
Age 0–24 months	
Any febrile UTI	Ultrasound.
Complex or atypical circumstances	VCUG.
Recurrent UTI	Further evaluation.
Canadian Paediatric Society (CPS)[35]	
Any febrile UTI aged <2 years	Ultrasound.
European Association of Urology/European Society for Paediatric Urology23	
Any febrile UTI	Ultrasound.
Suspicion of VUR and/or pyelonephritis	VCUG and/or DMSA scan.
Spanish Association of Paediatrics[36]	
UTI that requires admission, is recurrent or with suspected complications	Inpatient ultrasound.
First UTI if aged <6 months	Outpatient ultrasound.
Recurrent or atypical UTI	Outpatient ultrasound, and VCUG or contrast enhanced bladder ultrasound especially if aged <6 months, and DMSA scan especially if aged <3 years.

Ultrasound[31]

When imaging is necessary, ultrasound is a suitable first-line examination that is non-invasive and reasonably priced. Anatomical anomalies and hydronephrosis or hydroureter indicating blockage or VUR can be detected by ultrasound. NICE recommends ultrasound for infants under 6 months old with their first UTI only if the infection is unusual or not improving with treatment. American and Canadian guidelines recommend ultrasound for all children under 2 years old with their first UTI, while European Association of Urology guidelines recommend ultrasound for all children with their first feverish UTI.

Although routine imaging after a first UTI is not cost-effective, the NICE approach takes the view that imaging in younger children and other carefully chosen cases is more likely to uncover results of clinical importance. The majority of higher grade and clinically relevant instances of VUR should be detected by ultrasound, albeit it cannot rule out all cases.

KUB ultrasound	MCUG/VCUG	DMSA scan
	Uses	
Assess the presence and degree of hydronephrosis or ureteric dilation and signs of urinary tract obstructions or any other renal anomalies Assess the fluid collection and the bladder capacity and postvoid residual	Assess the presence of posterior urethral valves Assess the presence of VUR Assess the bladder capacity, trabeculation and postvoid residual. Gold standard for VUR diagnosis	The gold old standard for renal scar detection and to assess the renal function
	Indication	
Concurrent bacteremia Atypical UTI organism: *S. aureus* *Pseudomonas* Infancy age Inadequate response to 48 h of IV antibiotics Abdominal mass Abnormal voiding Recurrent UTI First febrile UTI and no prompt follow done Renal impairment Significant electrolyte disturbance No antenatal renal tract imaging in 2–3 trimester	Abnormal renal ultrasound Hydronephrosis Thick bladder wall Renal scarring Abnormal voiding postfebrile UTI Postsecond febrile UTI Suspicion of VUR and posterior urethral valves	Clinical suspicion of renal injury Reduced renal function Suspicion of VUR And obstructive uropathy
	Limitations	
Does not assess function Cannot diagnosis VUR	Radiation exposure Invasive Unpleasant to perform postinfancy	Cannot determine old versus new scarring

Dimercaptosuccinic acid (DMSA) scan[32]

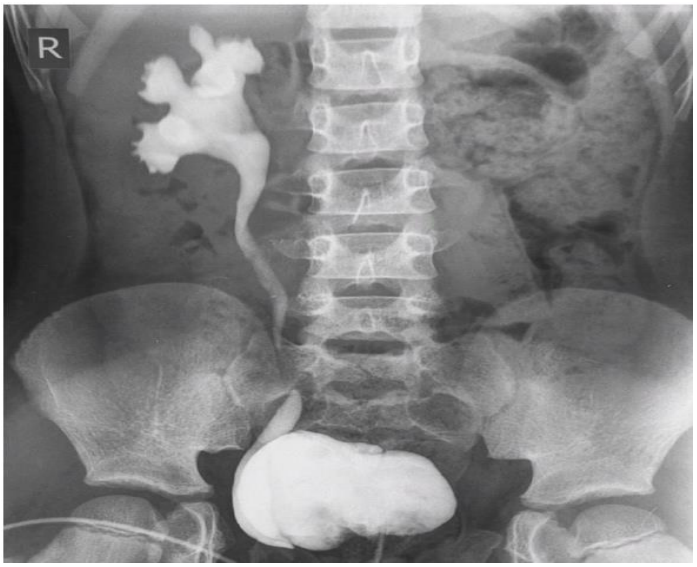
A nuclear isotope uptake scan is called a DMSA scan. Depending on when the test is performed, decreased uptake in the kidney may indicate either acute malfunction (pyelonephritis) or long-term injury (scarring). Although it is rarely necessary in the short term, it could influence long-term care. If the UTI is unusual, recurrent, or the original ultrasonography was noticeably abnormal, DMSA might be recommended.

VCUG/MCUG:

A real-time X-ray, is used in Voiding Cystourethrograms (VCUGs) to determine the path of contrast that is introduced by bladder catheterization. It is possible to diagnose ureteric reflux, bladder filling, and emptying. Although VCUG is the gold standard for locating and measuring VUR, the process is intrusive and has a radiation risk. There isn't enough agreement on who and how to image.

Cost, radiation exposure, and invasiveness must be weighed against the possibility of finding an anomaly that could require the child's care to be altered. While imaging is not necessary for the majority of children with uncomplicated UTIs that occur outside of infancy, some children who have UTIs run the risk of long-term morbidity. For kids with specific indications, tailored imaging and surveillance techniques are still appropriate.

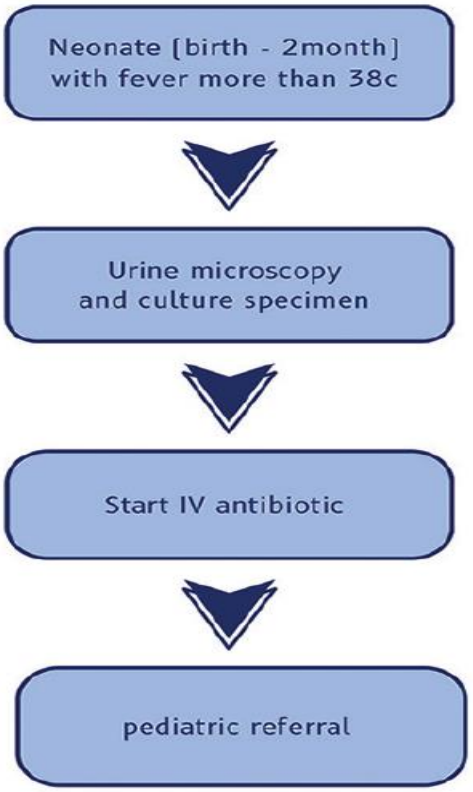
unilateral grade 4 vesicoureteral reflux on voiding cystourethrogram.



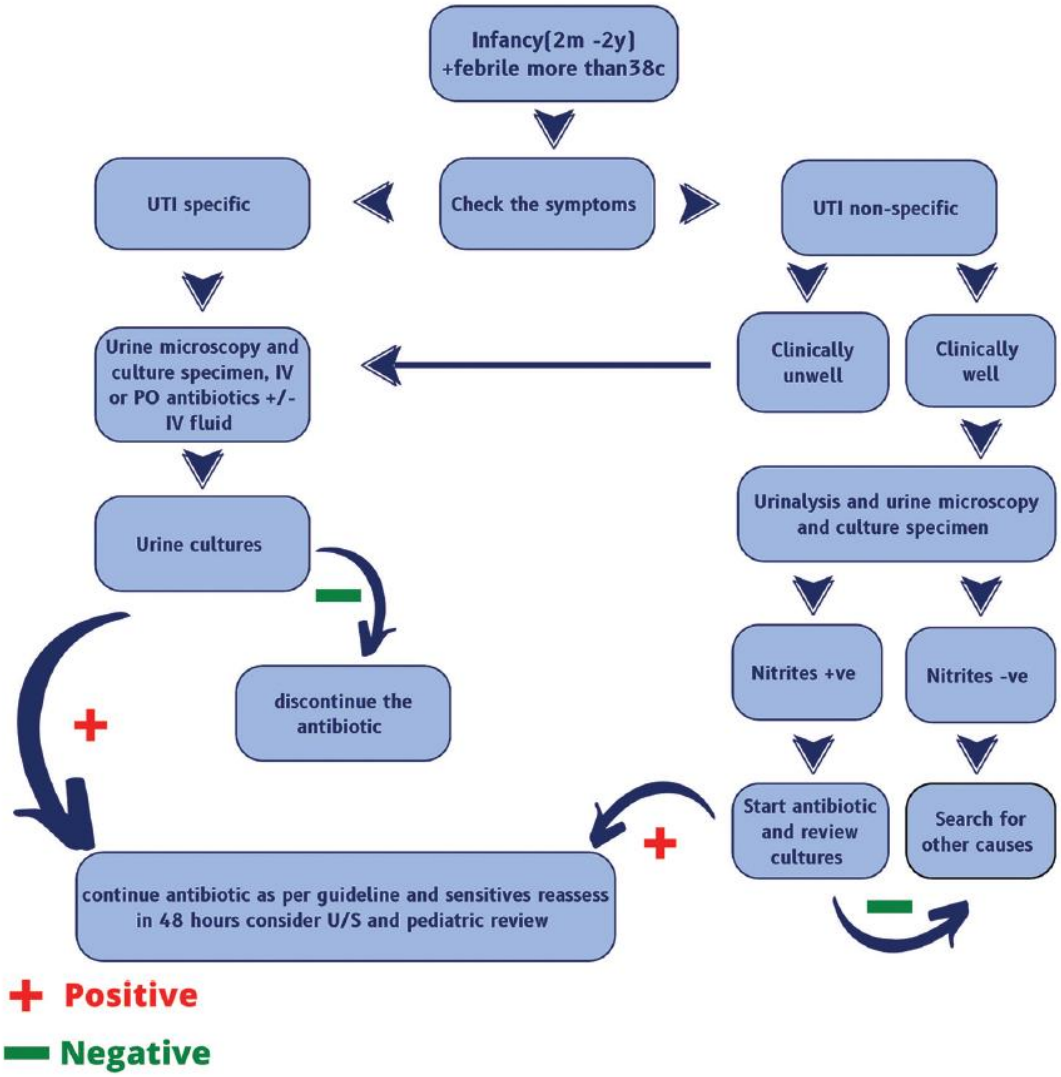
URINARY TRACT INFECTION MANAGEMENT[33]

The goals of treatment are to eradicate the infection, avoid serious systemic illness, and lessen the likelihood of long-term consequences like HTN and kidney scarring. After obtaining a history, physical examination, and positive urinalysis on a correctly collected specimen of urine, the decision to begin empirical treatment should be based on the clinical suspicion of the illness.

Most patients can be treated as outpatients if the child is nontoxic and can handle oral medication. Urine culture findings may be awaited before starting treatment if the diagnosis is unclear and the child is not toxic. Medication regimens should be adjusted based on urine culture-sensitive antibiotic results in both situations.



The child's age, underlying medical conditions, the severity of the illness, the child's capacity to take oral drugs, and—most importantly—local patterns of uropathogen resistance all play a role in the therapy choice. In ASB without + WBCS in urine analysis, antibiotic treatment should be avoided unless a planned surgical operation or a UTI causes complications. Oral antibiotics are most likely to be effective in treating simple UTIs. 48 hours after starting an antibiotic, each patient should have a follow-up evaluation, and the course of treatment should be adjusted based on sensitivity and culture.



Medical Management[34]:

In ASB without WBCS in urine analysis, antibiotic treatment should be avoided unless a planned surgical operation or a UTI causes complications. Oral antibiotics are most likely to be effective in treating simple UTIs. 48 hours after starting an antibiotic, each patient should have a follow-up evaluation, and the course of treatment should be adjusted based on sensitivity and culture.

A little child under two months old should be referred to a pediatrician and start parenteral antibiotics right away. After this age, the management will change based on the location and severity of the infection. Since parenteral and oral therapy are equally beneficial, the following is

a list of typical indications for parenteral therapy and/or hospitalization:

- A toxic or clinically sick appearance
- Extreme dehydration, vomitings or intolerance to oral drinks, necessitating intravenous fluids.
- High grade fever >102.4 F
- A febrile newborn with severe pyelonephritis under the age of two months.
- Not improving after receiving outpatient treatment.
- High-grade VUR grade (4-5) or suspected obstructive uropathy.

Parenteral antibiotics should be switched to oral based on the urine culture result when clinical improvement is observed, which is usually within 24–48 hours. Regardless of the route of antibiotic administration, therapy should last 7–14 days in cases of febrile UTI and pyelonephritis and 3–5 days in cases of afebrile UTI and cystitis.

Selection of antibiotic[35]:

It is recommended that children without genitourinary malformations be treated for UTIs using first-line oral cephalosporins of the third generation, such as cefixime, cephalexin, and cefpodoxime. Add ampicillin or amoxicillin if there is a suspected enterococcal infection. Aminoglycosides, such as gentamicin, and third or fourth generation cephalosporins, such as cefotaxime, ceftriaxone, and cefepime, are appropriate first-line parenteral medicines for the empirical therapy of UTI in children.

Based on the findings and sensitivities of the urine culture, definitive therapy is administered. After the right antimicrobial medication is started, the clinical status of the majority of patients improves in 24 to 48 hours. The expansion of antimicrobial therapy may be necessary in children whose clinical state (apart from persistent fever) worsens or does not improve as expected after 48 hours of starting antimicrobial therapy and the findings of culture and sensitivity are not yet available. The majority of the empirical regimens mentioned above do not offer sufficient coverage for Enterococcus. Furthermore, renal and bladder ultrasonography (RBUS) to determine whether a renal abscess, surgically correctable anatomic abnormalities, or obstruction exists, should be carried out as soon as feasible in children who get worse or don't get better within 48 hours.

Oral antibiotics regimens for paediatrics urinary tract infection

Antibiotic	Therapeutic dose	Side effect and complication	Bacterial coverage	Contraindication
TMP	Dose not mentioned like the others Not recommended for children younger than 2 months of age	Nausea and vomiting Pruritus Rash, Stevens-Johnson syndrome Hyperkalemia thrombocytopenia leucopenia Have multiple drug interactions	*E. coli* *Enterobacter* spp. *Klebsiella* spp. *P. mirabilis* Coagulase negative S. aureus	In renal impairment and folate deficiency
TMP-SMX	30–60 mg/kg SMZ 6–12 mg/kg TMP Divided Q 12 h Not recommended for children younger than 2 months	Same as TMP Hepatotoxicity Seizures, vertigo Peripheral neuropathy Kernicterus Can lead to pseudomembranous colitis Causes hemolysis in G6PD deficiency	Same as TMP Broader coverage of *Proteus* and *Morganellea* spp.	
Cephalexin	50–100 mg/kg divided Q 8 h	Nausea and vomiting Cholestatic hepatitis Neurotoxicity Blood dyscrasia Headache Risk of Clostridium difficile, Candida and *Enterococcus* spp. Infection	*E. coli* Mirabilia *Klebsiella* spp.	
Augmentin	20–40 mg/kg divided Q 8 h Take with meals to enhance absorption	Rash (are associated with infectious mononucleosis and/or leukaemia Transient disturbance of liver enzymes Nausea and vomiting Diarrhea Cholestatic hepatitis Electrolyte disturbance Neurotoxicity Blood dyscrasia Risk of *Clostridium difficile*, *Candida*, and *Enterococcus* spp. Infection	Useful against b-lactamase strains of *E. coli, Enterobacter* spp. and *Klebsiella* spp.	
Norfloxacin		Rash, pruritis Nausea and vomiting, diarrhea Phototoxicity Hearing loss and diplopia Peripheral neuropathy Tendon rupture Causes hemolysis in G6PD deficiency	*Pseudomonas* spp. Antibiotics resistant bacteria	
Nitrofurantoin	5–7 mg/lg divided Q 6 h Not recommended for children younger than 1 month Antacids reduce potency of drug	Nausea and vomiting, diarrhea Rash Vertigo Peripheral polyneuropathy Urine discoloration Hepatotoxicity is rare Pulmonary toxicity is rare Causes hemolysis in G6PD deficiency	Gram-negative and Gram-positive coverage	
Cefixime	8 mg/kg Q 24 h	Abdominal pain, diarrhea, flatulence, rash		
Cefpodoxime	10 mg/kg divided Q 12 h	Abdominal pain, diarrhea, nausea, rash		
Cefprozil		Abdominal pain, diarrhea, elevated results on liver function tests, nausea		

Antibiotic agent for parenteral treatment of a urinary tract infection

Antibiotic	Threptic dose	Side effect and complication	Bacterial coverage	Contraindication
Ceftriaxone	50–75 mg/kg/day IV/IM as a single dose or divided Q 12 h Do not use it in infant <6 weeks of age	Rash Induration at the site of injection diarrhea Elevated liver enzyme	*E. coli* *P. mirabilis* *M. morganii* *P. vulgaris* *K. Pneumoniae*	
Cefotaxime	150 mg/kg/day IV/IM divided Q 6–8 h Safe to use in infant <6 weeks of age; used with ampicillin in infants aged 2–8 weeks	Rash Induration at the site of injection Diarrhea Elevated liver enzyme Nausea and vomiting		
Ampicillin	100 mg/kg/day IV/IM divided Q 8 h Used with gentamicin in neonate <2 weeks of age And patient allergic to cephalosporins	Rash Diarrhea Pruritus Nausea and vomiting Fever	*Enterococcus* *E. coli* *P. mirabilis*	
Gentamicin	Term neonates <7 days: * 3.5–5 mg/kg/dose IV Q 24 h Infants and children <5 years: * 2.5 mg/kg/dose IV Q 8 h or single daily dosing with normal renal function of 5–7.5 mg/kg/dose IV Q 24 h Children ≥5: * 2–2.5 mg/kg/dose IV Q 8 h or single daily dosing with normal renal function of 5–7.5 mg/kg/dose IV Q 24 h Monitor the kidney function	Neurotoxicity Nephrotoxicity Ototoxicity Rash	*P. aeruginosa* *Proteus species* *E. coli* *Klebsiella*	
Meropenem	Sepsis: 20 mg/kg/dose IV		Multidrug resistance Gram-negative, Gram-positive, and anerobic organisms	
Tazocin	50–100 mg/kg/dose IV or IM		Gram-positive, Gram-negative, anaerobic includes pseudomonas and Group B strep	

Other Therapies[36]:

Immunocompromised patients are known to have fewer UTIs, particularly hemorrhagic cystitis, caused by viruses. Adenovirus and cytomegalovirus are the most common pathogens, and cidofovir is the recommended medication; however, its safety and effectiveness in pediatric patients under the age of 18 have not been shown. Determining the clinical relevance of candiduria can be challenging. Treatment for asymptomatic candiduria is rarely necessary. On the other hand, candiduria might be the only microbiological evidence of the spread of candidiasis. Patients experiencing symptoms, those experiencing neutropenia, low birth weight babies, individuals receiving renal allografts, and individuals

having urological manipulation should all receive treatment for candiduria. Brief therapy sessions are not advised. Therapy, however, has a better chance of working for seven to fourteen days.

Urinary tract tools, such as Foley catheters and stents, are usually best removed. It might be advantageous to substitute it if total elimination is not achievable. Amphotericin B deoxycholate has shown promise in a variety of dosages (0.3–1.0 mg/kg daily for 1-3 days) when combined with fluconazole (200 mg/day for 7–14 days). Oral flucytosine (25 mg/kg q. i. d.) may be helpful in treating candiduria in individuals with urological infections caused by Candida nonalbicans species if renal impairment is not present.

A pediatric infectious disease consultation is therefore advised if the patient is significantly immunocompromised, if there is an atypical pattern of organism or resistance, or if there is no response to treatment within 48 hours or if the fever lasts longer than 48 to 72 hours after starting treatment.

Complications[37]:

UTI complications, such as renal and perinephric abscesses, typically arise from obstruction of ascending pyelonephritis, which is typically caused by enteric Gram-negative bacilli or polymicrobial infection. Renal and perinephric abscesses are primarily predisposed to by diabetes mellitus and renal stones. Additionally, they arise in the context of hematogenic seed bacteremia, which is typically caused by Staphylococcus aureus. Infections in the renal and perirenal abscesses are occasionally referred to as carbuncles. Diabetes mellitus and anomalies of the

urinary system, such as benign cysts, renal stones (particularly big ones), VUR, neurogenic bladder, obstructive tumors, and polycystic kidney disease, are risk factors. Similar to acute pyelonephritis, renal and perinephric abscesses can present with fever, flank discomfort, abdominal pain, dysuria, and/or frequency of urine flow. The most helpful modalities for radiography in the diagnosis of renal or perinephric abscess are computed tomography and ultrasonography.

Antimicrobial therapy is part of the care strategy for renal and perinephric abscesses, when drainage is necessary. In addition, when a urological obstruction is present, it needs to be cleared right away.

Individuals who have renal abscesses larger than 5 cm in diameter should get antimicrobial therapy along with percutaneous drainage; for renal abscesses smaller than 5 cm in diameter, antimicrobial therapy should be started without drainage. If, after several days of therapy, clinical symptoms and radiographic findings do not improve, percutaneous draining of abscesses less than 5 cm should be considered, if technically feasible. In severe cases where medical treatment has failed, surgical drainage and/or rescue nephrectomy may be necessary for abscesses that are not appropriate for percutaneous drainage.

When an abscess develops in conjunction with an anatomical abnormality, such as big obstructive renal stones or VUR, or when it becomes too large to be treated with an antibiotic and catheter drainage, urological expertise should be consulted. If the abscess develops in a tiny, persistently pyelonephritic, poorly performing kidney that has been severely damaged by prior infection episodes, nephrectomy might also be necessary.

Drainage catheters should be kept in place for at least seven days, or until the drainage is low. If there are ongoing clinical complaints and abnormalities in the laboratory, or if the drainage does not go as planned, follow-up imaging should be performed. For both diagnostic and therapeutic purposes, patients with perinephric abscesses should undergo percutaneous drainage (ideally guided by US or computed tomography). In order to use the findings of the Gram stain and culture to inform the choice of therapy, rapid drainage, if it is possible, should ideally be carried out prior to starting antimicrobial therapy. Surgical management Surgical correction is necessary for conditions that can be corrected surgically, such as VUR, UPJO, or UVJO.

PREVENTION[38]:

In children, the natural method of UTI prevention is more beneficial. Giving children with or without VUR (first to fourth grade) antibiotic prophylaxis is no longer preferred. Urogenital hygiene education is vital, and it needs to be done correctly. Topical steroids and circumcision are two options for treating physiological phimosis. Topical steroids and estrogen creams are administered for two to four weeks in cases of labial adhesion. It is important to take into account all dietary elements that can help prevent UTIs, such as cranberries, probiotics, and breast milk. In order to reduce the rate at which UTIs reoccur in children, it is crucial that they consume enough fluids. Additionally, treating constipation and dysfunctional voiding will be prevented by starting toilet training at an appropriate age (18–24 months).

Special Cases:

Reflux: A state of Flux[39]

Previous methods presumed that VUR could result in considerable long-term kidney damage and should thus be detected at an early stage. More people are realizing that moderate hydronephrosis and VUR are probably typical physiological states that resolve on their own, and that a large portion of renal illness caused by reflux is hereditary. Aggressive identification of all VUR is not necessary, since minor scarring without other risk factors is unlikely to induce long-term renal impairment and lower grade reflux is unlikely to cause clinically significant scarring. For higher grade VUR, active management techniques should still be taken into account.

Anatomical abnormalities[40]

Renal system anatomic anomalies can increase the risk of UTI morbidity, however in industrialized countries, these abnormalities are now frequently (though not always) identified via standard prenatal ultrasonography screening. Significant deviations demand the proper amount of investigation.

Follow-up/monitoring[40]

Following infants with regular urine cultures in ASB is not usually advised. Follow-up cultures should only be carried out when a febrile sickness without an explanation first appears. Additionally, there's no need to follow any children with normal imaging. However, to stop or delay the evolution of chronic kidney disease, close observation and assessment are necessary for recurrent infections, abnormal imaging results, impaired kidney function, elevated blood pressure, and/or proteinuria.

VARIOUS ARTICLES SHEDDING LIGHT ON CLINICAL PROFILE OF UTI IN NEONATES WITH SUSPECTED SEPSIS AND UTILITY OF DIPSTICK

Najeeb at al. (2013) at the Department of Microbiology, Army Medical College, Rawalpindi measured the performance characteristic of dipstick tests for rapid diagnosis. In a patient cohort of 300 samples, this study showed that urine dipstick test may be considered for rapid urinalysis to diagnose UTI. Combined sensitivity of LE and NIT was 75.74% while specificity was 68.90%. Out of 300 samples, 136 were culture positive and 164 were culture negative. Out of 136 positive culture results, 103 were dipstick positive and 33 were negative. Sensitivity, specificity, positive predictive value and negative predictive value of both nitrite and leukocyte esterase were 75.74%, 68.90%, 66.66% and 77.40% respectively and urine culture was considered as a validation gold standard. They claim that in resource limited settings, urine dipstick is a reliable way to rule out urinary tract infection which can help assist in reducing misdiagnosis and mis-prescription of antibiotics.

In a similar study by Dr Ratna Baral (2017), 202 urine samples were evaluated with the rapid nitrate dipstick test using urine culture as the comparison standard and 46 patients tested positive using the dipstick test but 42 were found to be culture positive in the cohort. The overall sensitivity, specificity, positive and negative predictive values of nitrite test in relation to culture were calculated to be 69.04%, 89.4%, 63.0% and 91.6%, respectively. Dr Baral reveals that the rapid nitrate dipstick in conjunction with the urine culture for diagnosis can function as a rapid and highly sensitive combination to identify markers for bacterial UTI in district laboratories where culture facilities are rare.

A recent study by Lugira et al. (2022) reported a significant prevalence of UTI in neonates especially in premature babies, and explored the use of Ciprofloxacin, Amikacin and nitrofurantoin as first-line antibiotics in these cases. They utilized across-sectional analytical hospital-based study that included 152 neonates with clinical sepsis who were admitted at Dodoma regional referral hospital in Egypt from January to June 2020. Cases were confirmed with both Dipstick and bacterial colony culture showing similar sensitivity. There were 28 cases of UTI among the 152 sepsis cases (18.4% of cohort) with ~64% of them associated with Klebsiella pneumoniae and ~35% Enterobacter bacterial agents. It was studied that the bacterial isolates were 90% sensitive to ciprofloxacin and 60% sensitive to amikacin.

It has been reported previously that the occurrence of UTI is reportedly higher in pre-term than in full-term neonates. However, the true prevalence of UTI in preterm neonates is difficult to determine, as sterile urine cultures are not reliably obtained in all suspected sepsis assessments due to assumed complications of urine collection processes. A 2020 study by Wael Mohammed and team (Egypt) aimed to study the prevalence of UTI in neonates admitted to NICU and identify potential predictors of increased UTI risk in NICU populations. In their cohort, the prevalence of culture-proven UTI was 6.67% and was found to be more prevent among full-term neonates (70%). They found that only both fever and pyuria together were the only significant clinical associations with UTI. Their binary logistic regression methods showed that neonates with pyuria were almost 6 times likelier to have UTI, while having only fever by itself constituted far lower odds of having UTI (only 0.166x).

Another single center study by Youssef et al. (2015) with 206 neonate cohort over a study period of 6 months showed possible UTI in a total of 75 newborns in the studied cohort. According to their study design , ‘The diagnosis of UTI was established by the presence of at least 5 leukocytes per high power field’ and Urine culture, CBC (complete blood count), blood culture, and ultrasound scanning were also done in required patients. In the 75 possible UTI cases in this scenario, they divided them into two groups : Group I (Negative cases) without UTI that included 44 neonates (31 males and 13 females) and Group II (Positive cases) with UTI which included 31 neonates (24 males and 7 females). The incidence of UTI in NICU was 15.05% (33/206), prevalence among suspected cases of UTI in NICU was 41.3% (33/75), and of the 39 neonates with sepsis 33 had UTI (79.5%). Of the positive cases, 77.4% were full-term neonates and 22.6% were preterm neonates. Of the 31cases with positive urinary culture there were 18 cases (58.1%) showing Escherichia coli, and 13 cases (41.9%) were positive for Klebsiella.

In a study by Cleper et al. (2014), out of 64 patients with neonatal UTI (55 male and 9 female), VUR was diagnosed by VCUG in 13 of the patients (11 male and 2 female). Several parameters, such as patient sex, age at UTI diagnosis, causative pathogen and ultrasonographic findings, were comprehensively reviewed and then correlated with VUR instances. They found that UTI was 6 times more common in males than females, though VUR did not have a gender discrepancy. VUR was also associated with in the younger side of the cohort (>11.4+- years of age compared to <15) and was diagnosed at a higher rate in neonates with Klebsiella-induced UTI compared to E.coli -UTI. Serum creatinine

data available for the patient cohort also showed a 2.5 times higher incidence of renal abnormality in patients with VUR post renal abnormality diagnosis.

These studies highlight the critical need for routine urine analysis and culture, along with potential quicker methods for rapid screening in all newborns with suspected UTI to prevent any risk of complications that may end in renal scarring or renal failure.

MATERIALS AND METHODS

STUDY DESIGN: A Prospective Observational study

STUDY PERIOD: 18 months (August 2022 to April 2024)

STUDY PLACE: NICU Of Shri B M Patil Medical College Hospital and Research Centre, BLDE (Deemed University), Vijayapur, Karnataka.

SAMPLE SIZE: 64 patients

INCLUSION CRITERIA:

All neonates admitted in NICU with suspected sepsis.

Suspected Sepsis: CRP > 10 mg/dL and/or Body Temperature > 99.6F

EXCLUSION RITERIA:

- Any neonate who had received antibiotics 48 hours prior was not included in the study.
- Children with known congenital genitourinary anomalies.
- Parents/ Guardians not willing to enroll the child in the study.

METHODOLOGY

After obtaining ethical committee approval from the institutional review board & informed consent from the patients, 64 neonates who were admitted to NICU of Shri B M Patil Medical College Hospital and Research Centre, BLDE (Deemed University), Vijayapur, Karnataka were included in the study.

A predesigned proforma was used to obtain Clinical History of the Neonate. A thorough physical examination with relevant investigations was carried out in all neonates. Routine blood investigations (Complete Blood Picture and CRP), urine dipstick tests, urine microscopy, and urine culture and sensitivity was done.

COLLECTION OF URINE SAMPLE

Urine sample was collected under aseptic precautions by transurethral bladder cauterization. Around 10 ml of urine was collected into sterile bottle and sent for analysis.

Investigations: -

- Urine Microscopy, Dipstick Analysis and Urine Culture and Sensitivity in all neonates with suspected sepsis admitted in NICU

Urine Microscopy: Count more than or equal to 5 pus cells per high power field in a centrifuged urine sample was considered as positive

Dipstick was considered positive if positive for either Leucocyte Esterase or Nitrites as correlated by comparison chart provided by the manufacturer.

Culture and sensitivity: Bac-Tec Urine culture.

DIPSTICK TESTS

The urine dipstick test was performed immediately on all samples of fresh urine. Results of the dipstick test (Multistix 10SG 228) were interpreted visually according to standard colour charts. The leukocyte esterase (LE) measurement was read after 2 minutes and and the nitrite measurement was read at 60 seconds and were recorded as negative or positive. In the present study Urine dipstick was considered positive if was positive for either Leucocyte Esterase, or Nitrites or both.

URINE ANALYSIS

The fresh urine samples obtained from the above techniques were subjected for urinalysis. The urine specimens were centrifuged in a standard manner, 10ml of urine was spun at the rate of 2500 rpm for 20-30mintes, supernatant decanted off and sediment resuspended in the remaining 0.2ml. The urine was examined under microscope for leukocyturia. In the present study equal to or more than 5 pus cells/HPF in a centrifuged urine sample was taken as significant pyuria.

URINE CULTURE

Urine received in sterile containers was cultured in BACTEC System, for 48 hours under aerobic condition to obtain accurate colony count. On culture of urine, a colony count of more than $>10^5$ /ml organisms of a single species was considered significant.

Samples showing insignificant growth, mixed growth of two or more pathogens or growth of non-pathogens were not considered as culture positive. The following definitions were employed in the present study.

SIGNIFICANT PYURIA

Presence of equal to or more than 5 pus cells /HPF in a centrifuged urine sample.

POSITIVE URINE CULTURE

A positive urine culture was defined as growth of $>10^5$ colonies of a single urinary tract pathogen/ml of urine specimen.

STATISTICAL ANALYSIS:

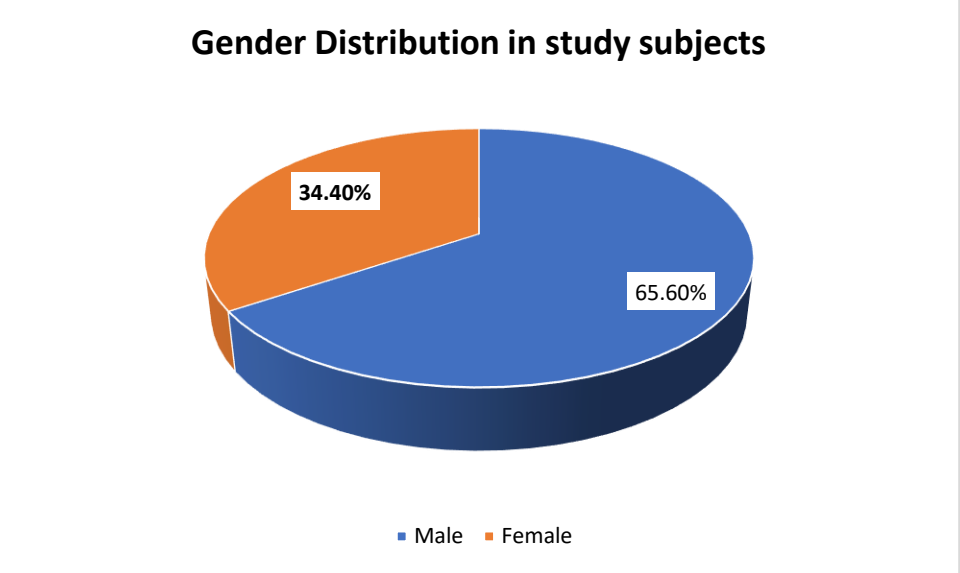
Data was collected and entered in excel sheet. Statistical analysis was done with the Statistical Package for the social sciences (SPSS) software 21.0 version.

Results were presented as Mean (Median) ±SD, counts and percentages and diagrams. Categorical variables were compared using Chi square test. Sensitivity, Specificity, PPV, NPV and Accuracy will be calculated of Urine Microscopy, culture and Dipstick methods and p-value < 0.05 was considered as statistically significant.

RESULTS

Gender Distribution in study subjects

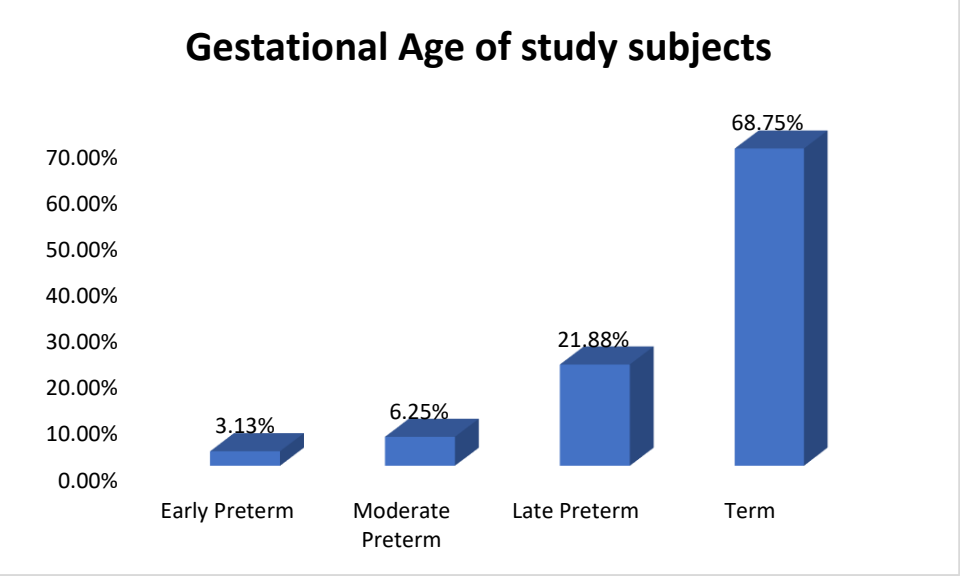
Gender	Frequency	Percentage
Male	42	65.6%
Female	22	34.4%



The sample population is predominantly male, with males accounting for 65.6% and females comprising 34.4%.

Gestational Age of study subjects

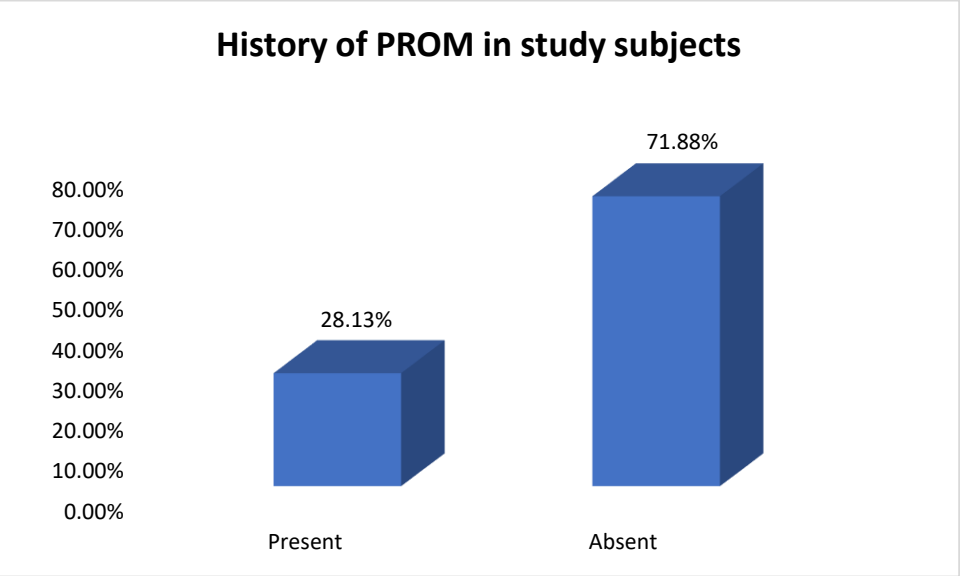
Gestational Age	Frequency	Percentage
Early Preterm	2	3.125%
Moderate Preterm	4	6.250%
Late Preterm	14	21.875%
Term	44	68.750%



The majority of births in the study were term births (68.750%), followed by late preterm births (21.875%). Early and moderate preterm births together account for a smaller portion of the population, with early preterm births at 3.125% and moderate preterm births at 6.250%

History of PROM in study subjects

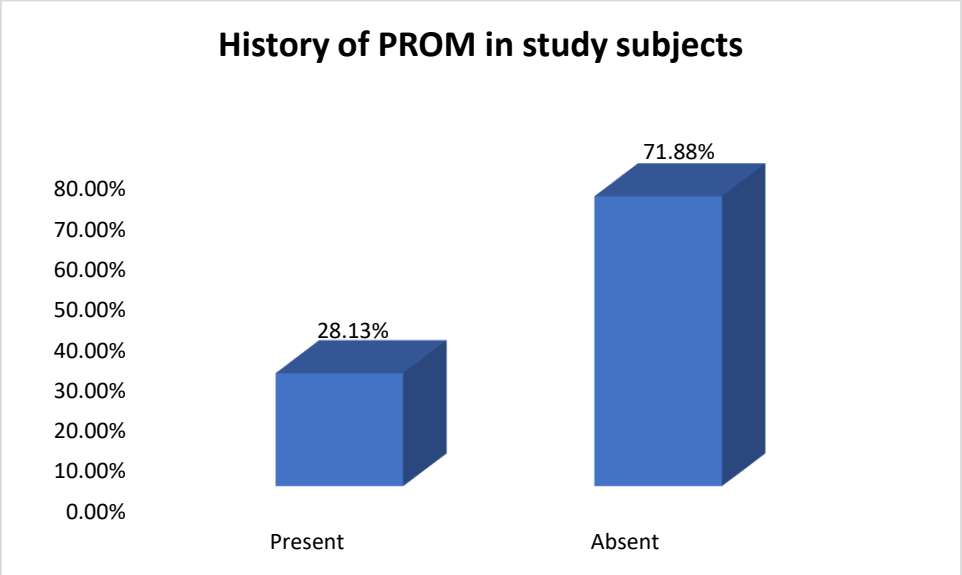
History of PROM	Frequency	Percentage
Present	18	28.125%
Absent	46	71.875%



The majority of the sample, 71.875%, did not have a history of PROM, while 28.125% did. This distribution shows that PROM was relatively less common among the study population.

History of Meconium-Stained Liquor

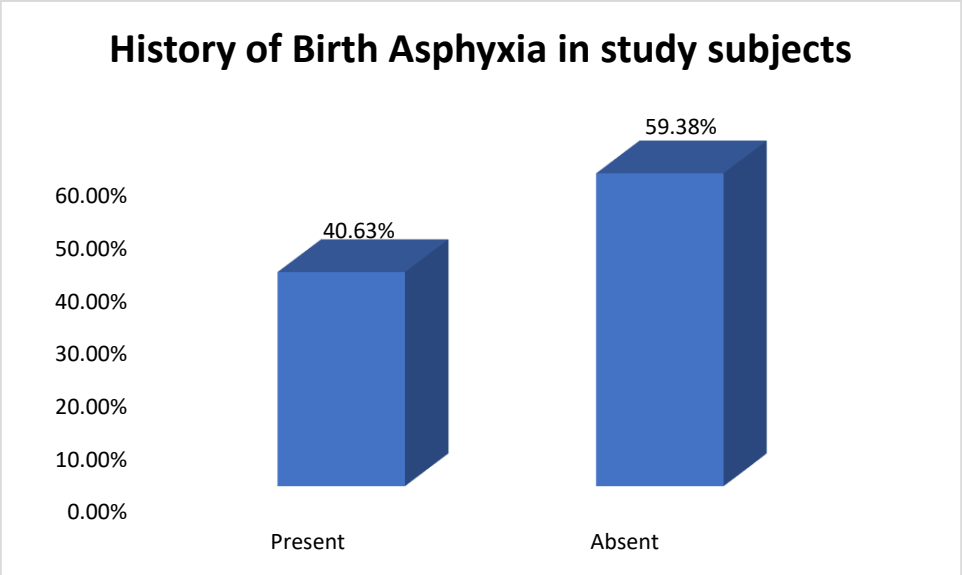
Meconium-Stained Liquor	Frequency	Percentage
Present	13	40.625%
Absent	51	59.375%



The majority of the sample, 59.375%, did not have a history of meconium-stained liquor, while a substantial portion, 40.625%, did experience it.

History of Birth Asphyxia

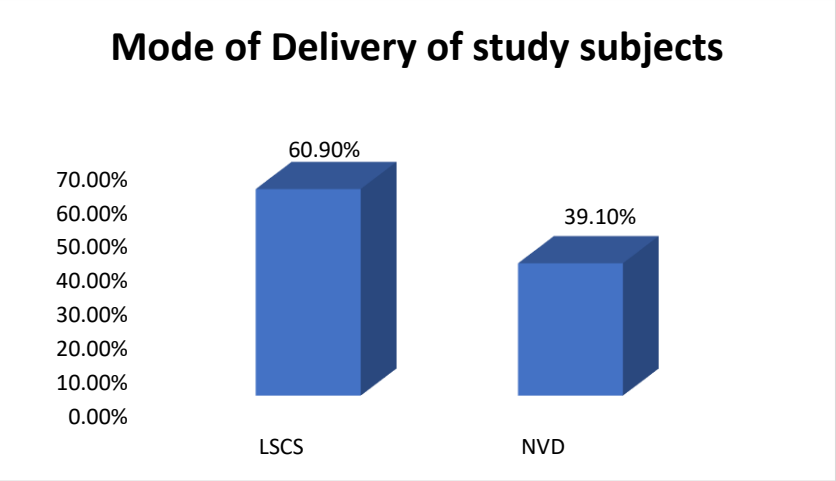
Birth Asphyxia	Frequency	Percentage
Present	26	40.625%
Absent	38	59.375%



The majority of the sample, 59.375%, did not have birth asphyxia, while a substantial portion, 40.625%, did experience it.

Mode of Delivery

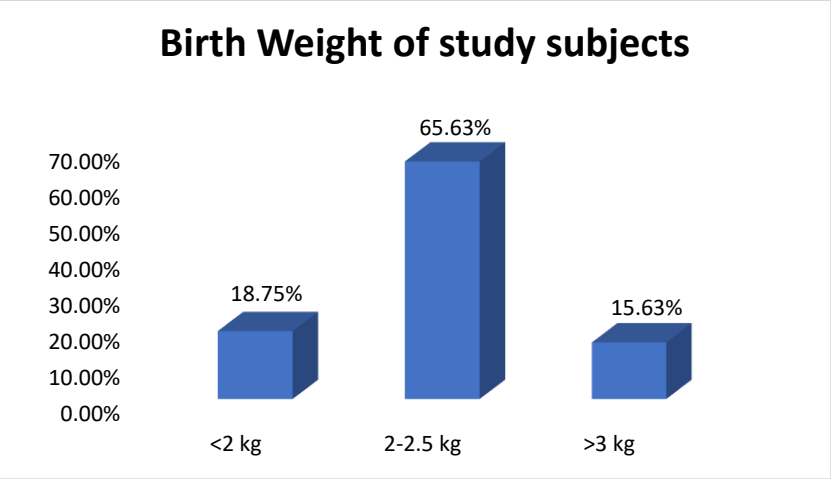
Mode of Delivery	Frequency	Percentage
LSCS	39	60.9%
NVD	25	39.1%



The majority of deliveries in the study population were by LSCS (60.9%), while a significant portion were by NVD (39.1%).

Birth Weight

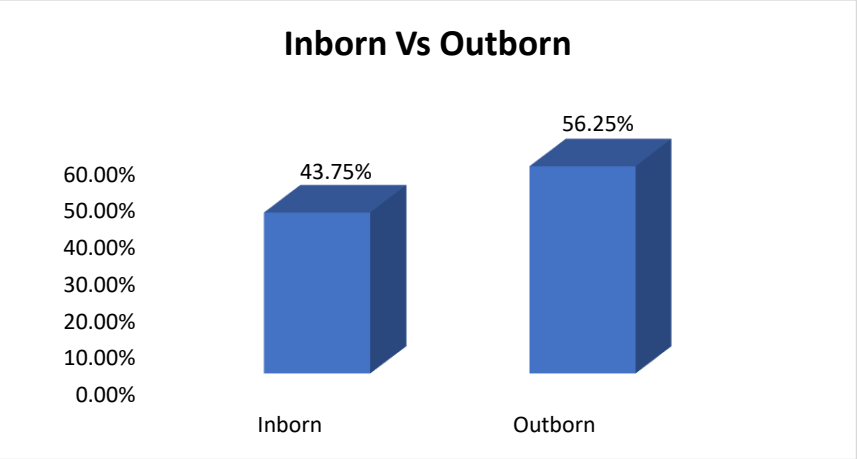
Birth Weight	Frequency	Percentage
<2 kg	12	18.75%
2-2.5 kg	42	65.625%
>3 kg	10	15.625%



The most common birth weight range among the sample is 2-2.5 kg, representing 65.625% of the population. Babies with a birth weight of less than 2 kg and more than 3 kg constitute smaller proportions, at 18.75% and 15.625%, respectively.

Inborn Vs Outborn

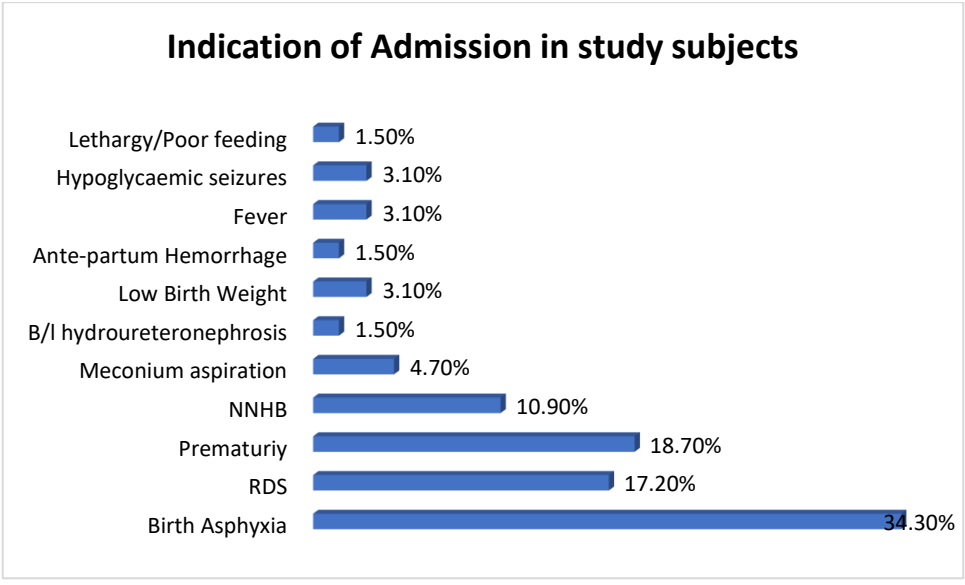
	Frequency	Percentage
Inborn	28	43.75%
Outborn	36	56.25%



The majority of the babies in the sample, 56.25%, were outborn, while 43.75% were inborn.

Indication of Admission

Indication	Frequency	Percentage
Birth Asphyxia	22	34.375%
RDS	11	17.1875%
Prematurity	12	18.75%
NNHB	7	10.9375%
Meconium aspiration	3	4.6875%
Bilateral hydroureteronephrosis	1	1.5625%
Low Birth Weight	2	3.125%
Ante-partum Hemorrhage	1	1.5625%
Fever	2	3.125%
Hypoglycemic seizures	2	3.125%
Lethargy/Poor feeding	1	1.5625%

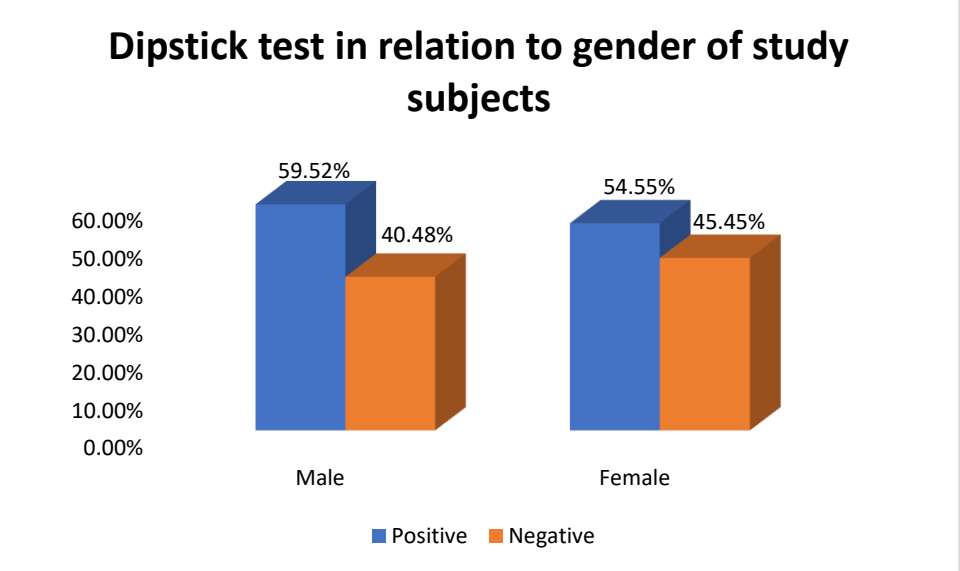


Birth asphyxia is the leading indication for neonatal care, comprising 34.375% of the cases, followed by prematurity (18.75%) and RDS (17.1875%). Other significant indications include NNHB (10.9375%) and meconium aspiration (4.6875%). Less common indications include bilateral hydroureteronephrosis, low birth weight, ante-partum hemorrhage, fever, hypoglycemic seizures, and lethargy/poor feeding, each accounting for smaller percentages of the cases.

Dipstick test in relation to gender of study subjects

Dipstick Test	Male	Female	Total
Positive	25 (59.52%)	12 (54.5%)	37
Negative	17 (40.48%)	10 (45.5%)	27
Total	42	22	64

Chi= 0.146; p=0.70^{NS}

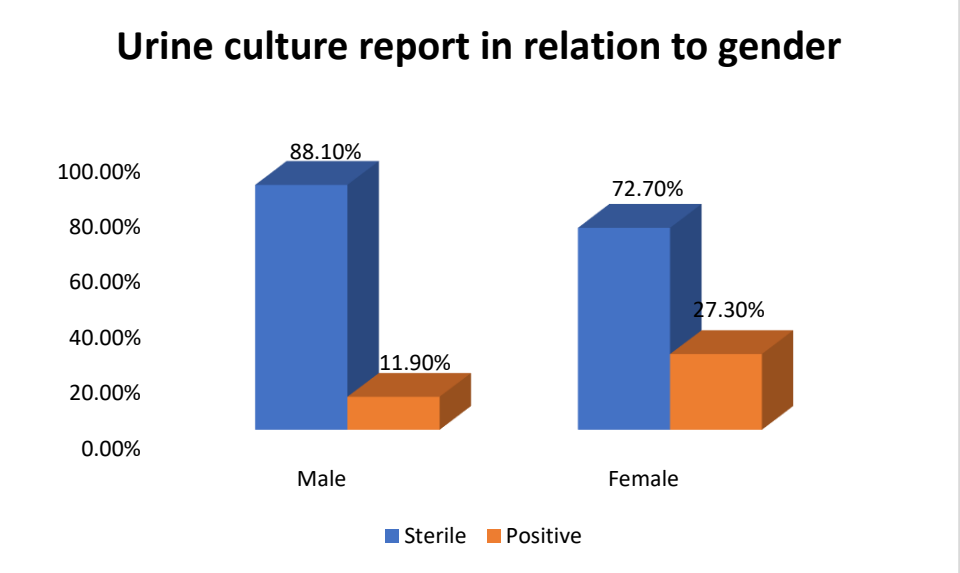


The dipstick test results show that a slightly higher percentage of males (59.52%) tested positive compared to females (54.5%). Conversely, a slightly higher percentage of females (45.5%) tested negative compared to males (40.48%). The overall positive rate for the dipstick test across all participants is 57.81%.

Urine culture report

Culture report	Male	Female	Total
Sterile	37 (88.10%)	16 (72.3%)	53
Positive	5 (11.9%)	6 (27.3)	11
Total	42	22	64

Chi= 2.39; p=0.12*

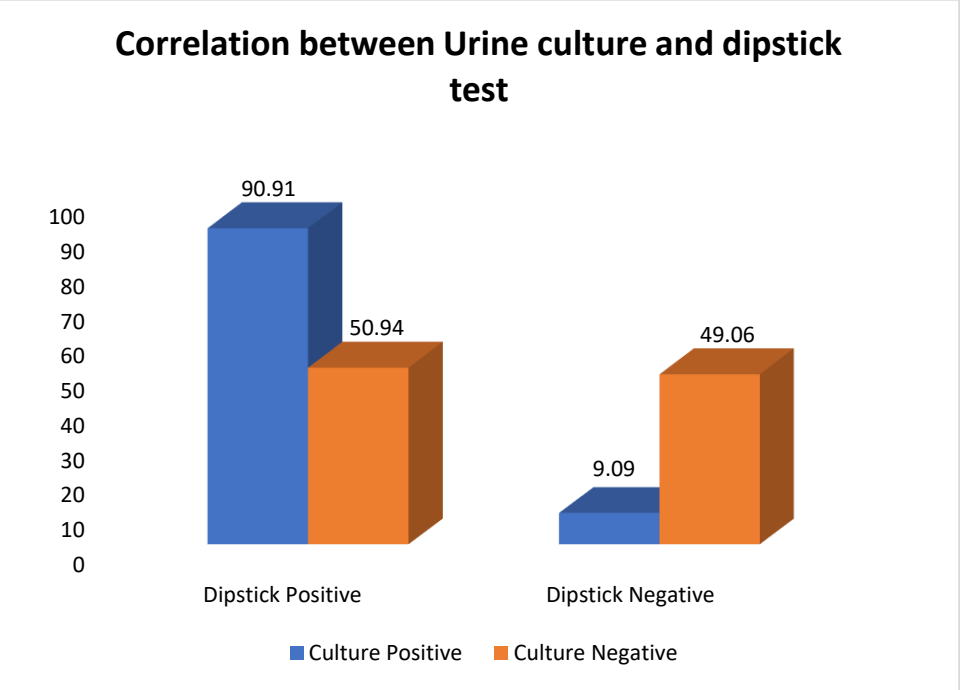


The culture report results show that a higher percentage of males (88.10%) had sterile culture reports compared to females (72.73%). Conversely, a higher percentage of females (27.27%) had positive culture reports compared to males (11.90%). The overall rate of sterile culture reports across all participants is 82.81%, while the overall rate of positive culture reports is 17.19%.

Correlation between Urine culture and dipstick test

Dipstick Analysis	**Urine Culture**		Total
	Positive	**Negative**	
Positive	10 (90.9%)	27 (9.1%)	37
Negative	1 (50.9%)	26 (49.1%)	27
Total	11	53	64

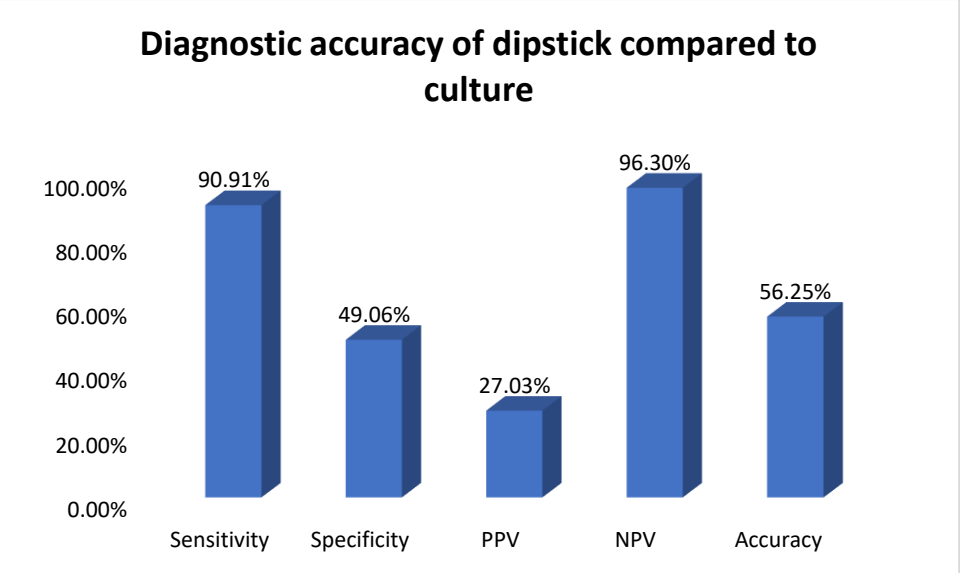
Chi= 5.96; p=0.014587



The dipstick test shows a high sensitivity (90.9%) in detecting positive urine cultures, meaning it correctly identifies most true positive cases. The specificity is moderate, with 50.9% of negative urine culture cases showing a positive dipstick result, indicating a significant rate of false positives. The overall accuracy and utility of the dipstick test should be considered in the context of its high sensitivity but moderate specificity. This finding is statistically significant

Urine culture vs dipstick

Statistic	Value	95% CI
Sensitivity	90.91%	58.72% to 99.77%
Specificity	49.06%	35.06% to 63.16%
PPV	27.03%	21.13% to 33.86%
NPV	96.30%	79.73% to 99.42%
Accuracy	56.25%	43.28% to 68.63%



The dipstick test is highly sensitive (90.91%) and very reliable in ruling out infections when the result is negative (NPV of 96.30%). However, the test has moderate specificity (49.06%) and a low positive predictive value (27.03%), leading to a significant number of false positives. The overall accuracy of the dipstick test is moderate at 56.25%. This suggests that Urine Dipstick analysis is a very good screening tool for UTI but positive results should be confirmed with a urine culture.

Dipstick Vs Variables

Variable	Dipstick		p-value
	Positive	**Negative**	
Gender			
Male	25	17	0.7
Female	12	10	
Mode of Delivery			
LSCS	22	17	0.77
NVD	15	10	
Birth Weight			
<2 kg	6	6	
2-2.5 kg	27	15	0.31
>3 kg	4	6	
PROM			
Present	16	2	0.0016*
Absent	21	25	
Meconium Stained			
Absent	29	22	0.76
Present	8	5	
Asphyxia			
Absent	22	16	0.98
Present	15	11	

Gestational age			
Early Preterm	1	1	0.93
Moderate Preterm	2	2	
Late Preterm	9	5	
Term	25	19	
Inborn/Out-born			0.15
Inborn	19	9	
Out-born	18	18	
Fever at admission			0.64
Present	24	19	
Absent	13	8	

PROM is the only variable with a statistically significant association with dipstick results (p-value: 0.0016), showing a higher percentage of positive dipstick results when PROM is present (88.89%). Other variables, including gender, mode of delivery, birth weight, meconium staining, asphyxia, gestational age, inborn/out-born status, and fever at admission, do not show statistically significant associations with dipstick results.

Urine Culture vs Variables

Variable	Urine Culture		p-value
	Positive	**Negative**	
Gender			
Male	5	37	0.12
Female	6	16	
Delivery			
LSCS	5	34	0.24
NVD	6	19	
Birth Weight			
<2 kg	4	8	
2-2.5 kg	5	37	0.21
>3 kg	2	8	
PROM			
Present	7	11	0.0039*
Absent	4	42	
Meconium Stained			
Absent	7	44	0.14
Present	4	9	
Asphyxia			
Absent	7	31	0.75
Present	4	22	

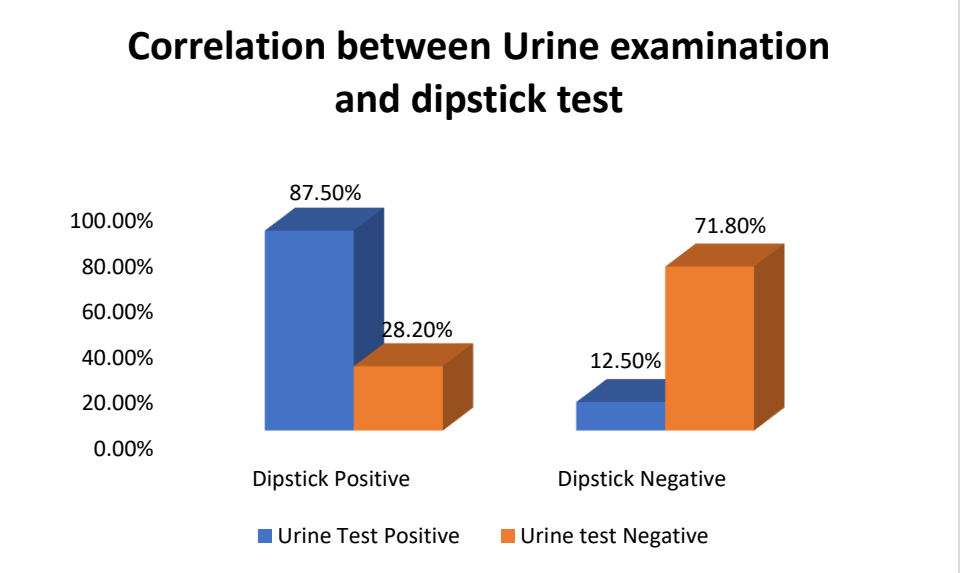
Gestational age			
Early Preterm	1	1	
Moderate Preterm	0	4	
Late Preterm	5	9	
Term	5	39	
Inborn/Outborn			
Inborn	4	24	0.58
Outborn	7	29	
Fever at admission			
Yes	6	37	0.32
No	5	16	

PROM is the only variable with a statistically significant association with urine culture results (p-value: 0.0039), showing a higher percentage of positive urine cultures when PROM is present (38.89%). Other variables, including gender, mode of delivery, birth weight, meconium staining, asphyxia, gestational age, inborn/out-born status, and fever at admission, do not show statistically significant associations with urine culture results.

Correlation between Urine examination and dipstick test

Urine Examination	Dipstick		Total
	Positive	Negative	
Positive (>5 cells)	28 (87.5%)	4 (12.5%)	32
Negative	9 (28.3%)	23 (71.8%)	32
Total	37	27	64

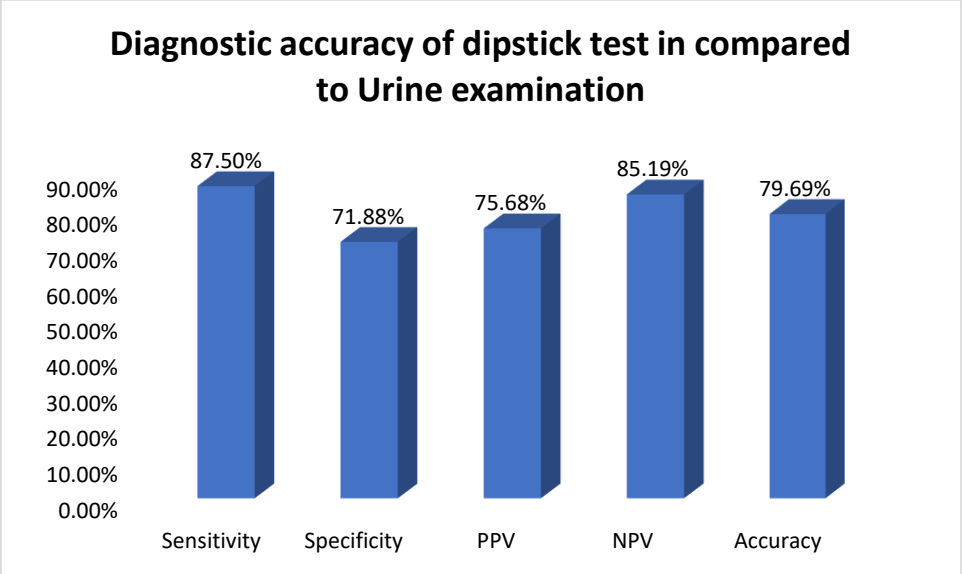
Chi square=23.1271; p-value<0.00001



The dipstick test correctly identifies significant cell counts (>5 puss cells) in 87.50% of positive urine examinations. However, it shows a 28.13% false positive rate. The dipstick test confirms the absence of significant cell counts with a 71.88% reliability in negative urine examinations.

Diagnostic accuracy of dipstick test in compared to Urine examination

Statistic	Value	95% CI
Sensitivity	87.50%	71.01% to 96.49%
Specificity	71.88%	53.25% to 86.25%
PPV	75.68%	63.78% to 84.61%
NPV	85.19%	69.15% to 93.65%
Accuracy	79.69%	67.77% to 88.72%

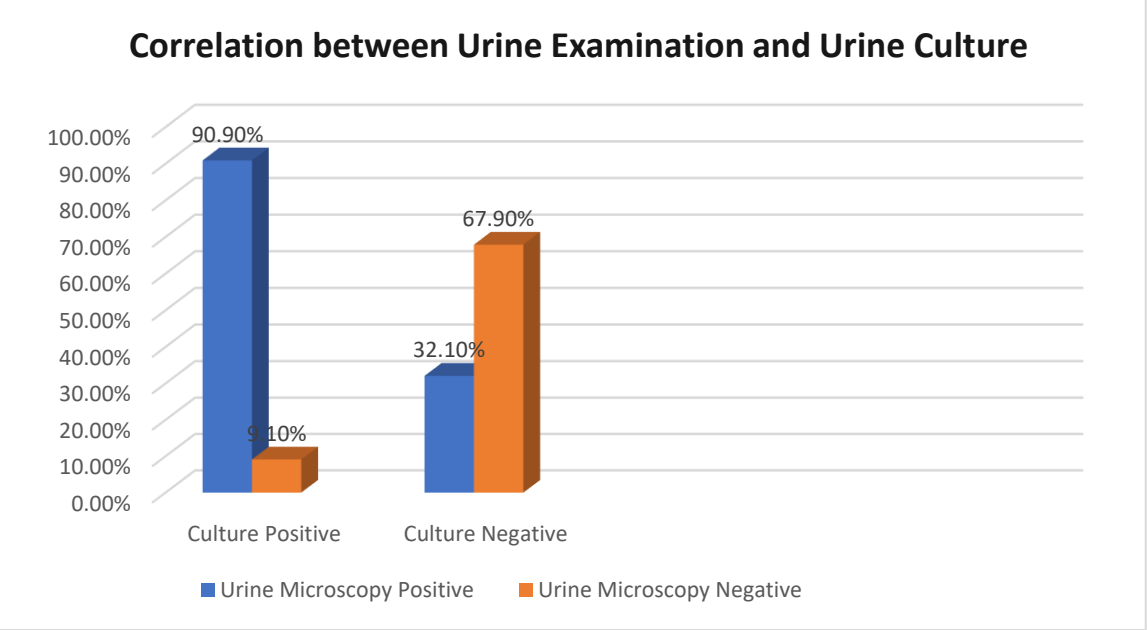


The dipstick test demonstrates a sensitivity of 87.50% (95% CI: 71.01% to 96.49%), indicating it correctly identifies 87.50% of cases with significant cell counts. Its specificity is 71.88% (95% CI: 53.25% to 86.25%), The positive predictive value (PPV) is 75.68% (95% CI: 63.78% to 84.61%), indicating that 75.68% of positive dipstick results are true positives, while the negative predictive value (NPV) is 85.19% (95% CI: 69.15% to 93.65%), meaning that 85.19% of negative dipstick results are true negatives. Overall, the accuracy of the dipstick test is 79.69% (95% CI: 67.77% to 88.72%).

Correlation between Urine examination and Urine Culture

Urine Microscopy	Urine Culture		Total
	Positive	Negative	
Positive	10 (90.9%)	17 (32.1%)	27
Negative	01 (9.1%)	36 (67.9%)	37
Total	11	53	64

Chi square=12.9281; p-value<0.000324



The urine Microscopy shows a high sensitivity (90.9%) in detecting positive urine cultures, meaning it correctly identifies most true positive cases. The specificity is moderate, with 67.9% of negative urine culture cases showing a positive urine microscopy, indicating a significant rate of false positives. The overall accuracy and utility of the urine microscopy should be considered in the context of its high sensitivity but moderate specificity. This finding is statistically significant

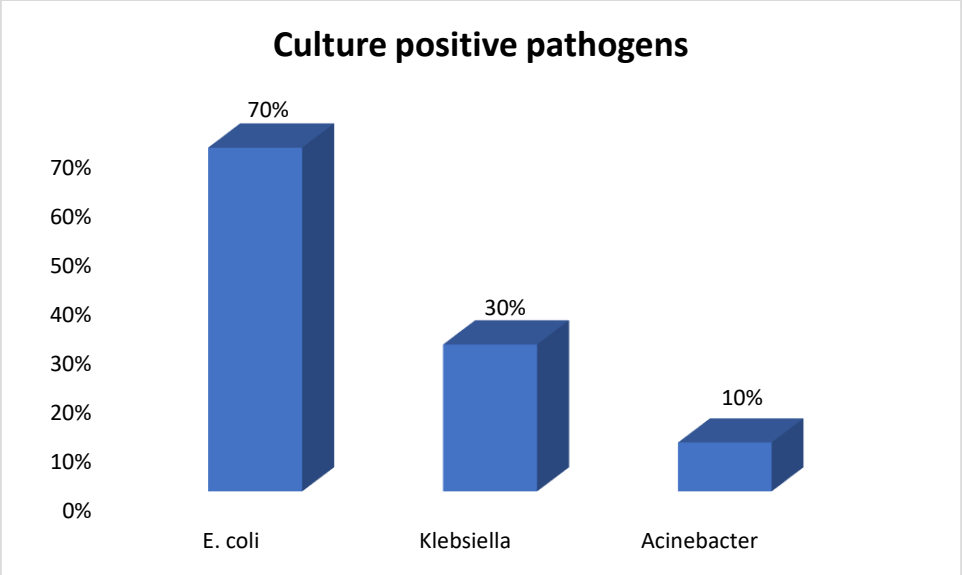
Diagnostic accuracy of Urine examination in relation to Urine Culture

Statistic	Value	95% CI
Sensitivity	90.91%	18.57% to 53.19%
Specificity	67.92%	89.11% to 100.00%
PPV	37.04%	71.51% to 100.00%
NPV	97.30%	54.25% to 66.19%
Accuracy	67.19%	54.31% to 78.41%

The Urine test is highly sensitive (90.91%) and very reliable in ruling out infections when the result is negative (NPV of 97.30%). However, the test has moderate specificity (67.92%) and a low positive predictive value (37.04%), leading to a significant number of false positives. The overall accuracy of the urine Microscopy is moderate at 67.19%. This suggests that Urine Microscopy is a very good screening tool for UTI but positive results should be confirmed with a urine culture. All the parameters of Urine microscopy are comparable with that of Urine Dipstick Analysis and hence we can infer that Dipstick analysis is as good as urine microscopy to be used as a screening tool for UTI and can be used in resource limited settings in place of Urine Microscopy.

Culture positive pathogens

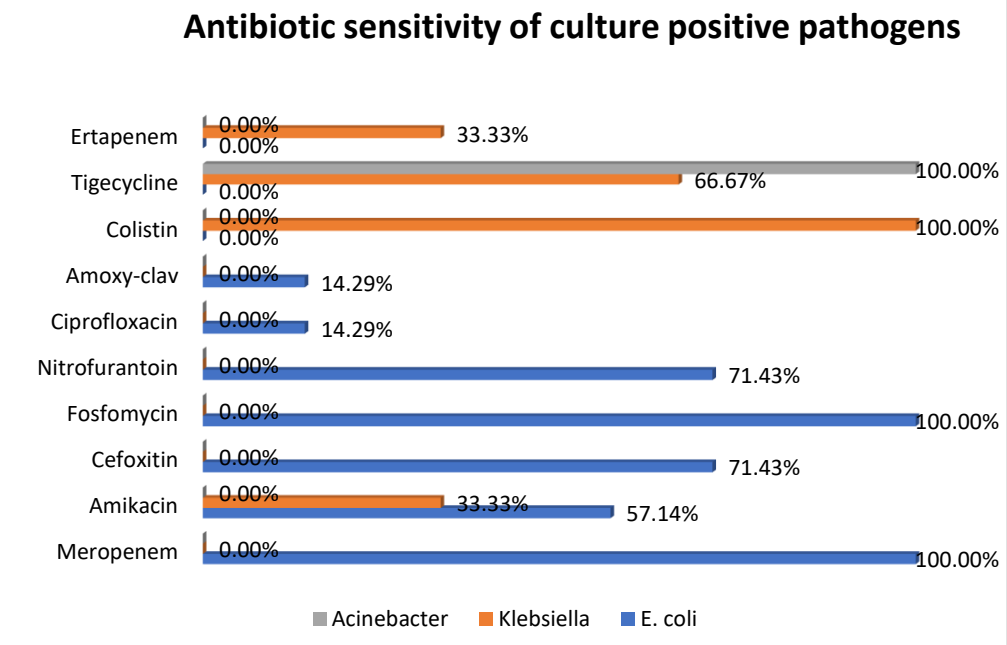
Pathogen	Frequency	Percentage
E. coli	7	70%
Klebsiella	3	30%
Acinetobacter	1	10%



E. coli is the predominant pathogen, found in 70% of the cases, indicating it is the major concern in this context. Klebsiella is also significant, present in 30% of the cases, while Acinetobacter, although less common, still represents 10% of the infections.

Antibiotic sensitivity of culture positive pathogens

Antibiotic	E. coli (n=7)	Klebsiella (n=3)	Acinetobacter (n=1)
Meropenem	7 (100.00%)	0 (0.00%)	0 (0.00%)
Amikacin	4 (57.14%)	1 (33.33%)	0 (0.00%)
Cefoxitin	5 (71.43%)	0 (0.00%)	0 (0.00%)
Fosfomycin	7 (100.00%)	0 (0.00%)	0 (0.00%)
Nitrofurantoin	5 (71.43%)	0 (0.00%)	0 (0.00%)
Ciprofloxacin	1 (14.29%)	0 (0.00%)	0 (0.00%)
Amoxy-clav	1 (14.29%)	0 (0.00%)	0 (0.00%)
Colistin	0 (0.00%)	3 (100.00%)	0 (0.00%)
Tigecycline	0 (0.00%)	3 (66.67%)	1 (100.00%)
Ertapenem	0 (0.00%)	1 (33.33%)	0 (0.00%)



E. coli is the most common pathogen and all the strains shows the highest sensitivity to Meropenem and Fosfomycin (both 100.00%), making these antibiotics highly effective against E. coli in this setting. Moderate effectiveness is seen with Cefoxitin, Nitrofurantoin, and Amikacin. Ciprofloxacin and Amoxiclav show low sensitivity and may not be as effective. Klebsiella is highly sensitive to Colistin and Tigecycline (100%). Other antibiotics show low to no sensitivity, indicating limited effectiveness. Acinetobacter in this setting shows complete sensitivity to Tigecycline (100.00%), but is resistant to all other anti-biotics.

DISCUSSION

In young children, urinary tract infections (UTIs) are one of the most frequent cause of severe bacterial infections. UTIs affect 3% to 5% of young children who are feverish, including 5% to 7% of those who don't have a known cause of fever. Identifying a UTI in a young child requires more than just diagnosing and treating the infection; it also requires looking into vesicoureteral reflux and other urinary tract irregularities that may put the patient at risk for long-term renal problems. While urine culture is the gold standard for diagnosing UTIs, it is both expensive and time-consuming, requiring at least 48 hours to yield results[41].

Recent evidence indicates that the use of rapid diagnostic tests, such as urine dipstick and microscopy, has been both cost-effective and efficient in reducing unnecessary urine sampling and cultures. These tests help guide the selective performance of urine cultures based on the analysis results, except in cases with strong clinical suspicion or prior antibiotic use. They also facilitate the initiation of empirical treatment in children with a high suspicion of urinary tract infection (UTI) while awaiting urine culture results. Many studies have shown that dipstick tests have high specificity and sensitivity, allowing for early therapeutic intervention and preventing complications. Despite extensive pediatric studies evaluating the performance of these rapid diagnostic tests in accurately diagnosing UTIs, there is a lack of sufficient research and data from developing countries, such as India[11].

This study aimed to assess the validity of the urine dipstick as an effective screening tool for early detection of childhood UTIs in neonates. It examined both individual and combined parameters to determine the maximum sensitivity and specificity, providing a better diagnostic criterion for identifying underlying urinary infections.

Gender

In this study, the population is mainly male, representing 65.6%, while females constitute 34.4%. The majority of births were term births (68.8%), with late preterm births at 21.9%. Early preterm births accounted for 3.1% and moderate preterm births for 6.3%, both being less frequent. 71.9% of participants had no history of PROM, whereas 28.1% did, suggesting that PROM was relatively common in this group. These findings align with those reported in prior studies.

Nine (14.75%) of the 48 isolates in the Gurung et al[42], study came from male patients, while 39 (25.00%) came from female patients. Some researchers in Nepal found similar results: between 30 and 51.98% of positive isolates came from females, and between 18.83 and 48.01% from males[43,44]. According to the current study's findings, women were more likely than men to get UTIs ($p > 0.05$). This result is consistent with other study done by other scientists[45,46]. It's possible that hormonal shifts, urodynamic disturbances brought on by ageing, and favorable anatomical characteristics contribute to the higher frequency of UTIs in females[47]. Patients aged 60–79 were found to be more likely to acquire UTIs (29.17%), even though the age group 21–39 accounted for the largest number of UTI-suspected patients ($p < 0.05$). This may be linked to a weakened immune system that leaves individuals more vulnerable to infection. Furthermore, the current study found that out-patients had a higher likelihood of developing a UTI (26.81%) compared to in-patients ($p < 0.05$). This is consistent with a study conducted in the United States, which discovered that most isolates that cause UTIs are associated with female outpatients[48].

Prevalence of UTI

The prevalence of UTI based on urine culture was 17.2% in our study. Out of the 11 positive cases, 5 were male and 6 were female.

A recent study by Lugira et al. (2022) reported a significant prevalence of UTI in neonates especially in premature babies, and explored the use of Ciprofloxacin, Amikacin and nitrofurantoin as first-line antibiotics in these cases. They utilized across-sectional analytical hospital-based study that included 152 neonates with clinical sepsis who were admitted at Dodoma regional referral hospital in Egypt from January to June 2020. Cases were confirmed with both Dipstick and bacterial colony culture showing similar sensitivity. There were 28 cases of UTI among the 152 sepsis cases (18.4% of cohort) with ~64% of them associated with Klebsiella pneumoniae and ~35% Enterobacter bacterial agents. It was studied that the bacterial isolates were 90% sensitive to ciprofloxacin and 60% sensitive to amikacin.

Another single center study by Youssef et al. (2015) with 206 neonate cohort over a study period of 6 months showed possible UTI in a total of 75 newborns in the studied cohort. According to their study design , ‘The diagnosis of UTI was established by the presence of at least 5 leukocytes per high power field’ and Urine culture, CBC (complete blood count), blood culture, and ultrasound scanning were also done in required patients. In the 75 possible UTI cases in this scenario, they divided them into two groups : Group I (Negative cases) without UTI that included 44 neonates (31 males and 13 females) and Group II (Positive cases) with UTI which included 31 neonates (24 males and 7 females).

The incidence of UTI in NICU was 15.05% (33/206), prevalence among suspected cases of UTI in NICU was 41.3% (33/75), and of the 39 neonates with sepsis 33 had UTI (79.5%). Of the positive cases, 77.4% were full-term neonates and 22.6% were preterm neonates. Of the 31cases with positive urinary culture there were 18 cases (58.1%) showing Escherichia coli, and 13 cases (41.9%) were positive for Klebsiella.

A 2020 study by Wael Mohammed and team (Egypt) aimed to study the prevalence of UTI in neonates admitted to NICU and identify potential predictors of increased UTI risk in NICU populations. In their cohort, the prevalence of culture-proven UTI was 6.67% and was found to be more prevent among full-term neonates (70%). They found that only both fever and pyuria together were the only significant clinical associations with UTI.

Previous reports on the prevalence of UTI in children have differed in terms of research demographics, UTI criteria, and urine collecting techniques. In a sizable population-based study conducted in Sweden, Marid and Jodal[52] discovered that among children under the age of six, the cumulative incidence rate for symptomatic UTI was 1.8% for boys and 6.6% for girls. Of 945 febrile babies under the age of one year, 5.3% had a UTI, according to Hoberman et al.[53]. Additionally, 7.5% of people without another possible cause of fever and 17% of white females with a temperature greater than 39°C were found to have this condition overall, according to the same investigators. Shaw et al.[11] collected catheterized urine specimens for culture from febrile (temperature >38.5°C) boys younger than 1 year and girls younger than 2 years who did not have another specific source of

fever by examination (bronchiolitis, stomatitis, cellulitis, perforated otitis media, croup, or varicella) or who were not concurrently taking antibiotics. This was the largest prospective prevalence study of UTI among febrile children. 83% of eligible patients in their research of 2908 children had a urine culture taken; the prevalence of UTI was 3.3% (80/2411; 95% CI, 2.6%-4.0%), with 16% of white girls and 5.9% of children without another possible cause of fever falling into this category.

The total detected prevalence for febrile children under 2 years of age in their study was 2.1% (785/37450) (95% CI, 2.0%-2.1%), while the prevalence for females and boys was 2.9% and 1.5%, respectively. According to previous statistics, girls prevailed after the first two to three months, when boys accounted for the majority of UTIs and greater prevalence was linked to higher fever (temperature >39°C) as opposed to lower fever (temperature 38.0°C–38.9°C), particularly in the first year of life.]

A urine culture was performed on 30% of the patients in the Bachur R[40] research, and a Urine analysis was performed on 47% of the feverish patients. These findings were similar to those of two earlier prospective studies of prevalence, which examined the cultures of 38%[53] and 54%[11] of feverish infants.

Type of organisms

In the present study, E. coli is the predominant pathogen, found in 70% of the cases, indicating it is the major concern in this context. Klebsiella is also significant, present in 30% of the cases, while Acinetobacter, although less common, still represents 10% of the infections.

48 (22.12%) of the 217 mid-stream urine samples in the Gurung et al.[42] investigation had culture positive. 46 (21.20%) of the total isolates were Gram-negative bacteria. Compared to the study done by other researchers, where in more than 90% of the cases, Gram-negative bacteria had been retrieved, the current study's incidence of Gram-negative bacteria is similar[54–56]. E. Coli 37 (77.08%) was the most common isolate out of all of them. This outcome aligns with the findings of some earlier research and also with this study.[57,42] The increased binding affinity of E. coli to the uroepithelial cells' glycoconjugate receptor may account for the higher frequency of the bacteria in UTIs[58].

According to a study by Baral et al.[59], E. coli was the most frequently isolated pathogen, found in 283 (74.9%) isolates, which is consistent with research by Bhansali et al. [60].

The most frequently isolated organism in the Harb et al[61]. investigation was E. coli. No isolated fungi were found in the culture. These findings concur with those of Tamimet al[62]. who found that Klebsiella sp. and E. coli were the most frequently isolated species from urine cultures of nosocomial UTI in neonatal intensive care unit patients. However, a previous study found that Candida sp[63] was more common in hospital-acquired UTIs.[64]

According to a recent study conducted in Lebanon by Sokhn et al.[65], E. Coli and K. pneumonia are the most frequently cultivated bacteria in UTI patients across various age groups. According to their research, E. Coli and K. pneumoniae are the two most common bacteria found in urine samples from patients—65.9% and 25.0%, respectively. E. coli and K. pneumoniae were the two most prevalent infections 81.2%) in a study involving 262 newborns with indirect hyperbilirubinemia, aged between 2 and 14 days, who received phototherapy treatment. The prevalence of UTI was reported to be 12.2%.[66] A further study by Chen et al[67]. that included 217 newborns with jaundice revealed a 5.5% rate of UTI, with E. coli accounting for 36.4% of the cases.

Predictive Ability of Dipstick in screening/diagnosing an UTI

In the present study, the dipstick test shows high sensitivity (90.91%) and a high negative predictive value (NPV) of 96.30%, making it reliable for ruling out infections when the result is negative. However, its moderate specificity (49.06%) and low positive predictive value (PPV) of 27.03% lead to a high rate of false positives.

Similarly, urine microscopy is highly sensitive (90.91%) and very reliable in ruling out infections when the result is negative (NPV of 97.30%). However, the test has moderate specificity (67.92%) and a low positive predictive value (37.04%), leading to a significant number of false positives. This suggests that Urine Dipstick analysis and Urine Microscopy are very good screening tools for UTI but positive results should be confirmed with a urine culture (low PPV and Specificity).

All the parameters of Dipstick Analysis are comparable with that of Urine Microscopy and hence we can infer that Dipstick analysis is as good as urine microscopy to be used as a screening tool for UTI and can be used in resource limited settings in place of Urine Microscopy where lab facility might not be available. And where a lab is available, both dipstick and urine microscopy can be done where the predictability and accuracy of diagnosing UTI increases (than each of them separately).

Historically, the authors of single center studies have found the urinalysis to have sub-optimal sensitivity when used as a screening test for UTIs in very young infants with fever. The authors of 3 of these studies defined UTIs by urine culture colony counts ≥10,000CFUs/mL, and they demonstrated the lowest sensitivities for the urinalysis (48%–81%).[68-70] In more recent studies, in which UTI has been defined by growth of ≥50 000 CFUs/mL, the sensitivities typically have been higher (84%–94%).[70,71]

In the study by Gurung et al[42], the sensitivity and specificity of the urinary dipstick test were 93.75% and 57.51%, respectively.[72,73] A study conducted in Ethiopia has also reported a decrease specificity (42.9%) and increased sensitivity (98.2%) of urine dipstick tests. These values of sensitivity, specificity, positive predictive values and negative predictive values are comparable to our study. Positive nitrite tests suggest that nitrite has been produced from the reduction of nitrate by the pathogens producing Nitrate reductase. When UTI is caused by microorganisms lacking nitrite reductase, false negative results can occur.[74]

When urine culture and dipstick results were compared in the study by Najeeb et al.[75,] urine culture was thought to be the gold standard for determining whether or not a urinary tract infection was present. The study's findings indicated that the specificity was 68.90% and the combined sensitivity of LE and NIT was 85.74%. Positive LE, NIT, and culture findings have been correlated in a number of prior investigations.

In an outpatient clinic, Laosuangkoon[76] ascertained the urine LE test's sensitivity and specificity. He found that the sensitivity of LE alone was 63.6%, but the sensitivity of combined LE and NIT was 86.7%. He came to the conclusion that, in order to avoid potential complications like hypertension and renal scarring, dipsticks should be added to the emergency room for prompt UTI detection, particularly in youngsters.

Taneja et al.'s study from 1977 revealed that the combined sensitivity and NPV of LE and NIT were 79.6% and 90.9%, respectively, while the NIT's corresponding values were 57.1%, 78.7%, 42.7%, and 86.8%. As for the LE, the corresponding values for sensitivity, specificity, PPV, and NPV were 73.5%, 58.5%, 33.0%, and 88.8%, and 57.1%, 78.7%, 42.7%, and 86.8%, respectively. He came to the conclusion that normal laboratory procedures should include dipstick tests for leukocyte esterase and nitrite assays in order to diagnose UTIs more quickly.

In a different study, Sundvall and Gunnarsson[78] found that there was a lower likelihood of positive culture findings if both NIT and LE were negative, but Khasriya et al.[79] found that the sensitivity of LE was 56% and that of NIT was 10%. His investigation yielded lower sensitivity results than our one. Leukocyte esterase sensitivity for the catheterized patient's samples was 59%, and nitrite sensitivity was 20%; the corresponding specificities were 84% and 97%.

In their evaluation of the urine dipstick screening test in febrile children aged one to ninety days, Glissmeyer et al[81]. found that the dipstick by itself can be used as a screening tool to rule out urinary tract infections in newborns and demonstrated greater predictive values for LE and NIT. They came to the conclusion that the dipstick is a trustworthy screening tool that may be used in the emergency room to diagnose UTIs.

Williamms et al[84] examined data from 95 trials including 95,703 children in a meta-analysis. The leucocyte esterase or nitrite positive dipstick had summary estimates for sensitivity and specificity of 88% (82—91) and 79% (69—87), respectively, while the nitrite alone positive dipstick had estimates of 49% (41—57) and 98% (96—99).

The nitrite test has a very strong specificity of 85–98% but a sensitivity of just 45–60%, according to the European Association of Urology Guidelines (2006). Leukocyte esterase testing is sensitive (48–86%) and specific (17–93%). As long as the results of the leukocyte esterase and nitrite tests are negative, the dipstick test can be used to quickly and accurately rule out the existence of a UTI. It is preferable to confirm the results in conjunction with the clinical symptoms and other tests if the tests are positive[85].

In a study by Zork et al.[86], the leukocyte esterase test had a sensitivity of 83(64-89)% and a specificity of 84(71-95)%, and either the leukocyte esterase or nitrite showed the sensitivity of 88(71-100)% and the specificity of 93(76-98)%. The rapid diagnostic urinary nitrite test showed sensitivity of 50(16-72)% and specificity of 98(95-100)%. Similar outcomes to the aforementioned research are also shown by our study

The sensitivity of the Urine analysis (dipstick and microscopy), according to Lohr[87], was 88% in children aged one month to sixteen. In febrile children under a year old, Hoberman[53] discovered a sensitivity of 54% for pyuria (>5 WBC per high-power field). Shaw et al[11] found that in febrile boys younger than six months and females younger than two years, the sensitivity of dipstick plus microscopy was 83%. The first to assess if Urine analysis sensitivity changed with ageing was Bachur R[69]. Among febrile children younger than two years old, we discovered that the sensitivity of Urine analysis was 82% and was stable for age subgroups. According to earlier research, the sensitivity did increase with increasing bacterial concentrations [88,89].

Urine dipsticks compared favorably with combined urinalysis and urine microscopy in the Glissmeyer et al[81]. investigation. In every measure, the dipstick matched or outperformed microscopy. Although combined urinalysis outperforms dipstick NPV statistically (98.7% [95% CI: 98.6%–98.8%] vs. 99.2% [99.1%–99.3%]), this difference might not be clinically meaningful. When compared to combined urinalysis, dipstick had a higher PPV (66.8% [66.2%–67.4%] vs. 51.2% [50.6%–51.8%).

Rehmani[90] noted that combining the two tests resulted in a lower specificity. According to Wilson et al[91]. the sensitivity (85%) and specificity (84%), when both positive nitrite and positive leukocyte esterase tests were combined, were enhanced.

In contrast to Leman et al[93].'s research, which stated that urine microscopy alone was 100% sensitive but 38.9% nonspecific, our study's urine microscopy had 86.54% sensitivity and 39.29% specificity.

A recent prospective multicenter study with 3401 feverish children under 90 days of age found that the urine analysis dipstick was 84% (95% CI: 80.8%–86.6%) sensitive and 92% (95% CI: 90.9%–92.9%) specific for UTI identification[71].

A positive urine analysis dipstick was defined in that study as having >1+ LE or any nitrites. In another study, when compared to the dipstick (positive for LE and/or nitrite) in febrile children under two years old with UTIs, an automated cell counts or Gram stain of uncentrifuged urine (the "enhanced urinalysis") was found to have high sensitivity (94%, 95%CI: 83%–99%) but lower specificity (84%, 95%CI: 82%–86%).[11]

In a different study, however, the dipstick urinalysis demonstrated comparable test performance characteristics to urine microscopy (defined as >10 WBCs/HPF or any bacteria in centrifuged samples) when it came to diagnosing UTIs in newborns who were feverish and younger than 90 days, EW Glissmeyer[81].

Ultimately, pyuria (defined as >5 WBCs/HPF) with a sensitivity of 96% (95% CI: 92.5–98.1) or any LE with a sensitivity of 97.6% (95% CI: 94.5–99.2)94 were the urine components with the highest sensitivity in the investigation of UTIs with bacteremia.

Tzimenatos et al[95] noted that the very high sensitivity of the aggregate urinalysis (the presence of any LE, nitrite, or pyuria >5 WBCs/HPF) in infants with UTIs and associated bacteremia was similar to the 99.4% sensitivity (95% CI: 98.3%–100%) identified in the recent retrospective study of 245 infants with UTIs and bacteremia done by Schroeder AR.[94]

Antibiotic Sensitivity

E. coli is the most common pathogen and all the strains shows the highest sensitivity to Meropenem and Fosfomycin (both 100.00%), making these antibiotics highly effective against E. coli in this setting which is the most common pathogen causing UTI. Moderate effectiveness is seen with Cefoxitin, Nitrofurantoin, and Amikacin. Ciprofloxacin and Amoxiclav show low sensitivity and may not be as effective. Klebsiella is highly sensitive to Colistin and Tigecycline (100%). Other antibiotics show low to no sensitivity, indicating limited effectiveness. Acinetobacter in this setting shows complete sensitivity to Tigecycline (100.00%), but is resistant to all other anti-biotics.

In the clinical setting of this study, Meropenem can be used for Empirical treatment of UTI in this NICU because 63.7% cases are sensitive to it or can be used in combination with Amikacin where 72.7% cases are sensitive to it. And anti-biotic must be changes accordingly after acquiring the culture and sensitivity report as there isolates of some highly resistant organisms.

CONCLUSION

The study focuses on urinary tract infections (UTI) in NEONATES, emphasizing their frequency and diagnostic challenges. Key findings and aspects include:

Prevalence and Impact: The prevalence of UTI based on urine culture obtained from neonates with suspected sepsis was 17.2% in our study and hence it can be inferred that UTI is a common cause of sepsis in Neonates. Therefore, all neonates with suspected sepsis should be screened for UTI.

Pathogens and sensitivity pattern

In the study population, the prevalence of UTI based on urine culture was 17.2%, with E. coli being the predominant pathogen (63.7%), followed by Klebsiella (28.1%) and Acinetobacter (9.09%).

E. coli was the most common pathogen in our setting and all the strains of it show the highest sensitivity to Meropenem and Fosfomycin (both 100.00%), making these antibiotics highly effective. Moderate effectiveness is seen with Cefoxitin, Nitrofurantoin, and Amikacin. Ciprofloxacin and Amoxiclav show low sensitivity and may not be as effective. Klebsiella is highly sensitive to Colistin and Tigecycline (100%). Other antibiotics show low to no sensitivity, indicating limited effectiveness. Acinetobacter in this setting shows complete sensitivity to Tigecycline (100.00%), but is resistant to all other anti-biotics.

In the clinical setting of this study, Meropenem can be used for Empirical treatment of UTI in this NICU because 63.7% cases are sensitive to it or can be used in combination with Amikacin where 72.7% cases are sensitive to it.

Diagnostic Tools: While urine culture is the gold standard, it is expensive and time-consuming. Therefore, it cannot be used as a screening tool. Rapid diagnostic tests like urine dipstick and microscopy are cost-effective alternatives. They help in guiding selective urine culture and enable early empirical treatment to prevent complications of UTI and also they reduce unnecessary antibiotic use. The study also aimed to validate the urine dipstick as a screening tool for detecting UTIs in neonates. It assessed sensitivity, specificity, and predictive values to optimize diagnostic criteria. The dipstick showed high sensitivity (90.91%) and negative predictive value (96.30%), making it reliable for ruling out infections emphasising its use as a screening agent in resource limited settings. However, its specificity (49.06%) and positive predictive value (27.03%) were moderate, leading to some false positives. These parameters are comparable to that of Urine Microscopy. Hence, Urine dipstick analysis is as good as urine microscopy for screening of UTI but both need to be confirmed with a urine culture because of their low specificity. When both are used together for screening, the Sensitivity and NPV reach almost 100%

Global Perspective: The study highlights variations in UTI prevalence, pathogen distribution, and antibiotic sensitivity across different regions and settings, emphasizing the need for localized approaches to diagnosis and treatment. In conclusion, the study underscores the importance of rapid diagnostic tools like urine dipstick in early UTI detection, especially in resource-limited settings. It also emphasizes the significance of antibiotic stewardship by tailoring treatment based on local resistance patterns.

REFERENCES

1. Modi N, Dutta S. Urinary tract infections in the newborn. In: Cloherty JP, Eichenwald EC, Stark AR, editors. Manual of Neonatal Care. 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2012. p. 421-431.
2. Schrag SJ, Zywicki S, Farley MM, Reingold AL, Harrison LH, Lefkowitz L, et al. Group B streptococcal disease in the era of intrapartum antibiotic prophylaxis. N Engl J Med. 2000 Jan 6;342(1):15-20.
3. National Institute for Health and Care Excellence (NICE). Urinary tract infection in under 16s: diagnosis and management. London: NICE; 2007. (Clinical guideline CG54).
4. Bauchner H, Philipp B, Dailey J, Klein JO. A randomized clinical trial of prophylactic antibiotics in newborns with umbilical artery catheters. N Engl J Med. 1986 Apr 10;314(15):961-965.
5. Ramasethu J. Prevention and treatment of neonatal nosocomial infections. Matern Health Neonatal, Perinatal. 2017; 3:5.
6. Clark R, Powers R, White R, Bloom B, Sanchez P, Benjamin DK Jr. Prevention and treatment of nosocomial sepsis in the NICU. J Perinatal. 2004 Jul;24(7):446-453.
7. Gomez B, Mintegi S, Bressan S, Da Dalt L, Blazquez D, Olaciregui I, et al. Validation of the "step-by-step" approach in the management of young febrile infants. Pediatrics. 2016 Oct;138(4)
8. Esposito S, Montinaro V, Priolo M, Sciarrone A, Terranova L, D'Errico G, et al. Management of febrile neonates in pediatric emergency departments in Italy. BMC Pediatrics. 2017 Jun 23;17(1):178.

9. Greenhow TL, Hung YY, Herz AM. Bacteremia in children 3 to 36 months old after introduction of conjugated pneumococcal vaccines. Pediatrics. 2012 Sep;130(3)
10. Tieder JS, Bonkowsky JL, Etzel RA, Franklin WH, Gremse DA, Herman B, et al. Brief Resolved Unexplained Events (Formerly Apparent Life-Threatening Events) and Evaluation of Lower-Risk Infants. Pediatrics. 2016 May;137(5)
11. Shaw KN, Gorelick M, McGowan KL, Yakscoe NM, Schwartz JS. Prevalence of urinary tract infection in febrile young children in the emergency department. Pediatrics. 1998;102(2).
12. Hoberman A, Chao HP, Keller DM, Hickey R, Davis HW, Ellis D. Prevalence of urinary tract infection in febrile infants. J Pediatr. 1993;123(1):17-23.
13. Ronald A. The etiology of urinary tract infection: traditional and emerging pathogens. Dis Mon. 2003;49(2):71-82.
14. Kaper JB, Nataro JP, Mobley HL. Pathogenic Escherichia coli. Nat Rev Microbiol. 2004;2(2):123-140.
15. Schanstra JP, Bachmann S. Pharmacology and functions of Tamm-Horsfall protein: a renal expectorant? Pflugers Arch. 2000;440(4):612-618.
16. Finnell SM, Carroll AE, Downs SM. Technical report—diagnosis and management of an initial UTI in febrile infants and young children. Pediatrics. 2011;128(3)

.

17. Peters CA, Skoog SJ, Arant BS Jr, et al. Summary of the AUA guideline on management of primary vesicoureteral reflux in children. J Urol. 2010;184(3):1134-1144.
18. Stoll BJ, Hansen NI, Sánchez PJ, et al. Early onset neonatal sepsis: the burden of group B Streptococcal and E. coli disease continues. Pediatrics. 2011;127(5):817-826.
19. Gorelick MH, Shaw KN. Screening tests for urinary tract infection in children: a meta-analysis. Pediatrics. 1999;104(5).
20. Shaikh N, Morone NE, Lopez J, Chianese J, Sangvai S, D'Amico F, Hoberman A, Wald ER. Does this child have a urinary tract infection? JAMA. 2007;298(24):2895-2904.
21. Shaw KN, Gorelick MH, McGowan KL, Yakscoe NM, Schwartz JS. Prevalence of urinary tract infection in febrile young children in the emergency department. Pediatrics. 1998;102(2).
22. Hoberman A, Charron M, Hickey RW, Baskin M, Kearney DH, Wald ER. Imaging studies after a first febrile urinary tract infection in young children. N Engl J Med. 2003;348(3):195-202.
23. Rushton HG. Urinary tract infections in children. Epidemiology, evaluation, and management. Pediatr Clin North Am. 1997;44(5):1133-1169.
24. Tseng MH, Lin WJ, Lo WT, Wang SR, Chu ML, Wang CC. Changing trend in antimicrobial resistance of pediatric uropathogens in Taiwan. Pediatr Int. 2008;50(6):797-800.
25. Zorc JJ, Kiddoo DA, Shaw KN. Diagnosis and management of pediatric urinary tract infections. Clin Microbiol Rev. 2005;18(2):417-422.

26. Subcommittee on Urinary Tract Infection, Steering Committee on Quality Improvement and Management. Urinary tract infection: clinical practice guideline for the diagnosis and management of the initial UTI in febrile infants and children aged 2 to 24 months. Pediatrics. 2011;128(3):595-610.
27. Copp HL, National Institutes of Health Chronic Prostatitis Collaborative Research Network. Recurrent urinary tract infections in children: risk factors and association with prophylactic antimicrobials. JAMA. 2010;304(21):2357-2362.
28. Shaikh N, Ewing AL, Bhatnagar S, Hoberman A. Risk of renal scarring in children with a first urinary tract infection: a systematic review. Pediatrics. 2010;126(6):1084-1091.
29. Schappert SM, Rechtsteiner EA. Ambulatory medical care utilization estimates for 2007. Vital Health Stat 13. 2011;(169):1-38.
30. Johnson JR, Stamm WE. Urinary tract infections in women: diagnosis and treatment. Ann Intern Med. 1989;111(11):906-917.
31. Mabeck CE. Treatment of uncomplicated urinary tract infection in non-pregnant women. Postgrad Med J. 1972;48(556):69-75.
32. Stark RP, Maki DG. Bacteriuria in the catheterized patient. N Engl J Med. 1984;311(9):560-564.
33. Kunin CM. Detection, prevention, and management of urinary tract infections. 4th ed. Baltimore: Williams & Wilkins; 1987.
34. Savage DC, Wilson MI, Ross EM, Fee WM, Barr JG. Controlled trial of therapy in covert bacteriuria of childhood. Lancet. 1975;1(7907):358-361.

35. Coulthard MG, Lambert HJ, Keir MJ. Occurrence of renal scars in children after their first referral for urinary tract infection. BMJ. 1997;315(7113):918-919.
36. Seibert JJ, North AF Jr, Burke EC. Prevalence of renal scarring in infants with pyelonephritis. Pediatrics. 1981;67(3):324-326.
37. Tullus K. Vesicoureteric reflux in children. Lancet. 2015;385(9965):371-379.
38. Smellie JM, Ransley PG, Normand IC, Prescod N. Development of new renal scars: a collaborative study. Br Med J. 1985;290(6479):1957-1960.
39. Elder JS, Peters CA, Arant BS Jr, et al. Pediatric vesicoureteral reflux guidelines panel summary report on the management of primary vesicoureteral reflux in children. J Urol. 1997;157(5):1846-1851.
40. Bachur R, Harper MB. Reliability and predictive value of urinalysis for urinary tract infections in young febrile children. Pediatrics. 2001;108(4):845-850.
41. Rushton HG. Urinary tract infections in children: Epidemiology, evaluation, and management. Pediatr Clin North Am. 1997;44(5):1133-69.
42. Gurung, S.; Kafle, S.; Dhungel, B.; Adhikari, N.; Thapa Shrestha, U.; Adhikari, B.; Banjara, M.R.; Rijal, K.R.; Ghimire, P. Detection of OXA-48 Gene in Carbapenem-Resistant Escherichia coli and Klebsiella pneumoniae from Urine Samples. Infect. Drug Resist. 2020,13, 2311–2321.
43. Awasthi, T.R.; Pant, N.D.; Dahal, P.R. Prevalence of multidrug resistant bacteria in causing community acquired urinary tract infection among the

patients attending outpatient Department of Seti Zonal Hospital, Dhangadi, Nepal. Nepal J. Biotechnol. **2015**,3, 55–59.

44. Yadav, K.; Prakash, S. Screening of ESBL producing multidrug resistant E. coli from urinary tract infection suspected cases in southern Terai of Nepal. J. Infect. Dis. Diagn. **2017**, 2, 116.
45. Zubair, K.U.; Shah, A.H.; Fawwad, A.; Sabir, R.; Butt, A. Frequency of urinary tract infection and antibiotic sensitivity of uropathogens in patients with diabetes. Pak. J. Med. Sci. 2019, 35, 1664.
46. Ganesh, R.; Shrestha, D.; Bhattachan, B.; Rai, G. Epidemiology of urinary tract infection and antimicrobial resistance in a pediatric hospital in Nepal. BMC Infect. Dis. 2019, 19, 1–5.
47. Storme, O.; Tiran Saucedo, J.; Garcia-Mora, A.; Dehesa-Davila, M.; Naber, K.G. Risk factors and predisposing conditions for urinary tract infection. Adv. Urol. 2019, 11, 1756287218814382.
48. Laupland, K.; Ross, T.; Pitout, J.; Church, D.; Gregson, D. Community-onset urinary tract infections: A population-based assessment. Infection 2007, 35, 150–153.
49. Honkinen O, Jahnukainen T, Mertsola J, Eskola J, Ruuskanen O. Bacteremic urinary tract infection in children. Pediatr Infect Dis J 2000;19:630-4.
50. Bilgen H, Ozek E, Unver T, Biyikli N, Alpay H, Cebeci D. Urinary tract infection and hyperbilirubinemia. Turk J Pediatr2006;48:51-5.
51. Cleper R, Krause I, Eisenstein B, Davidovits M. Prevalence of vesicoureteral reflux in neonatal urinary tract infection. Clin Pediatr (Phila). 2004 Sep;43(7):619-25.

52. Marild S, Jodal U. Incidence rate of first-time symptomatic urinary tract infec- tion in children under 6 years of age. Acta Paediatr. 1998;87:549-552.
53. Hoberman A, Wald ER. Urinary tract infections in young febrile children. Pediatr Infect Dis J. 1997;16:11-17
54. Guragain, N.; Pradhan, A.; Dhungel, B.; Banjara, M.R.; Rijal, K.R.; Ghimire, P. Extended spectrum -lactamase producing Gram negative bacterial isolates from urine of patients visiting Everest Hospital, Kathmandu, Nepal. Tribhuvan Uni. J. Microbiol. 2019, 6,26–31.
55. Thakur, P.; Ghimire, P.; Rijal, K.R.; Singh, G.K. Antimicrobial resistance pattern of Escherichia coli isolated from urine samples in patients visiting tertiary health care centre in eastern Nepal. Sunsari Tech. Coll. J. 2012, 1, 22–26.
56. Aryal, S.C.; Upreti, M.K.; Sah, A.K.; Ansari, M.; Nepal, K.; Dhungel, B.; Adhikari, N.; Lekhak, B.; Rijal, K.R. Plasmid-Mediated AmpCbeta-Lactamase CITM and DHAM Genes Among Gram-Negative Clinical Isolates. Infect. Drug Resist. 2020, 13, 4249–4261.
57. Odongo, I.; Ssemambo, R.; Kungu, J.M. Prevalence of Escherichia Coli and its antimicrobial susceptibility profiles among patients with UTI at Mulago Hospital, Kampala, Uganda. Interdiscip. Perspect. Infect. Dis. 2020, 2020, 8042540.
58. Mobley, H.L.; Jarvis, K.G.; Elwood, J.P.; Whittle, D.I.; Lockatell, C.V.; Russell, R.G.; Johnson, D.E.; Donnenberg, M.S.; Warren, J.W. Isogenic P-fimbrial deletion mutants of pyelonephritogenic Escherichia coli: The role of

Gal (1–4) Gal binding in virulence of a wild-type strain. Mol. Microbiol. 1993, 10, 143–155.

59. Baral R, Maharjan SK. Rapid nitrite dip stick vs urine culturefor diagnosis of urinary tract infections (UTI): Laboratoryprospective. Int J Biomed Res 2017;8:204-9.
60. Bhansali AJ, Inbaraj LR, George CE, Norman G.Can urine dipstick test be an alternative to detect urinary tract infection inlimited resource setting? – A validity study from Bangalore, India. J FamilyMed Prim Care 2020;9:561-6.
61. Harb A, Yassine V, Ghssein G, Salami A, Fakih H. Prevalence and clinical significance of urinary tract infection among neonates presenting with unexplained hyperbilirubinemia in Lebanon: a retrospective study. Infect Chemother. 2023 Jun;55(2):194-203.
62. Tamim MM, Alesseh H, Aziz H (2003) Analysis of the efficacy of urine cultureas part of sepsis evaluation in the premature infant. Pediatr Infect Dis J22(9):805–808
63. Phillips JR, Karlowicz MG (1997) Prevalence of Candida species in hospitalacquiredurinary tract infections in a neonatal intensive care unit. PediatrInfect Dis J 16(2):190–194
64. Stoll BJ, Hansen N, Fanaroff AA et al (2002) Late-onset sepsis in very lowbirth weight neonates: the experience of the NICHD Neonatal ResearchNetwork. Pediatrics 110(2 Pt 1):285–291
65. Sokhn ES, Salami A, El Roz A, Salloum L, Bahmad HF, Ghssein G. Antimicrobial susceptibilities and laboratory profiles of Escherichia coli, Klebsiella pneumoniae, and Proteus mirabilis Isolates as agents of urinary

tract infection in lebanon: paving the way for better diagnostics. Med Sci (Basel) 2020;8:32.

66. Bahat OzdoganE, Mutlu M, Camlar SA, Bayramoglu G, Kader S, Aslan Y. Urinary tract infections in neonates with unexplained pathological indirect hyperbilirubinemia: Prevalence and significance. PediatrNeonatol2018;59:305-9.
67. Chen HT, Jeng MJ, Soong WJ, Yang CF, Tsao PC, Lee YS, Chen SJ, Tang RB. Hyperbilirubinemia with urinary tract infection in infants younger than eight weeks old. J Chin Med Assoc 2011;74:159-63.
68. Crain EF, Gershel JC. Urinary tractinfections in febrile infants younger than 8 weeks of age. Pediatrics. 1990;86(3):363–367
69. Bachur RG, Harper MB. Predictive model for serious bacterial infections among infants younger than 3 months of age. Pediatrics. 2001;108(2):311–316
70. Reardon JM, Carstairs KL, Rudinsky SL, Simon LV, Riffenburgh RH, Tanen DA. Urinalysis is not reliable to detect a urinary tract infection in febrile infants presenting to the ED. Am J Emerg Med. 2009;27(8):930–932.
71. Velasco R, Benito H, Mozun R, et al;Group for the Study of Febrile Infant of the RiSEUP-SPERG Network. Using a urine dipstick to identify a positive urine culture in young febrile infants is as effective as in older patients. Acta Paediatr. 2015;104(1):e39–e44
72. Marques, A.G.; Pasternak, J.; Damascena, M.D.S.; França, C.N.; Martino, M.D.V. Performance of the dipstick screening test as a predictor of negative urine culture. Einstein 2017, 15, 34–39.

73. Bellazreg, F.; Abid, M.; Lasfar, N.B.; Hattab, Z.; Hachfi, W.; Letaief, A. Diagnostic value of dipstick test in adult symptomatic urinary tract infections: Results of a cross-sectional Tunisian study. Pan Afr. Med. J. 2019, 33, 131.
74. Demilie, T.; Beyene, G.; Melaku, S.; Tsegaye, W. Diagnostic accuracy of rapid urine dipstick test to predict urinary tract infection among pregnant women in Felege Hiwot Referral Hospital, Bahir Dar, North West Ethiopia. BMC Res. Notes 2014, 7, 1–5.
75. Najeeb S, Munir T, Rehman S, Hafiz A, Gilani M, Latif M. Comparison of urine dipstick test with conventional urine culture in diagnosis of urinary tract infection. J Coll Physicians Surg Pak. 2015;25(2):108-10.
76. Laosu-angkoon S. The sensitivity and specificity of a urine leukocyte esterase dipstick test for the diagnosis of urinary tract infection in the outpatient clinic of Rajavithi Hospital. J Med Assoc Thai. 2013;96:849-53.
77. Taneja N, Chatterjee SS, Singh M, Sivapriya S, Sharma M,Sharma SK. Validity of quantitative unspun urine microscopy, dipstick test leucocyte esterase and nitrite tests in rapidly diagnosing urinary tract infections. J Assoc Physicians India 2010; 58:485-7.
78. Sundvall PD, Gunnarsson RK. Evaluation of dipstick analysis among elderly residents to detect bacteriuria: a cross-sectional study in 32 nursing homes. BMC Geriatr. 2009;9:32.
79. Khasriya, R., Khan, S., Lunawat, R., Bishara, S., Bignall, J., Malone-Lee, M., Ishii, H., O'Connor, D., Kelsey, M., & Malone-Lee, J. The inadequacy of urinary dipstick and microscopy as surrogate markers of urinary tract infection in urological outpatients with lower urinary tract symptoms without

acute frequency and dysuria. The Journal of urology. 2010;183(5), 1843–1847.

80. Jido TA. Urinary tract infections in pregnancy: evaluation of diagnostic framework. Saudi J Kidney Dis Transpl. 2014;25:85-90.
81. Glissmeyer EW, Korgenski EK, Wilkes J, Schunk JE, Sheng X, Blaschke AJ, et al. Dipstick screening for urinary tract infection in febrile infants. Pediatrics. 2014.
82. Deville WL, Yzermans JC, van Duijn NP, Bezemer PD, van der Windt DA, Bouter LM. The urine dipstick test is useful to rule out infections. A meta-analysis of the accuracy. BMC Urol. 2004;4:4.
83. Yildirim M, Altunsoy M, Gul U, Kocer B, Ceylan Y, Sahin MA, et al. The validity of the rapidly diagnostic tests for early detection of urinary tract infection. Duzce Tip Fak Derg. 2008;10(3):39-42.
84. Williams GJ, Macaskill P, Chan SF, Turner RM, Hodson E, Craig JC. Absolute and relative accuracy of rapid urine tests for urinary tract infection in children: a meta-analysis. Lancet Infect Dis. 2010;10(4):240-50.
85. Watson AR. Pediatric urinary tract infection. EAU Update Ser. 2004;2:94-100.
86. Zorc JJ, Kiddoo DA, Shaw KN. Diagnosis and management of pediatric urinary tract infections. Clin Microbiol Rev. 2005;18(2):417-22.
87. Lohr JA. Use of routine urinalysis in making a presumptive diagnosis of urinary tract infection in children [see comments]. Pediatr Infect Dis J. 1991;10:646- 650.

88. Pryles CV, Eliot CR. Pyuria and bacteriuria in infants and children: the value of pyuria as a diagnostic criterion of urinary tract infections. Am J Dis Child. 1965; 110:628-635.
89. Goldsmith B, Campos J. Comparison of urine dipstick, microscopy, and culture for the detection of bacteriuria in children. Clin Pediatr. 1990;29:214-218
90. Rehman A.; Sapkota, A.; Shrestha, B. Antibiotic sensitivity pattern in urinary tract infection among adults in central part of Nepal. J. Chitwan Med. Coll. 2019, 9, 18–23.
91. Wilson ML, Gaido L. Laboratory diagnosis of urinary tractinfections in adult patients. Clin Infect Dis 2004;38:1150-8.
92. Duanngai K, Sirasaporn P, Ngaosinchai SS. The reliabilityand validity of using the urine dipstick test by patientself-assessment for urinary tract infection screening in spinalcord injury patients. J Family Med Prim Care 2017;6:578-82
93. Leman P. Validity of urinalysis and microscopy for detecting urinary tract infection in the emergency department. Eur J Emerg Med 2002;9:141-7.
94. Schroeder AR, Chang PW, Shen MW,Biondi EA, Greenhow TL. Diagnostic accuracy of the urinalysis for urinary tract infection in infants <3 months of age. Pediatrics. 2015;135(6):965–971
95. Tzimenatos L, Mahajan P, Dayan PS, Vitale M, Linakis JG, Blumberg S, Borgialli D, Ruddy RM, Van Buren J, Ramilo O, Kuppermann N; Pediatric Emergency Care Applied Research Network (PECARN). Accuracy of the Urinalysis for Urinary Tract Infections in Febrile Infants 60 Days and Younger. Pediatrics. 2018 Feb;141(2):e20173068.

BLDE
(DEEMED TO BE UNIVERSITY)
Declared as Deemed to be University u/s 3 of UGC Act, 1956
Accredited with 'A' Grade by NAAC (Cycle-2)
The Constituent College
SHRI B. M. PATIL MEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE, VIJAYAPURA

BLDE (DU)/IEC/ 648/2022-23 30/8/2022

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this University met on **Friday, 26th August, 2022 at 3.30 p.m. in the Department of Pharmacology** scrutinizes the Synopsis of Post Graduate Student of BLDE (DU)'s Shri B.M.Patil Medical College Hospital & Research Centre from ethical clearance point of view. After scrutiny, the following original/ corrected and revised version synopsis of the thesis/ research projects has been accorded ethical clearance.

TITLE: "STUDY OF CLINICAL PROFILE OF URINARY TRACT INFECTION IN NEONATES WITH SUSPECTED SEPSIS AND UTILITY OF DIPSTICK AS A DIAGNOSTIC TOOL".

NAME OF THE STUDENT/PRINCIPAL INVESTIGATOR: DR.ANURAG REDDY P.

NAME OF THE GUIDE: DR. S. S. KALYANSHETTER, Professor & HoD, Dept. of Pediatrics.

Dr. Santoshkumar Jeevangi
Chairperson
IEC, BLDE (DU),
VIJAYAPURA

Chairman,
Institutional Ethical Committee,
BLDE (Deemed to be University)
Vijayapura

Dr.Akram A. Naikwadi
Member Secretary
IEC, BLDE (DU),
VIJAYAPURA

MEMBER SECRETARY
Institutional Ethics Committee
BLDE (Deemed to be University)
Vijayapura-586103, Karnataka

Following documents were placed before Ethical Committee for Scrutinization.

- Copy of Synopsis/Research Projects
- Copy of inform consent form
- Any other relevant document

Smt. Bangaramma Sajjan Campus, B. M. Patil Road (Sholapur Road), Vijayapura - 586103, Karnataka, India.
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ANNEXURE II

INFORMED CONSENT FORM

TITLE OF RESEARCH: STUDY OF CLINICAL PROFILE OF UTI IN NEONATES WITH SUSPECTED SEPSIS AND UTILITY OF DIPSTICK AS A DIAGNOSTIC TOOL.

GUIDE : DR S.S. KALYANSHETTAR

PG STUDENT : DR ANURAG REDDY P

PURPOSE OF RESEARCH:

I have been informed that the purpose of this study is TO STUDY CLINICAL PROFILE OF UTI IN NEONATES WITH SUSPECTED SEPSIS AND UTILITY OF DIPSTICK AS A DIAGNOSTIC TOOL

PROCEDURE

I understand that after having obtained a detailed clinical history and thorough clinical examination and laboratory investigations, a final follow up of and its outcome is planned.

RISKS AND DISCOMFORTS:

I understand that I may experience some pain and discomforts during the examination or my treatment. This is mainly the result of my condition and the procedure of this study are not expected to exaggerate these feelings, which are associated with the usual course of treatment.

BENEFITS:

I understand that my participation in this study will have no direct benefit to me other than the potential benefit of the research and education.

CONFIDENTIALITY:

I understand that the medical information produced by the study will become a part of hospital record and will be subjected to confidentiality and privacy regulations of hospital. Information of sensitive personal nature will not be part of medical record but will be stored in investigations research file.

If the data is used for publication the identity will not be revealed; other identifiers such as photographs will be used only with special permission. I understand that I may see the photograph before giving my permission.

REQUEST FOR MORE INFORMATION:

I understand that I may ask for more information about the study at any time and Dr.Anurag Reddy P at the Department of Pediatrics will be available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during the course of the study,

I will be informed of any significant new findings discovered during the course of the study, which might influence my baby's continued participation. A copy of this consent form will be given to me to keep for careful reading.

REFUSAL OR WITHDRAWAL OF PARTICIPATION:

I understand that my baby's participation is voluntary, and I may refuse to participate or withdraw consent and discontinue participation in the study at any time without prejudice. I also understand that Dr,Anurag Reddy P may terminate my participation in the study after she has explained the reasons for doing so.

INJURY STATEMENT:

I understand that in the unlikely event of injury to my baby resulting directly from my participation in this study, if such injury were reported promptly, the appropriate treatment would be available to the baby. But, no further compensation would be provided by the hospital. I understand that by my agreements to participate in this study and not waiving any of my legal rights.

I have explained to _____the purpose of the research, the procedures required and the possible risks to the best of my ability.

Dr. Anurag Reddy P _____

(investigator) Date

PARENTS / GUARDIAN CONSENT STATEMENT:

We confirm that Dr. ANURAG REDDY P, is conducting a study on CLINICAL PROFILE OF UTI IN NEONATES WITH SUSPECTED SEPSIS AND UTILITY OF DIPSTICK AS A DIAGNOSTIC TOOL and Dr. Anurag Reddy P, has explained to us the purpose of research and the study procedure. We are willing to give as much as information required for the study and consent for interventions and the possible discomforts as well as benefits. We have been explained all the above in detail in our own language and we understand the same. Therefore, we agree to give consent for our baby's participation as a subject in this research project.

_____ _____

(Parents / Guardian) Date

_____ _____

(Witness to signature) Date

ANNEXURE III

SCHEME OF CASE TAKING- PROFORMA

Name:

Ip No:

Gender:

Gestational age:

Obstetric history:

History of PROM:

History of Meconium Stained Liquor:

History of Birth Asphyxia

Mode of delivery:

Birth weight:

Date of Birth:

Inborn/Out born:

Date of Admission:

Date of Discharge:

Indication for admission:

CRP:

Urine Routine pus cells:

Dipstick Analysis:

Antibiotics:

Febrile at any point during admission: yes/no

Number of days admitted in NICU:

Urine culture report:

BIO – DATA

GUIDE

Name	:	DR. S.S KALYANSHETTAR
Date of Birth	:	17/1/1974
Education	:	MBBS, MD
Present Designation	:	Professor & Head Of Department Dept of Pediatrics, BLDE (Deemed to be University) Shri. B.M Patil Medical College, Vijayapura, Karnataka.
Registration No	:	45576
Work experience	:	18 years
Membership	:	Indian Academy of Pediatrics

BIO – DATA

CANDIDATE

Name	:	Dr. Anurag Reddy P
Date of Birth	:	12/06/1998
Age	:	25 years
Qualification	:	MBBS
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Designation	:	Post graduate student Department of Pediatrics
ADDRESS	:	NEW PG hostel, BLDE (Deemed to be University) Shri B M Patil Medical College Hospital and Research Centre, Vijayapura, Karnataka- 586103

Signature of candidate

(Dr. ANURAG REDDY)