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Faculty of Graduate Studies

Prevalence of Urinary Tract Infection among Children of Primary Schools in Nablus

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This Thesis was defended successfully on 29/12/2009 and approved by

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Dedication

I dedicate my efforts in this study

To my father and mother for their continuous encouragement, guidance, and support throughout my life

To my beloved brothers Yazan and Majed

Also it is dedicated

To my husband Ayuob for his love, patience, and support

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إقرار

أنا الموقع أدناه، مقدم الرسالة التي تحمل العنوان:

انتشار التهابات المسالك البولية بين أطفال ألمدارس الأساسية في مدينة نابلس

Prevalence of Urinary Tract infection among Children of Primary Schools in Nablus

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Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's name: **اسم الطالب:**

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List of Acronyms

Abbreviation	Explanation
CO	CHROMagar orientation (Type of chromogenic media)
CFU	Colony Forming Unit
CLED	Cysteine Lactose Electrolyte Deficient agar
CPS ID3	Types of chromogenic media
GI	Gastrointestinal tract
HPF	High Power Field
NICE	The National Institute for Health and Clinical Excellence
TMP-SMX	Trimethoprim-sulphamethoxazole
UNRWA	United Nations and Works Agency For Palestine Refugees in the
USA	The United States of America
UTI	Urinary Tract Infection
VUR	Vesicoureteral reflux
WBCs	White Blood Cells

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Prevalence of Urinary Tract Infection among Children of Primary Schools in Nablus

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Abstract

Urinary Tract Infection (UTI) is a serious bacterial infection causing illness in infants and children. UTI is defined by a combination of clinical features and the presence of bacteria in urine, or it is the presence of more than 100,000 cfu/ml after doing urine culture, regardless to symptoms. Clinical symptoms of UTI usually include frequency, dysuria, abdominal pain, back pain, fever, and urgency. Diagnosis of UTI relies on both urinalysis and urine culture. Most of UTI cases are caused by gram negative bacteria such as *Escherichia coli* . UTI must be recognized and treated rapidly with an appropriate antibiotic to minimize any morbidity, mortality, and renal damage from acute UTI. Management of UTI in children faces the problem of the emergence of resistant of uropathogens to commonly used antibiotics for the treatment of UTI.Antibiotics are not recommended for initial empirical therapy, when their resistance rate ≥10-20% . This cross sectional study was conducted to measure the prevalence of UTI among children in primary schools in Nablus district, West Bank, Palestine, to identify microorganisms responsible for UTI, to explore sensitivity patterns of identified microorganisms to certain antibiotics used in the treatment of UTI, and to study the relation between some demographic variables and UTI. This study was conducted in the period

between February and May 2009, included 1462 children in the age group from 6-12 years. This study utilized two main instruments, questionnaire and urine testing (urinalysis and urine culture). The response rate in this study was 95.35% (1394/1462), from which 58 cases were excluded for taking antibiotics at the time of doing the test. Calculations were done on the remaining 1338 children (719 girls and 619 boys). Prevalence of UTI was calculated to be 4% (54/1338), 7.5% among girls (54/719) and 0% among boys (0/619). Gram negative bacteria were responsible for 59.25% of UTIs in comparison to gram positive bacteria which were 40.7%. *Escherichia coli* was the most predominant uropathogen with 51.8% (28/54) followed by *Staphylococcus aureus* 29.6% (16/54). All antibiotics used in this study had a resistance rate over 20%. UTI was statistically associated with the following variables; gender (p=0.0001), fever (p=0.012), burning sensation while urination (p=0.0001), nocturnal enuresis (p=0.035), and hygienic use of toilets (p=0.046). Pupils must be allowed to go to toilets up on their request during their stay at school and they must be educated on how to use the toilets by themselves in a safe and hygienic way, Urine culture is an important diagnostic tool to confirm UTI. Rules must be put on the consumption of antibiotics to limit their abuse and misuse, Physicians are asked to go back to traditional antibiotics like Trimethoprime/Sulphamethoxazole, a cheap antibiotic that showed a low resistance rate in this study over commonly used antibiotics such as Cephalosporin's which are more expensive.

Chapter One

Introduction and Literature review

1. Introduction and literature review

1.1. Background

Urine infection is the most common serious bacterial infection causing illness in infants and children [2]. It is one of the most common bacterial infections encountered by clinicians in developing countries [4]. 150 million patients are diagnosed with UTI yearly, resulting in at least $6 billion in health care expenditures [1]. In the year 1997 UTI accounts approximately 7 million office visits and 1 million emergency department visits, resulting in 100,000 hospitalizations in the United States [38].

UTI in children may indicate serious anatomic abnormality like Vesicoureteral reflux (VUR), or neurogenic bladder. It is very necessary to identify children with UTI and treat them as soon as possible to avoid any long term complications and to reduce the risk of any significant morbidity. Unrecognized UTI may progress into renal damage, hypertension and end-stage renal disease [23].

Misdiagnosis, delay in diagnosis, and treatment of pediatric urinary tract infection appears to cause renal scarring and may produce hypertension and end-stage renal disease [30, 52].

1.2. Definition of UTI

Urinary tract infection (UTI) is a term applied to a variety of clinical conditions ranging from asymptomatic presence of bacteria in the urine to severe infection of the kidney with resultant sepsis [1].

UTI is defined also as the growth of a known bacterial pathogen more than 10000 cfu/ml in association with a positive dipstick or urinalysis [37].

According to The National Institute for Health and Clinical Excellence (NICE) guidelines ,urinary tract infection is defined by a combination of clinical features and the presence of bacteria in urine [2].The Clinical symptoms of UTI usually include frequency, dysuria, pyuria, abdominal pain, back pain, fever or urgency [19,30]. But none of these symptoms alone is sufficient to establish UTI diagnosis in verbal children [30].although Fever of an unexplained source in children usually indicates UTI [3].

Urinary tract infections are categorized into either lower tract infection, located in the bladder and/or urethra (cystitis and urethritis), and upper tract infection, located in the ureters, collecting system, and parenchyma (pyelonephritis) [31]. It is necessary to understand the difference between the two types to make an accurate diagnosis. Cystitis is defined as an inflammatory condition of the urinary bladder, whereas pyelonephritis is defined as a diffuse pyogenic infection of the pelvis and parenchyma of the kidney .Signs and symptoms of cystitis include dysuria, frequency, urgency, malodorous urine, enuresis, hematuria, and suprapubic pain. On the other hand the signs and symptoms of Pyelonephritis include; fever over 38.5 ˚C, chills along with costovertebral angle or flank pain and tenderness with pyuria and positive urine culture [3, 23]. Pyelonephritis represents the most severe type of UTI in children with a great morbidity

rate and irreversible damage [23]. UTI symptoms include abdominal pain, back pain, dysuria, frequency, new-onset incontinence, but none of these symptoms alone is sufficient to establish UTI diagnosis in verbal children [30].

1.3. Risk factors of UTI

Both anatomic and physiologic factors put children at risk of developing UTI .Any anatomic or functional abnormalities of the urinary tract that impede urinary flow can increase the host susceptibility to UTI [1]. Anatomic abnormalities include short urethra in females, urinary obstruction, Vesicoureteral reflux (VUR), neurogenic bladder which is the improper storage of urine in bladder and improper emptying of urine from bladder, and uncircumcison in boys. Uncircumcised boys have a great tendency to harbor organisms in the foreskin due to warm, moist and mucosal environment as a result bacteria migrate up to the urethra and colonize in the bladder [3, 31].Another anatomical factors include posterior urethral valves, or bladder diverticulitis[31]. Physiologic factors include dysfunctional voiding, infrequent voiding, incomplete bladder emptying, and constipation. In constipation stool remains in the rectum for a long period of time, and bacteria tends to colonize in the perineum, as a result increasing the risk for UTI [3].

The risk of UTI can be increased by many factors such as urinary retention, urine stasis, and reflux of urine, unstable bladder, frequent UTIs, constipation, sexual intercourse, chronic illness, and prolonged use of

antibiotics. Prolonged use of antibiotics can damage periurethral flora allowing uropathogens to colonize and infect the urinary tract [1].

Various factors make bacteriuria more or less to occur for any individual. These factors are age, gender, race, genetic factors, sexual activity among the teen age girls, and circumcision in boys, nocturnal enuresis and some unhealthy behaviors [31]. UTI is age dependent and bacteriuria is more common at the extremes of life The Incidence of UTI is bimodal; highest during the first year of life and peaking again during adolescence [31].UTIs occurs in all races, but epidemiological studies show varying prevalence and complications of UTI in different races. [5]. White races are more vulnerable than other races to have UTI [31].In and Emergency Department based studies the prevalence of UTI among Asian, Hispanic, and White infants was reported to be 22%,16%,and 16%, respectively .Whereas the prevalence of UTI among black infants was 4% lower than others ethnic groups [30]. Gender is an important factor in UTI [5]. Sex shows a preponderance of UTI in boys during the first year of life, but after the first year of life more girls than boys have UTI [1]. Genetic factors may also affect the risk of bacteriuria, follow up studies show that individuals who have childhood UTIs continue to be at risk of adults UTIs whether or not they have Vesicoureteral reflux, in a study in the University Hospital in Bern, Switzerland, family history was positively associated with UTI in 42% of patients [12]. The risk of UTI is increased also by the increasing of sexual activity in teen girls the increased risk of infection is due to the movement of bacteria from vagina to the urethra, only small

percentage of teenage girls and women appear to be at risk for intercourse associated infection [3,31].Circumsion is one of the oldest surgical procedures in the world, it is performed for religious, social, and medical reasons ,its prevalence varies widely among different ethnicities and cultures[53] Many studies have suggested an association between UTI and the uncircumcised state, although these studies have been criticized on the methodological grounds a recent case control study on 144 children under 5 years of age showed that circumcision was strongly associated with a decreased risk of symptomatic UTIs [29] During the first year of life, uncircumcised boys have up to 10 times risk of circumcised boys of having a UTI [5] The prevalence of UTI among febrile male infants less than 3 months was 2.4% of circumcised males and 20.1% for uncircumcised males [14].Circumcision status in boys becomes unimportant after the first year of life as rates of UTI declines [31].

In a cross sectional study conducted on a 7562 children aged 5-18 years in Iran, the overall prevalence of enuresis was 6.8% , the prevalence of urinary tract pathology was 2.9% among enuretics which indicates high association between UTI and nocturnal enuresis [54]. Urinary tract infections can be caused by a variety of predisposing factors either working alone or in combination with others leading to inoculation of the urinary tract. Urine and fecal elimination habits are considered an important possible cause for UTI. Infrequent micturation and incomplete emptying of the bladder in children represent important factors in the causation of incontinence during the day, and of urinary tract infections (UTI),

Behavioral intervention seemed effective in improving children's micturation habits thereby changing the frequency of wettings, and the frequency of urinary tract infections [7].

Children with daytime wetting with/without night wetting have very often bladder sphincter dysfunctions which are in turn correlated with recurrent urinary tract infections, 8% of the school children (10-12 years old) report day time wetting with/without night wetting with some frequency [9]. 1% of healthy children over the age of 5 years have troublesome day wetting[11].

In a study was enrolled in the department of pediatrics, university hospital, Berne, Switzerland they found that poor genital hygiene or toilet habits are sufficient to cause infections if they were combined with other functional abnormalities such as infrequent voiding, inadequate fluid intake, functional stool retention or voiding dysfunction [8].Whereas another study stated that toilet habits affect strongly the development of urinary tract infections [10].

1.4. Epidemiology of UTI

Understanding the prevalence of Urinary Tract Infection in various populations will help guide to the appropriate level of suspicion and the appropriate work-up for urinary tract infection [35]. It is difficult to assess the accurate incidence of UTI due to underreporting; this situation is complicated as the accurate diagnosis of UTI depends on both the presence

of symptoms and positive urine culture [38]. Asymptomatic bacteriuria is a very important sign in epidemiological studies, as it allows revealing early stages of UTI and doing the suitable prophylactic action timely [36]. The epidemiology and Prevalence rates of UTI are grouped by age, sex, race, and circumcision status of the patient [1, 14].The Incidence of UTI is bimodal; highest during the first year of life and peaking again during adolescence [31].Throughout childhood the risk of UTI is 8% for girls and 2% for boys [39].

The prevalence of UTI in febrile infants is greater with younger age, with a rate of nearly 7 percent among febrile newborns; Up to 7 percent of boys will have a symptomatic, culture-confirmed Urinary tract infection by six years of age [47].

Most UTI cases that lead to scarring or diminished kidney growth occur in children younger than 4 years, and babies in the first year of life are more vulnerable. The overall prevalence of UTI in febrile infants in the emergency department is between 3%-5% [40] White girls, uncircumcised boys, and those without any other potential source for fever have higher rates of UTI [40] The overall incidence of pediatric urinary tract infections is 0.7% per person per year [33].In Sweden in 1999 a study showed that the mean incidence of UTI was 1% for both boys and girls (range 0.3%-3% and 0.4%-2.9%), whereas the minimum cumulative incidence at 2 years of age was estimated to be 2.2% for boys and 2.1% for girls in a children population less than 2 years old [46]. During the first year of life, males

contact more UTIs than females [5]. According to a meta-analysis study conducted by the division of general Academic Pediatrics at the University of Pittsburgh to measure the prevalence of UTI in children 0-19 years of age with symptoms of UTI, the overall prevalence of UTI among infants presenting with fever was 7.0%, the pooled prevalence rates of febrile UTI in females aged 0-3 months was 7.5%, for those aged 3-6 months was 5.7%, for those aged 6-12 months was 8.3% and for those over 12 months the prevalence was 2.1% [14]. According to an article in the Urologic Nursing Journal (Overview of the Evaluation, Diagnosis, and Management of Urinary Tract Infections in Infants and Children), the preschool and school age children prevalence of UTI is about 1% to 5% for females and is rare in males [3]. Whereas in the Campbell-Walsh urology the incidence of UTI in school-age children is 0.03%to 1.2% for boys and it rises to 1% to 3% for girls [5]. Following puberty the incidence increases for females and remains uncommon for males [3]. During adolescence, the incidence of UTI significantly increases (to 20%) in young women, while remaining constant in young men [1].In girls the rates of UTI declines after the age of 6 and rise again significantly in adolescence due to increase in sexual activity [31].Among older children less than 19 years with urinary symptoms the pooled prevalence of UTI (both febrile and afebrile) was 7.8 according to a study conducted by the Division of General Academic Pediatrics, University of Pittsburgh in the USA [14]. In another study conducted in Tunisia on a group of children aged between 2 months and 14

years with a mean age 5 years, the frequency of UTI was found to be 1.85% [16].

The incidence of UTI is high in the first 6 months and is more in boys than in girls [3% of girls and 1% of boys suffer from UTI in the first ten years of their life [28].

Infants younger than 3 months have higher urinary tract infection prevalence 7.5% in girls and 8.7% in boys [30].The actual incidence of UTI is unclear but patterns in northern of England suggest that 3.6% of boys and 11.3% of girls have had a UTI by the age of 16 years [34].

1.5. Causative organisms

1.5.1 Bacterial UTI

Most of urinary tract infections are caused by gram-negative bacteria like *Escherichia coli, Klebsiella species, Proteus mirabilis, Pseudomonas aeruginosa, Acinetobacter, and Serratia.* 90% of UTI cases are caused by gram-negative bacteria while only 10% of the cases are caused by gram-positive bacteria .Gram-positive bacteria include *Enterococcus, Staphylococcus, and Streptococcus agalactiae* [13].

Most UTIs in children are monomicrobic, often caused by Escherichia coli (60 to 80 percent of cases), Proteus (more common in boys and in children with renal stones), *Klebsiella*, *Enterococcus*, and coagulase-negative *staphylococci* [47].

Escherichia coli are the most common gram-negative bacteria responsible for UTI [5]. 75.5% to 87% of UTI cases are due to *Escherichia coli* [16, 18,]. At least 80% of the uncomplicated cystitis and pyelonephritis are due to *Escherichia coli* [1]. Whereas *Proteus mirabilis* and *Klebsiella pneumonia* infections accounts 10%, 6% respectively [16, 18, 20].Adherence properties of some organisms prevent the normal washout for of these organisms by bladder emptying and mucosal host defense mechanisms. *Escherichia coli* are virulent due to the presence of P. fimbriae, organelles on its strains that may attach or adhere on specific receptors of uroepithelial cells and interfere with the washout of bacteria [1]. *Escherichia coli* are predominant in girls, whereas *Proteus mirabilis* and *Klebsiella pneumoniae* are likely encountered in boys [16]. High incidence of UTI due to *Proteus* spp., *Klebsiella* spp. and *Enterobacter* spp. Infections are more common among children with recurrent UTIs and in those treated with antibiotic prophylaxis. Whereas other uropathogens like *Pseudomonas*, *Serratia* and *Candida* are more common among children with urogenital abnormalities [17]. 78% of community- acquired UTI are due to *Escherichia coli* and 12% by *Klebsiella*; whereas in hospital-acquired UTI 65% are caused by *Escherichia coli* and other pathogens, including *Pseudomonas* [22].

1.5.2 Fungal and Viral UTI

Urinary tract infection may be caused by viruses and Fungi.

Fungi, such as Candida, is the second most cause of Nosocomial UTI in children it can be spread systemically and can be life threatening

[39].Fungi infections are seen in infants and children who are on long-term antibiotics, patients who are Immunocompromised, or patients using invasive devices like IVs, grains and catheters [3, 39]. Candida Fungi infections are more prevalent in children with Urinary tract Anomaly (UTA) [26]; it is associated with infections after instrumentation of the urinary tract [21].The prevalence of UTI due to Candida increased gradually by the duration of hospitalization, with a prevalence rate 27.2% [27]. Treatment of Candiduria includes stopping antibiotics, removing or changing indwelling catheters, and starting antifungal therapy with antifungal agents like oral fluconazole, parental or intravesical amphotercin B [39].Viral UTI can be caused by Adenoviruses types 11 and 21, polyomavirus BK, and herpes simplex viruses [39].

1.6. Modes of bacterial entry

There are two major modes of bacterial entry into the genitourinary tract.

Most UTIs in children result from ascending infections, although hematogenous spread may be more common in the first 12 weeks of life[47].

1.6.1 The ascending route:

Most cases of pyelonephritis are caused by the ascent of bacteria from the bladder, through the ureters and into the renal parenchyma [1].Most cases of UTIs are caused by bacteria ascending from the perineum [31].

1.6.2 Hematogenous route:

This type usually occurs in neonates and immunocompromised patients [1]. At the first 8 to 12 weeks of life urinary tract infection may be secondary to hematogenous source. Because of that, the diagnosis of UTI in young children is very important as it is considered a marker for urinary tract abnormalities in the newborns .UTI from hematogenous source may be associated with bacteraemia [21]. *Staphylococcus aureus*, *Candida* species, and *Mycobacterium tuberculosis* are common pathogens travel through the blood to infect the urinary tract [1].

1.7. Pathogenesis of UTI

Circumcision status in males, periurethral flora, micturation disorders, bowel disorders, local factors, and hygienic measures are important factors involve in the pathogenesis of UTI [17].The main long term consequence of UTI is renal scarring which may lead to hypertension and end-stage renal disease [21]. Of the 3% of girls and 1% of boys who contract a prepubertal UTI, 17% or more have infection-related renal scarring, 10% to 20% may become hypertensive, but only a rare child has progressive renal dysfunction culminating in end-stage renal disease [5]. The pathogenicity of bacteria in UTIs is influenced by both bacterial and host factors like bacterial adhesion and motility, in addition to host immune response and genetic factors [31].

1.8. Diagnosis of UTI

UTI is defined by a combination of clinical features and the presence of bacteria in urine. It is also defined by the presence of more than 100,000 colony-forming units (cfu) of single bacteria in cultured urine .The clinical features of UTI may include both specific and nonspecific signs and symptoms. Accurate diagnosis and treatment of UTI is essential to limit its associated morbidity, mortality and to avoid prolonged or unnecessary use of antibiotics [1].Diagnosis of UTI is difficult particularly in young children and infants. Because in this age group, the clinical presentation of urine infection is often with non-specific clinical signs such as fever, irritability, and vomiting that are also commonly seen in other childhood viral illnesses [2].Evaluation of UTI relies on both lab investigations and clinical signs and symptoms. Lab investigations include both urinalysis and urine culture.

1.8.1Urinalysis

Dipstick screening test and microscopy are the components of urinalysis, and they are very useful in the evaluation and rapid screening of UTI [3]. Urine dipstick consists of chemically treated paper, which displays different colors indicating the presence of leukocyte esterase, nitrites, blood, and protein when dipped into urine sample [24].

Normal urine contains nitrates. Gram negative bacteria present in the urinary tract produce the enzyme "reductase" which reduces nitrate to

nitrite. The presence of nitrites on urinalysis may be indicative of UTI. Leukocyte esterase is an enzyme made up by the breakdown of neutrophils white blood cells (WBCs) in the urine secondary to bacterial invasion [24]. Microscopic examination of the urine for the presence of WBCs and bacteria is usually performed after centrifugation. More than three WBCs per high-power field suggest a possible infection [1]. Elevation in number of WBCs in urine is a result of an inflammatory response of urogenital mucosa to colonizing bacteria [24]. Examination of uncentrifuged urine sample is considered to be more sensitive and specific and is called enhanced urinalysis [31].

1.8.2Urine culture

Urine culture is usually done to confirm a positive dipstick test result [30], to identify the causative organism of UTI, and to make an accurate decision about the best treatment for UTI [5]. Urine culture is a test done on a sample of urine to see if infection-causing organisms are in the urine, through plating a quantified amount of urine on a culture media and incubating them at 37 ˚C for 24 hours in an Incubator after that identifying the uropathogens and counting the number of bacterial colonies that grow on the culture plate by colony forming unit per millimeter CFU/ml [5]. Urine samples should be sent to culture in infants and children who have a diagnosis of acute pyelonephritis, in infants and children with high risk to serious illness, in infants and children under 3 years, in infants and children with a single positive result of leukocyte esterase or nitrite, or in infants

and children with recurrent UTI [2]. Urine should be collected in a sterile container and cultured immediately after collection. Urine culture is necessary for diagnosis of urinary tract infections in children if there is high clinical suspicion, cloudy urine, or if urine dipstick testing shows positive leukocyte esterase or nitrite activity [47]. Blood agar, Mackonkey agar and Chromogenic media are different types of media, used in primary screening of UTI

Chromogenic media are newly used media in urine culture. It differentiates and identifies bacterial isolates from clinical specimen. Specific enzymes in the bacterial isolates breakdown the chromogenic substrates, producing different colored colonies. It allows the growth and primary identification of the predominant uropathogens like *Escherichia coli*, *Klebsiella* spp. And *Enterobacter* spp. This media also supports the growth and differentiation of gram positive organisms like *Staphylococcus aureus* and *Enterococcus*. [32].There are different types of chromogenic media, vary in their specificity, sensitivity and accuracy such as CHROMagar Orientation (CO), and CPS ID3. A study in Taiwan to compare CPS ID 3 and CHROMagar with standard biplate technique for culture of clinical urine samples approximately 91.9% of *Escherichia coli* and 100% of *Enterobacter* spp could be identified directly on CO media, while 97.5% of *Escherichia coli* and 94.4% of *Enterobacter* spp could be identified on CPS3 media [57]. In a study in France to compare three chromogenic agar plates (CPS ID 2, Chromogenic UTI, and USA agar) for isolation and identification of urinary tract pathogens it was shown that

detection rates and identification rates of the three media were very close and only minor differences were noted[58]. In another study in Sweden to compare the performance of four chromogenic urine culture media with reference media after one or two days of inoculation in which 1200 urine specimens were tested, minor differences were noted between these media as 96% of all isolates were recovered on blood agar, 96% were recovered on Cysteine Lactose and Electrolyte Deficient agar for detection of uropathogens (CLED), 92% were recovered on CPS ID2, 96% were recovered on CHROMagar Orientation from BBL,95% were recovered on CHROMagar Orientation from CHROMagar company, and 95% were recovered on Chromogenic UTI media [59]. Evaluation and introduction of a chromogenic urinary tract infection (UTI) medium for the primary culture of routine urine specimens has led to quality improvements, with enhanced discrimination of mixed cultures and inefficiencies in staffing and working time that counterbalance increases in media costs [56].

1.9 Urine collection

When collecting urine samples, two things must be taken in accounts, the way of collecting urine and the time until the sample is tested [31].There are four ways in which urinary specimens are obtained in children, The bagged specimen which is a plastic bag attached to the perineum, the midstream clean catch voids, catheterization, or suprapubic aspiration [5] .According to NICE a midstream clean catch urine sample is the recommended method for urine collection .Urine samples must be

tested immediately after collection, but if urine cannot be tested and cultured within 4 hours of collection, the sample should be refrigerated or preserved with boric acid [2]. Urine can be stored in the refrigerator for up to 24 hours [1].

1.10 Treatment of UTI

It is very important to recognize and treat UTI rapidly. Treatment of UTI with the appropriate antibiotic can minimize mortality, morbidity and any renal damage from acute UTI. Choosing the appropriate antimicrobial agents sounds difficult, but advances in the understanding of the pathogenesis of UTI, the development of new diagnostic tests, and the introduction of new antimicrobial agents have allowed physicians to appropriately tailor specific treatment for each patient [1].Treatment of UTI depends on the age of the child, location of infection, etiology of the disease, degree of illness in the child, efficacy of antibiotic and resistance profile within the community [31, 33]. Sick children and infants less than 3 months should be treated as inpatients, whereas healthy children and older infants may be treated as outpatients [41].Predominant pathogens in the patient's age group, antibacterial sensitivity patterns in the practice area, the clinical status of the patient, and the opportunity for close follow-up are important factors must be taken in consideration when choosing the appropriate antimicrobial [21]. The main treatment of UTI is to initiate appropriate antibiotic therapy promptly. Most organisms causing UTI originate from the gastrointestinal tract; the most common of them is

Escherichia coli. Antibiotics prescribed must be active against these organisms, in cases where children are seriously ill broader spectrum antibiotics must be used. Majority of patients respond to oral antibiotics, but in some cases intravenous antibiotics must be used, these cases are seriously ill or septic patients, children less than 1 month of age, and in the case of vomiting. The duration of traditional treatment with antibiotics is 7-10 days in acute pyelonephritis, whereas in lower tract UTI short course treatment from 3-4 days is effective in clearing the infection [34]. Antibiotics used in the treatment of UTI must be active against urinary pathogens with low rate of resistance, to be free of side effects, palatable, sugar-free preparations, available, and having no effect on normal gut flora [34]. Antibiotics used in the treatment of UTI include:

Sulphamethoxazole / Trimethoprime, Fluroquinolones (e.g. Ciprofloxacin), Nitrofurantoin, Amino glycosides (e.g. Gentamicin, Amikacin), cephalosporin and Aminopenicillins (e.g. Ampicillin and Amoxicillin)[1]. Trimethoprime/Sulphamethoxazole, Cephalosporin's and amoxicillin-clavulanate are considered to be the most acceptable antibiotics for the treatment of UTI in pediatrics in comparison to quinolones, which has an effect on joint development, and first line therapy of amoxicillin which has a high prevalence of resistance to *Escherichia coli* in many communities [31]. Management of UTI in children faces the problem of the emergence of resistant strains to antibiotics [16]. Since antibiotics are given empirically, it is necessary to assess the distribution and susceptibility of the microorganisms in each case .In addition, there should

be a periodic re-evaluation for UTI treatment policies in children every 5 years [6, 15].Antibiotics are not recommended for initial empirical therapy ,when their resistance rate ≥10-20% [55].

Resistance to commonly used antibiotics was found to be very high among the isolates due to prolonged use of antibiotics as the use of antibiotics can damage periurethral flora, allowing uropathogens to colonize and subsequently to infect the urinary tract, leaving clinicians with very few choices of drugs for the treatment of UTI [1, 4].Antibiotic resistance varies from one country to another depending on antibiotic use. Trimethoprim-sulphamethoxazole is commonly used to treat many UTIs, except those caused by *Enterococci* and *Pseudomonas* spp. It interferes with the bacterial metabolism of folate. It is highly effective and relatively inexpensive [1]. The use of TMP-SMX has declined due to the increased incidence of bacterial resistance [1]. In a study was conducted in northern Israel, it was shown that ampicillin, cephalexin and TMP-SMX cannot be used empirically in the treatment of community-acquired UTI as the incidence of bacterial resistance has increased for these antibiotics [6].

Antibiotic resistance varies from one geographical region to another, depending on antibiotic consuming habits and laws in that region.

Resistance of gram-negative pathogens to Trimethoprim-sulphamethoxazole is 6.5% in a study in the Department of Emergency Medicine, University of Florida in the USA while appeared to be 55.2% in another study done in Taiwan [19, 20].

Trimethoprim-sulphamethoxazole resistance is high among older children and those with a history of antibiotic use [19].Resistance to Ampicillin and sulfamethoxazole/Trimethoprim tends to increase year after year [20].As a result treatment with Trimethoprim-sulphamethoxazole and Ampicillin alone appeared to be insufficient in many cases due to high resistance rates of *Escherichia coli* and other uropathogen. In a Tunisian study conducted in the hospital of Fattouma Bourguiba to precise the frequency of the different germs and their susceptibility to antibiotics 96% of uropathogens strains are resistant to Ampicillin, Amoxicillin and cefalotin, 67% of strains are resistant to amoxicillin with clavulanic acid and only 34% of them are resistant to Cotrimoxazole (a combination of Sulphamethoxazole/Trimethoprime) [16]. There is 20% increase in resistance rates to Cotrimoxazole and 1st generation cephalosporin's [15]. Third generation cephalosporin and amino glycosides are still active on the majority of strains [16]. In a study conducted in the University Children Hospital in Belgrade from 1986 to 1995, the sensitivity of isolated gram-negative bacteria *Escherichia coli, Klebsiella* species, *Proteus mirabilis* and *Pseudomonas aeruginosa* was most prominent to amino glycosides (amikacin and gentamicin)[13].Whereas Ampicillin which has a significant role in the treatment of urinary infections has showed increased resistance rates among *Escherichia coli* and *Klebsiella* species, *Klebsiella* species have natural resistance against Ampicillin. *Proteus mirabilis* species are often sensitive to amino penicillin [13].In a Turkish study to assess the resistance patterns of urinary isolates to commonly used antimicrobials and to evaluate the options for empirical treatment of UTI Ampicillin has the

highest resistance rate against *E. coli* (74.2%) followed by co-trimoxazole (61.3%); whereas Nitrofurantoin has the lowest resistance rate against E. coli (2.2%), followed by amikacin (4.9%), ceftriaxone (7.5%) and ciprofloxacin (12%) [18].In another study, resistance rate to Ampicillin is (82%) followed by Sulfamethoxazole/trimethoprim (55.2%), Gentamicin (24.9%) and Cefazolin (24%).Only 19 to 25% of pathogens are susceptible to Ampicillin; whereas 30-35% and 27 to 66% susceptible to Trimethoprim-Sulphamethoxazole and cephalothin, respectively [22].The use of ampicillin and co-trimoxazole as single agents in the treatment of UTI may not be of great value as they have high resistance rates when compared to Amikacin and Gentamicin that have a great value as an empirical treatment of UTI in children above one year. Nitrofurantoin also could be a reasonable alternative empirical treatment of lower UTI in older children [18]. The emergence of microbial resistance problem is increasing due to the inappropriate use of antibiotic prophylaxis, self medication with some types of antibiotics and the inadequate dosage of these antibiotics [17, 52]. Proper use of antibiotics helps reducing the frequency and clinical expression of UTI such as VUR, resolving any underlying pathology [17].

1.11. Prevention of UTI:

Prevention of recurrent UTI focuses both on detection and correction if possible, of urinary tract abnormalities. Interventions that have been associated with a decrease in symptomatic UTI in children with a history of recurrent UTI include relief of constipation and voiding dysfunction [21]. According to The National Institute for Health and Clinical Excellence

(NICE) guidelines, prevention of UTI recurrence includes: Relieving constipation and dysfunctional elimination syndromes in children who have had a UTI ,encouraging them to drink an adequate amount, and ensuring that these children have ready access to clean toilets when required [2]

1.12 Objectives of study

1.12.1 Main objective

The main objective of this research was to measure the prevalence of urinary tract infections among male and female children with ages ranging between 6 and 12 years old in both governmental and UNRWA primary schools in Nablus, West Bank.

1.12.2 Secondary objectives

Secondary research objective was to:

1. Identify the microorganisms responsible for urinary tract infections in Nablus UNRWA and governmental schools and compare results with worldwide data.

2. Explore the sensitivity of the identified microorganisms to certain antibiotics used to treat UTI in this age group.

3. Consider the demographic variables and their relationship with UTI (Demographic variables include: child's age, child's gender, if males are circumcised or not, child's order in his family, father's level of education, mother's level of education, and place of residence).

Chapter Two

Methodology

This chapter describes the type of study, identification of population and sample size, setting, ethical considerations, instruments, data collection, and experimental work.

This cross-sectional study was designed to measure the prevalence of UTI among children in the age group from 6-12 years old, in primary schools in Nablus district, West Bank, Palestine. Twenty four primary schools were involved in this study, both UNRWA and governmental schools (12 in Nablus city, 8 in Nablus villages, and 4 in Nablus refugee camps) . This study was conducted in the period from February and May 2009. According to UNRWA and Ministry of education statistics for the year 2008/2009, the total number of students in the age group from 6-12 years old was 29640 students (23794 in governmental schools and 5666 in UNRWA schools). Based on this population, a theoretical sample of 1462 students was calculated, with 95% confidence level. Cluster sampling method was used to identify numbers of males to females students, to identify numbers of children in Nablus city schools, in Nablus surrounding villages, and in Nablus refugee camps schools, to identify numbers of children in each school, and finally to identify numbers of children in each class. Whereas random sampling method was used to choose school names in city, its villages and refugee camps, also random sampling method was used to choose children from each class. After doing all of these calculations 1462 questionnaire were distributed among children at schools with a letter to their parents to take their signed permission of taking urine samples from their children the next day they return the questionnaire and the signed permission letter. Sterile urine cups were distributed only to

students who brought their patients permission to participate in this study. Children who were taking antibiotics at the same time of taking urine sample were excluded from the study calculations. A midstream fresh urine sample was taken from students and samples were transferred to the university lab in a cooler to prevent any bacterial multiplication. In the lab samples were tested through urinalysis which includes both dipstick screening test and microscopic examination for both WBCs and bacteria. All positive urine samples for either or both leukocyte esterase and nitrite were examined under the microscope after doing centrifugation 1000 rpm/5 min for urine sample. Then all samples were cultured on a chromogenic culture media and incubated at 37 c˚ for 18-24 hours. After identification and counting of microorganisms on the urine culture plate, sensitivity test was done to explore the sensitivity patterns for each type of microorganism responsible for UTI. Sensitivity tests were done over Muller Hinton Media using various types of antibiotics that are used in the treatment of UTI in the age group from 6-12 years. The overall prevalence of UTI was calculated by dividing the number of positive samples by the number of children considered in our calculations; prevalence of UTI was calculated also for males, females, in Nablus city, villages and refugee camps. Finally all of these data were analyzed and tabulated by Statistical Package for Social Sciences (SPSS) software.

2.1 Sample Size

Sample size was calculated to be 1462 based on the population of the study (29640) with confidence level 95% according to the sample size equation on www.surveysystem.com website [25].

2.2 Inclusion criteria:

1- Children (6-12) years of age.

2- Children with good general health

2.3 Exclusion criteria:

Children taking antibiotics at the time of taking samples were excluded from our calculations for the prevalence.

2.4 Data Collection:

Questionnaires were distributed and urine samples were taken from school children after obtaining the permission of Palestinian Ministry of Education and area education office of UNRWA in Nablus and after obtaining the permission of children's parents to take urine samples from them.

2.5 Instrument of data collection

The study utilized two main instruments:

2.5.1 Questionnaire:

A specially designed questionnaire was prepared for this purpose. The questionnaire included both demographic and clinical parts. And it was tested on 20 children to be sure that questions can be answered.

2.5.2 Urine testing

2.6 Materials used in urine testing:

1. Urine multisticks (Medi-Test Combi 10®SGL)
2. Microscope (Olympus)
3. Centrifuge (Hermile Z200A)
4. Chromogenic Media (Uriselect®BioRad)
5. Muller-Hinton Media (Oxoid®)
6. Antimicrobial susceptibility test discs (Oxoid®)
7. Sterile calibrated loops 10 (ml)
8. Incubator (Thermostar J-Dahan Technologies)
9. Autoclave (Tuttanuer Autoclave-Steam Sterilizer model 1730 MK EC).

2.7 Methods:

2.7.1Collection of urine samples

Urine samples from school children were collected in sterile cups and were transported to the university lab by using a portable cooler filled with ice blocks to avoid any bacterial. Children were sampled by clean catch midstream urine.

Samples were collected in the period between February and May 2009.

2.7.2 Urinalysis:

Samples of urine were tested within few hours of sampling .Urinalysis was performed on these specimens.

2.7.2.1 Dipstick screening technique

Urine samples were tested by using the dipstick technique for leukocyte esterase and nitrite using Multisticks of Medi-Test combi 10®SGL

2.7.2.2 Microscopy

Microscopic examination of a centrifuged sample for White blood cells and bacteria was done for samples positive for one or both Leukocyte and Nitrite. The presence of more than 5 WBC/HPF indicated pyuria.

2.7.3 Culture and sensitivity :

All samples positive for one or both Leukocyte and Nitrite and positive for one or both WBCs and bacteria were inoculated on chromogenic media And incubated at 37 C for 24 hours in an incubator. Antimicrobial susceptibility of isolates was tested by the disk diffusion method using Mueller—Hinton medium, using antibiotic discs with the minimum inhibitory concentration (MIC). Antimicrobial agents tested were Amoxicillin, Ampicillin, Amoxicillin+ Clavulanic acid, Trimethoprim-Sulphamethoxazole, Ciprofloxacin, Ofloxacin, Norfloxacin, Nitrofurantoin, Gentamicin, Amikacin, Cephalexin, Cefuroxime, Ceftriaxone, Cefotaxim,Cefepime, Ceftriaxone (Oxoid®). These antibiotics were chosen as they are the antibiotics of choice in the treatment of UTI. All of these

antibiotics can be given to children in the age group from 6-12 except the Ofloxacin and Norfloxacin due to their effect on joint development.

2.7.4 Statistical analysis

Data was tabulated and analyzed using the Statistical Package for Social Sciences SPSS software. Data were presented as frequencies. Chi-square analysis (χ^2) was used in findings on comparison of positively UTI cases according to individual characteristics. Evaluations were carried out at 95% confidence level and $P < 0.05$ was considered statistically significant.

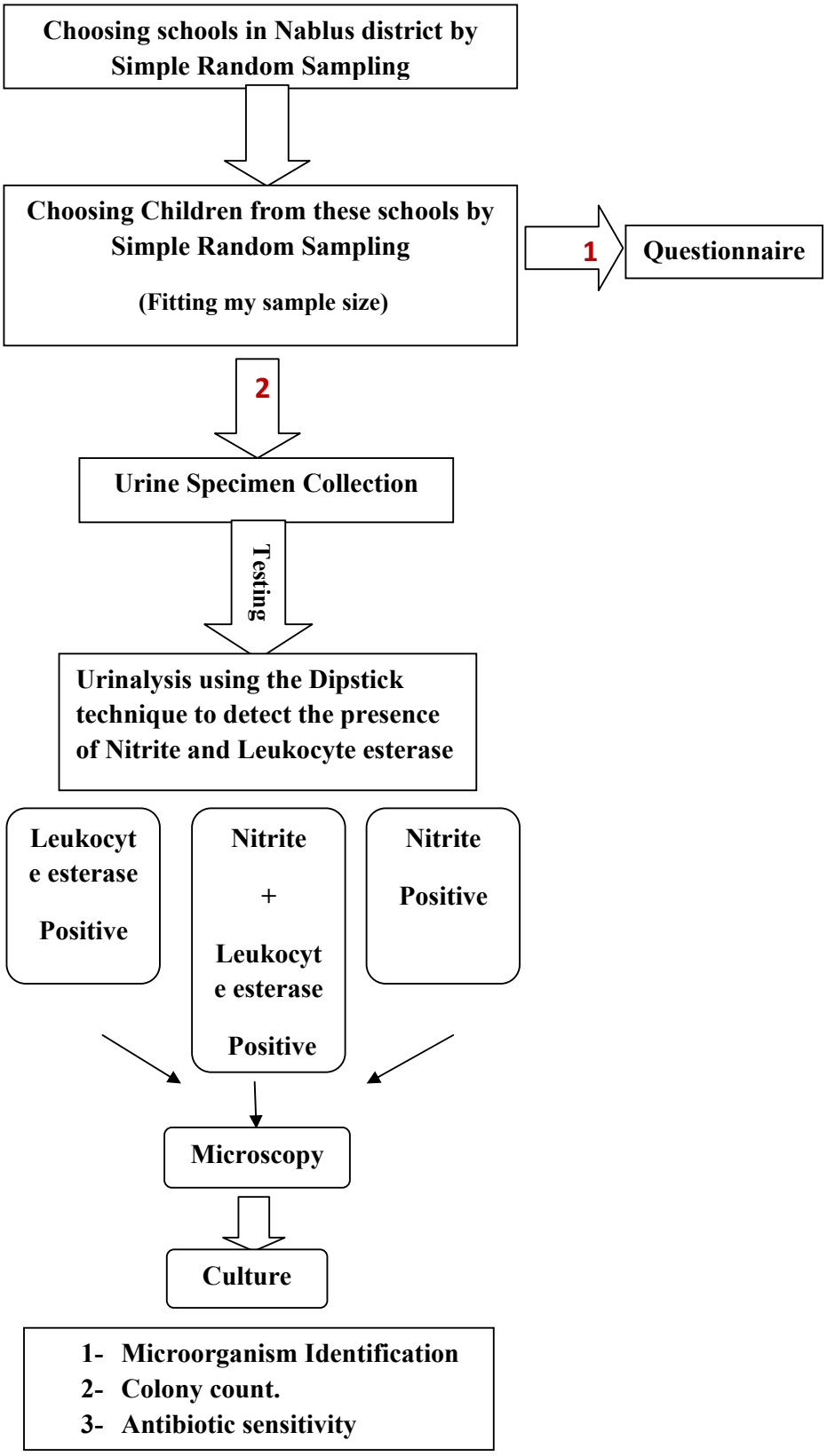
2.8 Study limitation: Lack of cooperation from some children and their parents, Check points and Lack of financial resources limit the widespread of this study all over the West Bank.

2.9 Ethical issues:

Permission obtained from the Palestinian Ministry of Education in Nablus as well as a permission from UNRWA to conduct this study in the chosen schools.

A letter was sent to the parents of children to obtain their signed permission for taking urine samples from their children. In addition parents have filled out the questionnaire.

2.10 Flow chart explaining the experimental work:



Chapter Three

Results

This cross-sectional study was on a group of 1462 children in the age group from 6-12 years in both governmental and UNRWA schools, but only 95.35% (1394/1462) responded to both taking urine samples from them and filling the study questionnaire, 58 urine samples were excluded from this study calculations as children that urine sample was taken from them were taking antibiotics at the same time of doing the test. Prevalence and other variables calculations were done on the rest 1338 (91.51%) children 719(53.7%) girls and 619 (46.2%) boys.

3.1Urinalysis

3.1.1 Dipstick results

After doing lab tests on urine samples, it was found that 98 samples were positive for leukocyte, nitrite or both by the dipstick method. 7 samples were positive for both leukocyte and nitrite, 74 samples were positive for leukocyte only, and 17 samples were positive for nitrite only as shown in table 3.1

3.1.2 Microscopy results

Microscopic examination for WBCs and bacteria, found that of the ninety eight cases positive on the dipstick screening test, 17 cases were positive for pyuria, 16 cases positive for bacteriuria and the rest (11 cases) negative for pyuria or bacteriuria. These data are presented in table 3.1

3.2 culture results

According to data presented in table 3.1, twenty nine (29) cases showed no growth upon culture, thirty four (35) cases showed insignificant growth less than 100,000 cfu/ml and thirty five (35) cases more than 100,000 cfu/ml.

Table (3.1): Urinalysis and culture results

Cases	Multisticks		Microscopy			Culture		
	Nitrite	Leukocyte	Bacteriuria	Others (Amorphou , oxalate)	Pyuria	+ve ≥100,000 cfu/ml	+ve ≤100,000 cfu/ml	-ve No growth
7	+	+	0	0	7(+)	7(+)	0	0
74	-	+	2	10	62(+)	15	33	26
17	+	-	14	1	2	13	2	2
Total			16	11	71	35	35	28
98			98			98		

In the current study UTI was confirmed by two criteria:

First, if one or both of leukocyte and nitrite are positive after doing the dipstick urine test, plus a bacterial colony count over 100,000 cfu/ml following urine culture. ˚regardless to symptoms. The second, if one or both of leukocyte and nitrite are positive, after doing the dipstick urine test, plus any colony count on the culture plate following urine culture. But with one or more UTI symptoms such as burning sensation during urination or fever of unexplained source.

In reference to the previous data thirty five (35) cases, showed bacterial count over 100,000 cfu/ml, whereas thirty five (35) cases showed bacterial growth over the culture plate less than 100,000 cfu/ml, but nineteen cases of them were symptomatic

According to the criteria used to confirm UTI cases, thirty five (35) cases were over than 100,000 cfu/ml plus nineteen (19) cases with bacterial count less than 100,000 cfu/ml but symptomatic for UTI, as a result the total number of UTI cases thirty five plus nineteen, fifty four (54) cases.

3.3 Prevalence of UTI result:

In reference to the previous numbers the overall prevalence of UTI (boys and girls) in this study is 54/1338 (4%), 54/719 (7.5%) in girls and 0/619 (0%) in boys.

3.4 Distribution of Uropathogens among the 54 positively UTI samples.

Data presented in table 3.2 showed that *Escherichia coli* was the most predominant pathogen followed by *Staphylococcus aureus* and *Klebsiella Pneumonia* with 51.8%, 29.6%, 5.6% percentages respectively.

Table (3.2) Distribution of uropathogens

Microorganism	Frequency	Percentage
Escherichia coli	28	51.80%
Staphylococcus aureus	16	29.60%
Klebsiella Pneumonia	3	5.60%
Staphylococcus Saprophyticus	2	3.70%
Enterococcus facials	2	3.70%
Streptococcus agalactiae	2	3.70%
Enterobacter cloacae	1	1.90%

3.5 Distribution of gram negative and gram positive bacteria among uropathogen

Gram negative bacteria was the most common of uropathogens responsible for UTI with a 59.3% percentage in comparison to 40.7% for gram positive bacteria, as shown in table 3.3.

Table (3.3) Distribution of gram positive and gram negative bacteria among uropathogens

Gram +ve	Gram -ve
Staphylococcus aureus 29.6%	*Escherichia coli* 51.8%
Staphylococcus Saprophyticus 3.70%	*Klebsiella Pneumonia* 5.6%
Enterococcus facials 3.70%	*Enterobacter cloacae* 1.9%
Streptococcus agalactiae 3.70%	
Total 40.7%	**Total 59.3%**

3.6 Sensitivity of uropathogens to common antibiotics used in the treatment of UTI in the age group (6-12) years old.

3.6.1 Sensitivity of *Escherichia coli* and *Staphylococcus* aureus to antibiotics

Escherichia *coli and Staphylococcus aureus* were highly resistant to all antibiotics (›20% resistance).

Table (3.4) sensitivity of *Escherichia coli* to antibiotics

Antibiotic	Sensitive	Resistance
Sulphamethoxazole/Trimethoprim	32.14%	67%
Cephalosporins		
Cefotaxime	32.14%	67%
Ceftriaxone	14.30%	85%
Cefuroxime	0%	100%
Cefepime	0%	100%
Cephalexin	0%	100%
Cephixime	0%	100%
Fluroquinolones		
Norfloxacin	28.57%	71%
Ofloxacin	21.40%	78%
Ciprofloxacin	21.40%	78%
Aminoglycosides		
Amikacin	14.30%	85%
Gentamicin	0%	100%
Penicillin's		
Amoxicillin/Clavulanate	3.57%	96.42%
Amoxicillin	0%	100%
Ampicillin	0%	100%
Nitrofurantoin	3.57%	96.42%

Table (3.5) Sensitivityof *Staphylococcus aureus* to Antibiotic

Antibiotic	Sensitive	Resistance
Sulphamethoxazole/Trimethoprim	25%	75%
Cephalosporins		
Cefotaxime	13.50%	87.50%
Ceftriaxone	0%	100%
Cefuroxime	0%	100%
Cefepime	0%	100%
Cephalexin	0%	100%
Cephixime	0%	100%
Fluroquinolones		
Norfloxacin	37.50%	62.50%
Ofloxacin	37.50%	62.50%
Ciprofloxacin	31.50%	68%
Aminoglycosides		
Amikacin	25%	75%
Gentamicin	18.75%	81.25%
Penicillin's		
Amoxicillin/Clavulanate	13.50%	87.50%
Amoxicillin	6.25%	93.75%
Ampicillin	0%	100%
Nitrofurantoin	13.50%	87.50%

3.7 UTI and demographic characteristics

Prevalence of UTI was found to be 3.6% in Nablus city, 3.6% in its villages, and 6% in refugee camps .But statistical percentages were not significantly different (p=0.235). On the other hand gender was significantly (p=0.0001) associated with UTI with UTI prevalence 7.5% in females and 0% in males. The age of the child, his grade at school and the order of the child in his family were not statistically significant with p values (p=0.417), (p=0.066), and (p=0.119) respectively. Variation in father's educational levels was statistically significant (p=0.004), whereas mothers educational level was not (p=0.574). This was clearly noticed in table 3.6 below

Table (3.6) Comparison of Demographic characteristics and UTI positivity

Demographic characters	UTI (+) N=54	UTI(-) N=1284	Chi square value	P value
	No. (%)	No. (%)		
Residency				
City	24(3.6)	642(96.4)		
Village	16(3.6)	424(96.4)	2.895	0.235
Camp	14(6)	218(94.0)		
Gender				0.0001
Male	0(0.00)	619(100.0)		
Female	54(7.50)	665(92.5)		
Age (years)				
6-9	34(5.52)	639(94.84)	1.890	0.169
10-13	20(3.46)	557(96.54)		
Grade				
1	12(6.66)	168(93.34)		
2	11(5.72)	181(94.28)		
3	9(4.18)	206(95.82)		
4	11(4.66)	225(95.36)	11.816	0.066
5	4(1.74)	225(98.26)		
6	7(3.50)	191(96.50)		
Unknown	0(0.00)	88(100.0)		
Mother education level				
Secondary education or below	43(4.79)	854(95.21)		
Bachelor degree	10(3.00)	323(97.00)	6.224	0.574
Higher education	1(5.88)	16(94.12)		
Unknown	0(0.00)	88(100.0)		
Father education level				
Secondary education or below	42(5.24)	759(94.76)		
Bachelor degree	7(1.86)	369(98.14)	13.448	0.004
Higher education	5(7.35)	63(92.65)		
Unknown	0(0.00)	93(100.0)		
Order of the child in his family				
The first	12(3.98)	289(96.02)		
Between the first and last	34(4.89)	661(95.11)	5.856	0.119
The last	8(3.30)	234(96.70)		
Unknown	0(0.00)	100(100.0)		

UTI may cause obvious symptoms such as burning sensation while urination, fever, frequency of urination, and urgent need to urinate (urgency) .In the current study UTI was strongly associated with both fever (p=0.012) and burning with urination (p=0.0001). Whereas the other symptoms like frequency of urination and urgent need to urinate was not statistically significant with p values (p=0.099) and (p=0.106) respectively. All of these data were shown in table 3.7 below

Table (3.7) Comparison of symptoms and UTI positivity

UTI symptoms	UTI (+) N=54	UTI(-) N=1284	Chi square value	P value
	No. (%)	No. (%)		
Frequency of urination				
≤2 times	3(2.13)	137(97.87)		
2-4 times	35(4.96)	671(95.04)	6.28	0.099
›4 times	15(3.86)	377(96.14)		
Unknown	0 (0.00)	99(100.0)		
Urgency				
Yes	35(4.28)	783(95.72)		
No	19(4.50)	403(95.50)	4.483	0.106
Unknown	0(0.00)	98(100.0)		
Burning sensation while urination				
Yes	25(9.36)	242(90.64)		
No	29(2.97)	949(97.03)	26.372	0.0001
Unknown	0(0.00)	93(100.0)		

Night or bedwetting (nocturnal enuresis) and day wetting are common in young children, this study have demonstrated a significant relation between UTI positivity and nocturnal enuresis ($p=0.035$), whereas no significant difference was shown between UTI positivity and day wetting (p=0.078). These information are illustrated in table 3.8 below

Table (3.8) Comparison of day and night wetting with UTI positivity

Day and night wetting	UTI (+) N=54	UTI(-) N=1284	P value
	No. (%)	No. (%)	
Nocturnal enuresis (night wetting)			
Yes			
No	10(6.80)	137(93.20)	
Unknown	44(4.00)	1057(96.0)	0.035
	0(0.00)	90(100.0)	
Day wetting			
Yes	4(6.90)	54(93.10)	0.078
No	50(4.20)	1140(95.80)	
Unknown	0(0.00	90(100.0	

Children stay long time at school, during which they need to use toilets several times alone without the supervision of any one. Variables like: using school toilets , school permission of the child to use toilets upon his need, whether the child knows well how to use toilets in proper and hygienic way and whether the child is able to clean urine residues were studied with relation to UTI positivity, but none of these variables was significant except for using of school toilets in a proper and hygienic way which was statistically associated with UTI positivity (p=0.046) as presented in table 3.9 below

Table (3.9) Comparison of children's behavior and school role with UTI positivity

Children behavior and school role	UTI (+) N=54	UTI(-) N=1284	P value
	No. (%)	No. (%)	
Using of school toilets			
Yes	42(4.76)	840(95.24)	
No	12(3.26)	356(96.74)	0.065
Unknown	0(0.00)	88(100.0)	
If children are permitted to use school toilets			
Yes	52(4.53)	1096(95.47)	
No	2(2.08)	94(97.92)	0.06
Unknown	0(0.00)	94(100.0)	
If children know how to use toilets in proper and hygienic way			
Yes	48(4.11)	1120(95.89)	
No	6(7.41)	75(92.59)	0.046
Unknown	0(0.00)	89(100.0)	
If children know how to clean the residues of urine after urination and they do that			
Yes	51(4.30)	1135(95.70)	
No	3(4.62)	62(95.38)	0.14
Unknown	0(0.00)	87(100.0)	

Parents must be careful in noticing UTI symptoms in their children as children cannot express their feelings well as adults, as a result they should take their children immediately to the doctor to avoid any complication that may result from any delay in both diagnosis and treatment of these children. In the current study UTI positivity was studied with the parent's response to high fever and burning sensation while urination in their children found a significant association (p=0.004) as shown in table 3.10

Table (3.10) Comparison of parent's attitudes toward their children with UTI positivity

	UTI (+) N=54	UTI(-) N=1284	P value
If the child was taken to the doctor as a result to high fever and burning sensation while urinating			
Yes	30(6.17)	456(93.87)	
No	24(3.15)	739(96.85)	
Unknown	0(0.00)	89(100.0)	0.004

Chapter Four

Discussion and Recommendations

The presence of infection in the sterile posterior urethra, bladder, ureters, renal pelvis or renal parenchyma indicates Urinary Tract Infection [28]. Epidemiological studies of UTI are based on the presence of a positive urine culture. The classical diagnosis of urinary tract infection (100,000 cfu/ml) is applied in the childhood diagnosis of urinary tract infection, in addition to pyuria (more than 5 white cells per high powered field on microscopy) and bacteriuria .The presence of both pyuria and bacteriuria from a fresh urine sample are highly indicative for UTI. Urine dipsticks that detect the presence of white blood cells (leukocyte esterase), or the production of nitrite are highly recommended in the preliminary diagnosis of UTI with high specifity and low rate of false positive results [29].

4.1 Prevalence of UTI

After screening 1338 primary school children in Nablus district from the city, villages, and camps both governmental and UNRWA schools, the overall prevalence of UTI (boys and girls) was calculated to be 54/1338 (4%), whereas the prevalence of UTI in girls was calculated to be 7.5%. The prevalence of UTI in Nablus city, villages, and camps was 3.6%, 3.6%, 6% respectively. In the current study there were no UTI cases in boys and the prevalence of UTI in boys was 0/619(0%)

In Jordan, a study was conducted to determine conditions that result in pediatric nephrology consultations in the academic hospital of Jordan

University in the age group from one day to 16 years and found that urinary tract infections account 14.2% of consultations.

An Egyptian study was conducted on 5% of primary school children from 6-12 years of age in Ismailia Governorate to measure the prevalence of UTI in primary school children showed 2.4% overall prevalence of UTI 1.7% among males and 2.7% among females. In this study the prevalence of UTI in urban areas was 1.8% in comparison to that in rural areas which was 2.4% [61]. The overall prevalence of UTI in this study was found to be higher than that of the Egyptian study, but found no difference in UTI prevalence between urban and rural areas.

Another study was conducted by the Division of General Academic Pediatrics, University of Pittsburgh in the USA revealed a 7.8% prevalence of UTI among children less than 19 years with urinary symptoms (both febrile and afebrile)[14]. Their result is higher than ours because their study included febrile and afebrile infants, and their study included infants symptomatic for UTI, whereas our study included children regardless of symptoms.

In north of England the incidence of UTI was 3.6% in boys and 11.3% in girls by the age of 16 years [34]. In the current study the prevalence of UTI was 0% in boys due to 100% circumcision rate in boys in comparison to western countries like England, whereas the prevalence of UTI in England was higher in girls because the incidence was calculated until 16 years of age in that study. At this age girls have become

adolescents and sexually active. Our study included only the age group from 6-12 years old.

4.2 Uropathogens in this study

The second aim of this study was to identify the uropathogens responsible for UTI in this age group. According to the current study gram negative bacteria was responsible for 59.3% of UTIs in comparison to gram positive bacteria which was 40.7%. *Escherichia coli* was the most predominant uropathogen with 51.8%, followed by *Staphylococcus aureus* 29.6%, *Klebsiella Pneumoniae*5.6%, *Staphylococcus Saprophyticus* 3.7%, *Enterococcus facials* 3.7%, *Streptococcus agalactiae* 3.7%, and *Enterobacter cloacae* 1.9%

In a study conducted in Israel, gram negative rods caused 98% of UTI infections, of which *Escherichia coli* accounts for 87%, followed by *Klebsiella Pneumonia*e 4% and proteus mirabilis 4%. This study included 151 children younger than 14 years and 79% of them (119) were females[43].

Escherichia coli, *Enterococcus* sp, *Proteus* spp., and *Morganella morganii* were the most isolated bacteria children in 1-18 years old [44].

In a prospective study undertaken over a 14-month period in northwest Iran a 5136 urine samples were collected from outpatients in the age group 1.5-65 years (mean age 28.2) to explore the causative agents responsible for UTI and their antimicrobial susceptibility, the causative

agents in the age groups belonging to our study were as follows: *Escherichia coli* 80%, *Klebsiella* spp 2.7%, *Enterobacte*r spp 2.7%, *Proteus* spp 2.7%, *Pseudomonas aeruginosa* 6.7%, *Staphylococcus aureus* 1.3%, *Staphylococcus Saprophyticus* 4% in the age group (0-9), Whereas in the age group from (10-19) *Escherichia coli* 78.2%, *Klebsiella* spp 11.5%, *Enterobacter* spp 0%, *Proteus* spp 1.3%, *Pseudomonas aeruginosa* 1.3%, *Staphylococcus aureus* 0%, *Staphylococcus Saprophyticus* 6.4% [45].

In a study by the University of Florida, USA of a group of patients aged 17 years or less urine specimens were collected in an emergency department and grew cultures with greater than 100,000 cfu/ml of single organism on Mackonky and blood agar. All patients lacking UTI symptoms were excluded. After making all exclusions 81 patients met the inclusion criteria of this study. Of these 81 patients 89% had UTI due to *Escherichia coli*, 3.7% to *Klebsiella*, 1.2% to *Proteus*, 1.2% to *Citrobacter*,1.2% to *Staphylococcus* 1.2% ,and *Enterococcus* 3.7% [48].

In a study done in Jordan to assess the antibiotic resistance in children with recurrent or complicated urinary tract infection in a 121 children patients, *Escherichia coli* was determined to be the predominant microorganism with 71% in patients with recurrent UTI and 47% in patients with complicated UTI. *Proteus* , *Pseudomonas*, and *Candida* Spp. were more prevalent in patients with complicated UTI[49].

In another a study in Jordan conducted by the department of pediatrics, Princess Haya Hospital Jordan on 100 patients suffering from

UTI in the age group from 0-15 after doing urine culture and colony count the most common responsible uropathogens for UTI in the age group 5to 15 years were as the follows: *Escherichia coli* 76%, *Klebsiella Pneumoniae* 13%, *Proteus* 6.5%, *Staphylococci* 2.2%, and *Pseudomonas* 2.2% [50].

4.3 Sensitivity of *Escherichia coli* and *Staphylococcus aureus* to antibiotics

Resistant rate of bacteria against all antibiotics was more than 20%, as a result none of these antibiotics can be used as initial empirical treatment for UTI. For both *Escherichia Coli* and *Staphylococcus aureus* which were the most predominant uropathogens in this study. The antibacterial sensitivity profile of antibiotics showed a high resistance rate up to 100% among first line antibiotics like Ampicillin, Amoxicillin, and Amoxicillin/clavulanic acid, Cephalosporins such as Cefotaxime, Ceftriaxone, Cefepime, Cephalexin, and Cephixime, Aminoglycosides, Trimethoprime /Sulphamethoxazole. Even Fluroquinolones antibiotics like Ciprofloxacin, Norfloxacin, and Ofloxacin which their use in this age group is controversial due to their effect on joint development showed high resistant rates to both *Escherichia coli* and *Staphylococcus aureus*. These numbers alert us that we a have a serious problem in that the bacteria are resistant to antibiotics.

In a retrospective study among children patients below 14 years treated at Queen Alia Military Hospital and Prince Aisha Bent Al-Hussein

Military Center / Jordan from January 2006 to April 2007. Resistance to Ampicillin, sulfamethoxazole, and trimethoprim (TMP-SMZ) was common and multidrug-resistant (MDR) among *Escherichia coli* isolates was 59.9% [51].

4.4 UTI and demographic variables

The fourth aim of this study was to explore the relationship between UTI and demographic variables like age, gender, residence, order of the child in the family, father's and mother's education level, and circumcision status in boys.

4.4.1UTI and gender

In our study there was a significant difference (p=0.0001) between the frequency of UTI and gender. The prevalence of UTI was 7.5% in girls and 0% in boys due to 100% circumcision rate .The age group in our study was from 6-12 years. Throughout childhood the risk of UTI was 8% for girls and 2% for boys according to department of urology/university of Wisconsin education module number 7 of Pediatric Urinary Tract Infection [39].The prevalence of UTI was higher in females than that in males for many reasons like female short urethra, the age group in our study was from 6-12 years and some females in the age group 10-12 has started their adolescence period and the start of menstrual cycle. Since the circumcision rate in our study was 100%, and circumcision tends to decrease the frequency of UTI by 10-20 fold, and that explains the 0% prevalence of

UTI in our study. The low prevalence (0%) of UTI in boys could be due to the fact that all boy were circumcised.

4.4.2 UTI and age

The Incidence of UTI is bimodal; highest during the first year of life and peaking again during adolescence [31**].** In our study we had only one age group from 6-12 years old, so there were no significant difference (*P*= 0.417) in the frequency of UTI and the ages of children.

And there were also no significant difference (p=0.066) between the child's grade and the frequency of UTI.

4.4.3 UTI and residency

Despite the variation in prevalence among the three residency areas, 3.6% in the city, 3.6%in the village, and 6% in the camps, there was no significant difference (P value 0.235) between the frequency of UTI and residency. Although there were no significant difference between residency and UTI frequency, the frequency of UTI in camps 6% tends to be high, that is may be due to the nature of camps (crowdiness, high number of children in the same house, and unhealthy living conditions), the frequency of UTI in Nablus city and its villages was the same.

4.4.4 UTI and education

The present study showed no significant relation between UTI frequency and the educational level of the child's mother (P =0.574), on

the other hand this study showed a significant difference (p=0.004) between the child's father educational level and the frequency of UTI. Although our study showed a significant difference between fathers educational level and frequency of UTI in children over mothers educational level, mother educational level tends to be more important as the mother spend more time than the father with her children, but higher education level of fathers tend to increase the quality of life for his family.

4.4.5 UTI and circumcision

Circumcision in boys was 100% in the current study due to observance of conservative Islamic tradition. On the other hand, the prevalence of UTI in boys in our study was 0%. Although circumcision tends to decrease the frequency of UTI by 10 folds, circumcision status in boys becomes unimportant after the first year of life as rates of UTI declines [31]. But 100% circumcision rate is the only explanation for 0% prevalence of UTI in our study.

4.5 UTI and nocturnal enuresis

The prevalence of nocturnal enuresis (night wetting) in this study was measured to be 10.9% (147/1338) and 18.5 %(10/54) of UTI children were enuretics. Nocturnal enuresis was highly significant to UTI (P= 0.035).

In a cross sectional study conducted on a 7562 children aged 5-18 years in Iran, the overall prevalence of enuresis was 6.8% , the prevalence

of urinary tract pathology was 2.9% among enuretics which indicates high association between UTI and nocturnal enuresis [54].

4.6 UTI and day wetting

Children with daytime wetting with/without night wetting very often have bladder sphincter dysfunctions which are in turn correlated with recurrent urinary tract infections, 8% of the school children (10-12 years old) report day time wetting with/without night wetting with some frequency [9]. 1% of healthy children over the age of 5 years have troublesome day wetting [11]. In our study the prevalence of day wetting was measured to be 4.3% but showed no significant relation (p=0.078) between the infection with UTI and day wetting.

4.7 UTI and children's habits in using toilets

Behavioral intervention seemed effective in improving children's micturation habits thereby changing the frequency of wettings, and the frequency of urinary tract infections [7]. Our results showed significant difference between the proper use of toilets by children and the frequency of UTI (p=0.046), but showed no significant difference between the frequency of UTI and using of school toilets, and cleaning urine residues after urination with P values (0.065, 0.140) respectively. Proper use of toilets includes frequent micturation and complete emptying of the bladder as infrequent micturation and incomplete emptying of the bladder in children represent important factors in the causation of incontinence during

the day, and of urinary tract infections [7]. Although our study showed no significant difference between cleaning urine residues and the frequency of UTI, keeping the urogenital area clean and wet tends to decrease the probability for UTI.

4.8 UTI and symptoms

The Clinical symptoms of UTI usually include frequency, dysuria, pyuria, abdominal pain, back pain, fever or urgency [19, 30].

Despite urgency and frequency of urination are important signs to confirm UTI. Our study showed no significant relation between the UTI infection with urgency and the frequency of urination with P values 0.106, 0.099 respectively.

High fever and burning sensation while urination had a high significant relation with UTI as was shown in our study with P values 0.012, 0.0001 respectively. Fever of an unexplained source in children usually indicates UTI [3].

Only 6.04 % of children suffered from high fever and burning sensation while urination and have UTI in this study was taken to the doctor. And only 7.63% of the children with UTI were taken to the doctor, the doctor asked them to do urinalysis. Medicine was prescribed for only 8.46% of those children did urinalysis.

4.9 Conclusions

1. The overall prevalence of UTI is 4% in Nablus district in the age group from 6-12.
2. Females are more susceptible for UTI with 7.5% prevalence, in comparison to 0% for males
3. Gram negative bacteria are responsible for 59% of UTIs and *Escherichia Coli* is the most predominant uropathogen in this study.
4. Resistance rate is more than 20% against all antibiotics in this study.

4.10 Recommendation

1. Doctors are encouraged to ask their patients to do urine culture when they suspect UTI, in order to give the best treatment.
2. Another study should be implemented to measure resistance rate of uropathogens to commonly used antibiotics; this study must include all positive confirmed cases of UTI either for *Escherichia coli*, *Staphylococcus aureus*, or other uropathogens from all labs in Nablus, and then do antibiotic sensitivity tests for them. This study can give us a better idea about antibiotic resistance rates.
3. A widespread screening program for UTI should be implemented to know the exact prevalence of UTI in Palestine, as there are no studies on the subject.
4. Policies must be put on antibiotic prescribing as the resistant rate in all antibiotics in this study is over 20%.

5. More health promotion programs are needed to be implemented at schools, to increase the awareness of students and their teachers and improve their healthy behaviors.

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Appendices

بسم الله الرحمن الرحيم

جامعة النجاح الوطنية

كلية الدراسات العليا

برنامج الصحة العامة

هذه الاستبانة معده لدراسة مقدمة لنيل درجة الماجستير في الصحة العامة، تقــوم بهــا الطالبة راية محمد صوالحة من كلية الدراسات العليا / جامعة النجاح الوطنية، وهي بعنوان

انتشار التهابات المسالك البولية بين أطفال مدارس نابلس الأساسية

Study title: Prevalence of Urinary Tract Infection in Nablus Primary School Children

يهدف هذا الاستبيان إلى قياس مدى انتشار وأسباب التهابات المسالك البولية بين أطفال مدارس مديرية نابلس, إن تعاونكم معنا في تعبئة هذه الاستبانة سيعود بالفائدة الكبرى على صحة أطفالكم . مع العلم أن هذه المعلومات ستستخدم لإغراض البحث العلمــي و ســتعامل بالســرية التامة, لذا يرجى التعاون معنا مع جزيل الشكر لكم.

الطالبة

راية صوالحة

2009

القسم الأول الرجاء الإجابة عن الأسئلة التالية:

المدرسة: _____.

اسم الطفل: _____.

عمر الطفل: _____.

للصف:_____.

– الأول – الثاني – الثالث – الرابع – الخامس – السادس.

جنس الطفل:

أ. ذكر ب. أنثى

– إذا كان طفلك ذكراً هل قمتم بإجراء الطهور له؟

أ. نعم ب. لا

القسم الثاني: الرجاء وضع دائرة حول الإجابة التي تراها مناسبة:

1. مستوى تعليم الأم:

أ. ثانوي أو أقل ب. جامعي ج. دراسات عليا

2. مستوى تعليم الأب:

أ. ثانوي أو أقل ب. جامعي ج. دراسات عليا

3. ترتيب الطفل بين الأخوة من حيث العمر:

أ. الأول بين أخوته ب. ببين الأول والأخير ج. الأخير

4. عدد مرات دخول طفلك الحمام يومياً

أ. مرتين أو أقل ب. من مرتين الى أربع مرات ج. أكثر من أربع مرات

القسم الثالث: الرجاء وضع إشارة على الإجابة (نعم) أو (لا)

1. هل يستخدم طفلك عادة حمامات المدرسة؟

أ. نعم ب. لا

2. هل يسمح لطفلك بالذهاب للحمام عندما يطلب ذلك؟

أ. نعم ب. لا

3. هل لديك الثقة أن طفلك يستخدم الحمام بصورة سليمة؟

أ. نعم ب. لا

4. هل يعرف طفلك كيفية غسل منطقة الإخراج لديه بعد قضاء حاجته؟

أ. نعم ب. لا

5. هل يقوم طفلك بغسل منطقة الإخراج لديه بعد قضاء حاجته؟

أ. نعم ب. لا

6. هل يعاني طفلك من مشكلة التبول الارادي أثناء الليل؟

أ. نعم ب. لا

7. هل سبق وأن عاد إليك طفلك مبتل الملابس من المدرسة؟

أ. نعم ب. لا

8. هل يمسك طفلك نفسه عن الذهاب للحمام حتى العودة إلى البيت؟

أ. نعم ب. لا

9. هل شكى طفلك مؤخراً من حرقة في البول؟

أ. نعم ب. لا

10. هل عانى طفلك بالفترة الماضية من ارتفاع في درجة حرارته؟

أ. نعم ب. لا

11. هل قمتي باصطحاب طفلك الى الطبيب بالفترة الماضية؟

أ. نعم ب. لا

12. هل طلب الطبيب منك اجراء فحص للبول لطفلك؟

أ. نعم ب. لا

13. هل قام الطبيب بوصف دواء لطفلك بعد قراءة نتيجة الفحص؟

أ. نعم ب. لا

إذا كنت تتذكرين اسم الدواء الرجاء كتابه أسمه بالفراغ:

---

14. هل اخذ طفلك الدواء كاملا ؟

أ. نعم ب. لا

15. بعد أخذ طفلك للدواء هل تحسنت صحته؟

أ. نعم ب. لا

16. هل عادت لطفلك أعراضا مشابهه بعد فتره وجيزة من إنهائه للدواء؟

أ. نعم ب. لا

17. هل يتناول طفلك أي دواء حالياُ؟

أ. نعم ب. لا

إذا كانت الإجابة نعم هلا كتبتي لنا اسم الدواء:

شكرا لحسن تعاونكم معنا

حضرة أولياء الأمور الكرام

يرجى التفضل بالموافقة على اخذ عينة بول من أبنائكم بغرض البحث العلمي, علماً أن النتائج ستعامل بالسرية التامة.

في حال الموافقة يرجى التوقيع على النموذج أدناه.

انا ولي أمر الطالب / الطالبة _____

في مدرسة_____ لا مانع من اخذ عينة بول من ابني / ابنتي لغرض البحث العلمي.

التوقيع:_____

التاريخ:_____

بسم الله الرحمن الرحيم

السلطة الوطنية الفلسطينية
وزارة التربية والتعليم العالي
مديرية التربية والتعليم/نابلس

Palestinian National Authority
Ministry of Education & Higher Education
Directorate Of Education/Nablus

الرقم: م ن/ ١٩/ ٢/ ٥٩٤
التاريخ: ٥/2/2009م
الموافق: ١٩/2/1430هـ

حضرات السادة مديري ومديرات المدارس المحترمين،،

بعد التحية،،

الموضوع: (تسهيل إجراء بحث الطالبة راية صوالحة/تخصص ماجستير صحة عامة)

نعلمكم أن الطالبة راية صوالحة تقوم بدراسة مدى انتشار التهابات المسالك البولية عند طلبة المدارس كمتطلب للحصول على درجة الماجستير في الصحة العامة من جامعة النجاح الوطنية، لذا يرجى تسهيل عمل الطالبة المذكورة.

شاكرين لكم حسن تعاونكم،،

مديرة التربية والتعليم
أ. سحر عكوب

السلطة الوطنية الفلسطينية * وزارة التربية والتعليم العالي * مديرية التربية والتعليم نابلس

- النائب الفني المحترم
- الملف
- أ.ش/ن ح

عاصمة الثقافة العربية
Capitale Culturelle Arabe
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INTER OFFICE MEMERANDUM
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مذكرة داخلية

الرقم : ي د / 3 / 6 - 9 / 2009 التاريخ : 09/02/05

إلى : مديري و مديرات المدارس المحترمين

من : مدير التعليم – نابلس

الموضوع : تسهيل اجراء بحث الطالبة راية صوالحة

تحية و بعد :

يرجى تسهيل مهمة الطالبة راية صوالحة والتي تقوم بدراسة مدى انتشار التهابات المسالك البولية عند طلبة المدارس الابتدائية ، عن طريق اخذ عينات البول من الطلاب وتعبئة الاستمارات .

مع تحياتي،
معاوية إعمر

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نسخة : الملف

جامعة النجاح الوطنية
كلية الدراسات العليا

انتشار التهابات المسالك البولية بين أطفال ألمدارس الأساسية في مدينة نابلس

إعداد
راية محمد حسين صوالحة

إشراف
د. أدهم أبو طه

قدمت هذه الأطروحة استكمالا لمتطلبات درجة الماجستير في الصحة العامة بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس،فلسطين
2009م

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الملخص

عدوى المسالك البولية هي عدوى بكتيرية خطيرة تسبب المرض عند الرضع والأطفال. عدوى المسالك البولية يتم تعريفها من خلال مزيج من المظاهر السريرية ووجود البكتيريا في البول ، أو هي وجود أكثر من 100،000 cfu/ml بعد القيام بزراعة البول وبغض النظر عن الأعراض الإكلينيكية التي عادة ما تشمل ارتداد في البول، عسر البول ،ألم في البطن ،ألم في الظهر ، وحمى. تشخيص عدوى المسالك البولية يعتمد على تحليل البول و زراعته على حد سواء. معظم حالات عدوى المسالك البولية تسببها الجراثيم سلبية الغرام مثل *Escherichia coli*. يجب تشخيص و معالجة عدوى المسالك البولية بالمضادات الحيوية المناسبة لتقليل أي اعتلال أو وفاه أو تلف في ألكلى ناتجة عنها. ألسيطرة على عدوى المسالك البولية عند الأطفال تواجه مشكلة ظهور مقاومة للمضادات الحيوية من قبل البكتيريا المسببة لالتهابات المسالك ألبولية والتي عادة ما يشيع استخدامها لعلاج التهابات ألمسالك ألبولية.و لكن لا ينصح باستخدام ألمضادات ألحيوية كعلاج أولي، عندما يكون معدل مقاومتهم أكثر من 10-20 %. هذه دراسة مقطعية أجريت لقياس مدى انتشار عدوى المسالك البولية بين الأطفال في المدارس الابتدائية في محافظة نابلس، الضفة الغربية، فلسطين، لتحديد الكائنات الدقيقة المسؤولة عن عدوى المسالك البولية لاستكشاف أنماط الحساسية من الكائنات الدقيقة التي تم تحديدها لبعض المضادات الحيوية المستخدمة في العلاج من عدوى المسالك البولية ، ودراسة العلاقة بين بعض المتغيرات الديمغرافية وعدوى المسالك البولية. هذه الدراسة أجريت في الفترة بين شباط وأيار 2009، وشملت 1462 طفل في الفئة العمرية من 6–12 سنة. هذه الدراسة تستخدم أداتين رئيسيتين، الاستبيان واختبار البول (تحليل البول و زراعة البول). معدل الاستجابة في هذه الدراسة هو 95.35 ٪ (1462/1394)، 58 من الحالات تم استبعادها لأخذ ألأطفال مضادات حيوية في

وقت الاختبار. ألحسابات أجريت على 1338 طفلا (719 البنات والبنين 619). تم حساب انتشار التهابات ألمسالك ألبولية 4٪ (1338/54)، 7.5٪ بين الفتيات (719/54) و 0٪ بين الذكور (0 / 619). الجراثيم سلبية الغرام كانت مسؤولة عن 59.3 ٪ من المسالك البولية مقارنة مع البكتيريا إيجابية ألغرام 40.7٪ وكانت*Escherichia Coli* ألبكتيريا الغالبة 51.8٪ (54/28) تليها *Staphylococcus aureus* 29.6٪ (54/16). جميع المضادات الحيوية المستخدمة في هذه الدراسة كان لها معدل مقاومة أكثر من 20٪. التهابات ألمسالك ألبولية كانت مرتبطة إحصائيا مع المتغيرات التالية ؛ الجنس *(p=0.0001)* ، والحمى *(p=0.012)*، إحساس بحرقان حين التبول *(p=0.0001)*، سلس البول الليلي *(p=0.035)* ، واستعمال المراحيض بطريقة صحية *(p=0.046)*. يجب أن يسمح للتلاميذ بالذهاب إلى المراحيض بناء على طلبهم ، أثناء وجودهم في المدرسة ، ويجب تعليمهم كيفية استخدام المراحيض بأنفسهم بطريقة آمنة وصحية ، وزراعة البول أداة هامة لتأكيد التهابات ألمسالك ألبولية ، يجب وضع قيود على استهلاك المضادات الحيوية للحد من سوء وكثرة استخدامها.

وقد أظهرت النتائج مقاومة البكتيريا على اختلاف أنواعها لهذه المضادات، وعليه ومن ضمن ما يمكن فعله وضع سياسات تتعلق بضبط وصفات المضادات الحيوية، حيث أن نسبة المقاومة لجميع المضادات في هذه الدراسة كانت تزيد عن 20%.