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RESEARCH ARTICLE

CORRECT INTERPRETATIONS OF URINALYSIS IN THE DIAGNOSIS OF SOME MEDICAL CONDITIONS

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ABSTRACT

Urinalysis (UA) is a simple, non-invasive diagnostic tool that examines the visual, chemical, and microscopic properties of urine samples for medical or routine diagnosis, prognosis and monitoring of various medical conditions, including kidney disorders; urinary tract infections; and systemic diseases, such as diabetes mellitus. Conventionally, urine can be characterized by physical appearance, chemical composition, and microscopical examinations. Physical examination of urine includes description of colour, odour, clarity, volume, and specific gravity. Chemical examination of urine includes the identification of protein, blood cells, glucose, pH, bilirubin, urobilinogen, ketone bodies, nitrites, and leukocyte esterase; microscopic examination entails the detection of crystals, cells, casts, and microorganisms. A urinalysis is a diagnostic tool that plays an essential role in the health assessment process and is typically a first step treatment procedure done in individuals with urinary symptoms (e.g. painful urination, urinary frequency and urgency, lower abdominal pain) as well as in pregnant individuals to determine the presence of asymptomatic bacteriuria. It also offers clinicians valuable information for the monitoring of several medical conditions, including diabetes mellitus, liver disease, or renal disease. Some urine tests occasionally done but are not commonly part of the urinalysis include screening for the usage of recreational drugs (e.g. cannabis, amphetamines, cocaine, opiates, etc.), urine cytology (i.e. examination of cells in the urine, used to screen for urological cancers), measuring electrolyte levels or hormones, as well as a urine pregnancy test. Complete urinalysis is highly recommended as routine screening in all clinical or health centres in the tropical zones.

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INTRODUCTION

Urinalysis, is a conception of two words *urine*and *analysis.* Urine is from Old French word *orine*, Latin:"*urina"* and Greek:"*ouron"* and is a variant of root "water, liquid, milk"; while Analysis is from Greek word meaning: *"solution of a problem by analysis,"* or *"resolution of anything complex into simple elements"* (Armstrong, 2007). Urinalysis is a group of medical investigations involving visual/physical (macroscopic) examination of the urine, chemical assessment using urine test strips, and microscopic examination. Macroscopic examination centred on parameters like colour, clarity, odour, and specific gravity; urine test strips measure chemical properties like pH, glucose concentration, and protein levels; and microscopy is performed to identify elements such as cells, casts, crystals and organisms (McPherson and Pincus 2017). More than 5,000 years ago, laboratory medicine started with the analysis of human urine called *uroscopy,* which later became a generalized termed ***"urinalysis."*** The word *"uroscopy" was* coined from two Greek words: ***"ouron,"*** and ***"skopeoa,"*** meaning: *urine* and to: *'behold, contemplate, examine, inspect'.* Ancient physicians spoke of urine as a window to the body's inner workings and reflected different diseases. From ancient beliefs, the Hindu civilizations established that a "sweetness" in certain people's urine, which attracted black ants (Armstrong, 2007).

Hippocrates (460–355 BC) hypothesized that urine was a filtrate of the humors in the body, originating from the blood filtered through the kidneys. Aphorisms, described bubbles on the surface of freshly voided urine as a sign of long-term kidney disease and associated urinary sediment with fever (Diamandopoulos *et al.,* 2009). Galen used the phrase "*diarrhea of the urine"* to describe excessive urination (Angeletti and Cavarra 1994). Theophilus Protospatharius, a seventh-century physician who wrote the first manuscript focused exclusively on urine called "*De Urinis"*, discovered heating urine would precipitate proteins, documenting proteinuria as a disease state. Ismail of Jurjani, an eleventh-century physician, acknowledged food and aging altered urine constituents and was the first to propose 24 hours urine collection (Androutsos, 2007). Since ancient times, the diagnostic value of urine has been established. Urine examination was practiced in Sumer (the earliest civilized region of southern Mesopotamia) and ("the country of Akkad')as early as 4000 BC, (an Amorite-ruled state 1894 BC); and is described in ancient Greek and Sanskrit texts (Armstrong, 2007; Redirecting, 2023).

Hippocrates, Celsus and Galen published some essential works associating the characteristics of urine with patients' health (Rosenfeld, 1999). During the Middle Ages, the optic examination of urine known as ***"****uroscopy****"*** attracted universal quality. The earliest publication devoted exclusively to the examination of urine in the 7th-century manuscript, writen by Theophilus Protospatharius, the Byzantine physician was called ***"****De Uritis****."*** Protospatharius notably represented a method for precipitating protein out of urine using heat (Armstrong, 2007; Redirecting, 2023). Many effective works on urinalysis followedthereafter. Publications by Isaac Judaeus improved upon Protospatharius' work, and Zayn al-Din Gorgani, an 11th-century Persian physician, published manual for specimen collection which illustrated that urine samples were affected by ageing and exposure to heat and light. Other historic writers include Gilles de Corbeil, published a favourite device literary work on uroscopy and thereby introduced the ***"****matula****",*** a round flask used to examine urine; and Joannes Actuarius, who wrote seven volumetric books on uroscopy. The 1491 book of *Fasciculus Medicinae,* published by Johannes de Ketham, became touristed with ordinary people which was employed for self-diagnosis(Armstrong 2007; Kamaledeen and Vivekanantham 2015). The matula came to symbolize the practice of medicine in general (Rosenfeld, 1999).

Urinalysis, is a combination of the two words *urine* and *analysis* (Armstrong, 2007), and is describe as a panel of medical examinations that includes physical (macroscopic) examination like colour, clarity, odour, and specific gravity; chemical evaluation such as pH, glucose, protein, bilirubin, urobilinogen, ketone, specific gravity and blood/leucocytes concentrations levels using urine test strips; microscopic examination to identify features like cells, urinary casts, crystals and organisms (Armstrong, 2007; Van *et al.,* 2021). And urine culture attempts to grow large numbers of bacteria from a urine sample to diagnose a bacterial urine infection. Urinalysis is therefore a routine examination of the urine for cells, tiny structures, bacteria, and chemicals that suggest various illnesses (Armstrong, 2007; Van *et al.,* 2021). Urinalysis is a test of urine or a routine screening and diagnostic tool that can be used to identify infections and diseases. It involves many tests to detect and measure various compounds that pass through the bladder. It is one of the key tools to evaluate kidney and urinary tract disease. It can yield ample amount of information when done with the right clinical diagnosis. It is used to detect and manage a wide range of disorders, such as urinary tract infections, kidney disease and diabetes. A urine sample can reveal a lot about why you're experiencing certain symptoms, and whether a symptom may indicate a current or future medical condition (Pallin *et al.,* 2014). It is used to detect and manage a wide range of disorders, such as urinary tract infections, kidney disease and diabetes (Van *et al.,* 2021). Urinalysis involves checking the appearance, concentration and content of urine. Urine test reveals disease conditions like: Diabetes or prediabetes, chronic kidney disease, Kidney or bladder stones, Kidney or bladder cancer, Bacterial or yeast infections, urinary tract disorder, sexually transmitted infections (STIs), Liver or bile duct damage (Armstrong, 2007; McPherson and Pincus, 2017).

The Urinary System: The urinary system, also known as the renal system, consists of the two kidneys, ureters, the bladder, and the urethra. Each kidney consists of millions of functional units called *nephrons*. The functions of the renal system is to eliminate wastes from the body, regulate blood volume and pressure, controls the electrolytes and metabolites levels, regulates acid-base balance and regulate both pH of the blood and body fluids through removing wastes and excess substances (Brunzel, 2016; Guyton, 2011; Hall and Hall, 2021).

Urine Formation: The operation of urine formation occurs in the nephron. These steps are found in a particular part of the kidney, the ***nephron***. Functionally, cortical and juxtamedullary nephrons have distinct roles. Cortical nephrons (85% of all nephrons in humans) mainly perform excretory and regulatory functions, while juxtamedullary nephrons (15% of nephrons in humans) concentrate and dilute the urine. The urine formation can be divided into three processes: Glomerular Filtration, Tubular Reabsorption and Tubular Secretion (Guyton, 2011; Ovalle *et al.,* 2020).

Glomerular Filtration: O*ccurs in "Glomerulus and Bowman's Capsule":* When blood from the afferent arteriole enters the glomerulus, some particle move from the glomerulus into the Bowman's capsule. The filtrates are pushed into the Bowman's capsule by the blood pressure in the glomerulus. Water and small molecules (nitrogenous wastes, nutrients, salts). Not all blood components passes through. Some are too large like part of the blood itself (blood cells and platelets), (Guyton, 2011; Hall and Hall, 2021).

Tubular Reabsorption: *Occurs in the "Proximal convoluted tubule and pertubular capillary network":* The filtrate from the Bowman's capsule flows into the proximal convoluted tubule where components of it are reabsorbed into the blood of the pertubular capillary network. Some of the product that enters the proximal convoluted tubule cannot be reabsorbed. The substances that are not reabsorbed continue to pass through the Nephron will further be processed into urine. The components of the filtrate that are reabsorbed include mostly water, nutrients and required salts (ions).

The constituent that cannot be reabsorbed are some water, excess salts (ions) and most nitrogenous wastes (Guyton, 2011; Hall and Hall, 2021).

Tubular Secretion: Occurs in the *"convoluted tubules, collecting duct, minor/major calyx, renal pelvis and then to the Ureter:* Some substances from the blood in the peritubular capillary network are added to the fluid inside the convoluted tubules. These substances join the components that were not reabsorbed into the bloodstream in step to form urine. The urine formed from several nephrons enters one collecting duct which carries the urine to the renal pelvis and then to the ureter. These substances include hydrogen ions, potassium ions, creatinine, and drugs (ie. penicillin) (Hall and Hall, 2021).

Final Contents of Urine: The urine contains: (a) substances that have undergone glomerular filtration but have not been reabsorbed. (b) Substances that have undergone tubular secretion. These include: Water; Excess Salts (ions); Nitrogenous wastes (urea, uric acid, ammonium, and creatinine) (Hall and Hall, 2021).

Preparation for the Test: For a regular urinalysis, patients are asked to urinate into a clean plastic cup. When urine is collected for a urine culture, it is important to use a *"clean catch"* midstream urine sample, uncontaminated by skin cells and bacteria. The trick (harder for a woman than a man) is to pee/urinate directly into a sterile container without having the stream of urine first touch the skin or the non-sterile tissues of the vagina (Tenke *et al.,* 2017).

Urinary catheters: This is when the clinician obtain urine samples directly from the bladder, usually there should be no bacteria. Contrary to this, there are numerous bacteria on the skin of a penis or in a vagina. Urinary catheterization increases the risk for urinary tract infections. The risk of bacteria(bacteria in the urine) is between three and six percent per day and prophylactic antibiotics are not effective in decreasing symptomatic infections (Dielubanza and Schaeffer 2011). The risk of an associated infection can be reduced by catheterizing only when necessary, using aseptic technique for insertion, and maintaining unobstructed closed drainage of the catheter (Gould *et al.,* 2010; Smith and Nicolle, 2001; Phipps *et al.,* 2006 and Gould *et al.,* 2010). Male scuba divers using condom catheters and female divers using external catching devices for their dry suits are also susceptible to urinary tract infections (Harris, 2009).

Specimen Collection: Samples for urinalysis are collected into a clean (preferably sterile) container (Brunzel, 2018). The sample can be collected at any time of the day, but the first urine of the morning is preferred because it is more concentrated (Echevrry *et al.,* 2010). To prevent contamination, a *"midstream clean-catch"* technique is recommended, in which the genital area is cleaned before urinating and the sample is collected partway through the urination (Bardsley, (2015). Samples can also be collected from a urinary catheter or by inserting a needle through the abdomen and into the bladder through suprapubic aspiration (Mcpherson & Pincus, 2017). In infants and young children, urine may be collected into a bag attached to the genital region, but this is associated with a high risk of contamination (Brunzel, 2018). If the sample is not tested promptly, inaccurate results can occur because bacteria in the urine will multiply and elements such as cells and casts will degrade. It is recommended that urinalysis is performed within two hours of sample collection if the urine is not refrigerated (Echevrry *et al.,* 2010).

Types of Urinalysis: When we mention urinalysis, we typically presume urinating in a cup at your healthcare provider's office. In truth, that is just one of the ways urinalysis is performed in clinical practice.

A urinalysis may refer to:

A **complete urinalysis (microscopic examination of urine)** performed in a laboratory to assess the physical, chemical, and microscopic characteristics of your urine (MedlinePlus, 2020). A rapid urinalysis performed at your healthcare provider's office using test strips to routinely check for common renal abnormalities. This type of analysis is very common in the control and monitoring of diabetic patients. The time taken for the appearance of the test results on the strip can vary from a few minutes after the test to 30-60 seconds after immersion of the strip in the urine (depending on the brand of product being used) (MedlinePlus, 2020). A 24-hour urine collection in which urine is collected over 24 hours to provide your healthcare provider a clearer picture of your overall renal function, including output and composition (Landry and Bazari, 2020; Verbalis, 2020). Urine culture (in which a urine sample is placed in a growth medium to check for bacteria or fungi) is not technically a form of urinalysis, it may be an extension of the test if a UTI is suspected. It can even be performed using the same urine sample (Colgan *et al.,* 2011;verywell, 2022).

Why is Urinalysis Conducted: Urinalyses are typically conducted when someone is admitted to the hospital or before they have surgery. Your doctor may also order a urinalysis if you experience symptoms like:Blood in urine; Back or abdominal pain; Painful urination; Frequent urination; Cloudy urine. Urinalyses are usually useful since they can often detect medical problems before additional symptoms arise. They are most frequently performed to monitor overall health, to diagnose a medical problem, or to monitor some medical conditions like:Urinary tract infections, Diabetes, Kidney problems, Liver problems, Pregnancy.

Purpose of Urinalysis: Since the urinary tract is composed of the kidneys, ureter, bladder, and urethra, therefore its essential role is to filter waste and regulate the balance of water, electrolytes, proteins, acids, and other substances in the body. If any part of this system is damaged or impaired, the chemical composition and/or urine volume will be altered. So urinalysis is a direct means of assessing these changes. Sometimes, urinalysis is not diagnostic (meaning that it cannot determine the cause of a disease), but can suggest the nature of a disease and may be used to support a diagnosis. A urinalysis can also be used to monitor and manage a wide range of disorders, most specifically kidney (renal) disorders. Among its applications, a urinalysis may be used to:

Help to diagnose some medical conditionslike urinary tract infection (UTI), kidney stones, uncontrolled diabetes, chronic

kidney disease (CKD), acute renal failure, polycystic kidney disease (PKD), and kidney inflammation (glomerulonephritis).

Help to screen for diseases such as kidney disease, diabetes, high blood pressure (hypertension), liver disease, and other conditions in which the urinary tract is involved.

Monitor disease progression and your response to treatment for kidney failure, diabetic nephropathy, lupus nephritis, and hypertension-related renal impairment, among others.

Provide a preoperative assessment of your renal function prior to undergoing surgery.

Monitor for pregnancy abnormalities, including bladder or kidney infection, dehydration, preeclampsia, and gestational diabetes, among others.

To determine your general health: A typical medical exam, pregnancy check-up or pre-surgery preparation may include a urine test. When you are admitted to a hospital, it may also be used to screen for a number of diseases, including diabetes, renal disease and liver illness.

To determine the cause of a disease: If you experience back pain, frequent or painful urination, blood in your urine or other urinary issues, then a urine test may be required.

To keep an eye on a health situation: The clinician might advise routine urinalysis if one has been diagnosed with a medical problem, such as kidney disease or a urinary tract infection, to monitor the condition and treatment (CDC, 2022).

METHODS

In urinalysis, urine samples can be evaluated in three ways: visual exam, dipstick test and microscopic exam.

Physical/Visual examination: A lab technician examines the urine's appearance. Normal urine is typically clear, but any sign of cloudiness or an unusual odour can indicate a problem, such as an infection. Protein in urine can make it appear foamy. Blood in the urine can make it look red, brown or otherwise. Urine colour can be influenced by what one has just be eaten or by certain medications/drugs one is taking. For example, beets or rhubarb might tint your urine red. Rifanpicin (one of the tuberculosis medications) causes urine to appear reddish-orange to reddish-brown colour (CDC, 1992; CDC, 2003; Sanofi-Aventis, 2007).Urines of different patient before centrifugation might appears cloudy or turbid but after centrifugation, all urines must appear clear and look very similar (Lehmann, 2021).

Biochemical/Dipstick test: A dipstick is a thin, plastic stick with strips of variable coloured chemicals on it. When placed in urine, the chemical strips changes colour if certain substances are present or if their levels are above distinctive levels. Dipstick sensitivity method could be considered a good screening test to guess UTI in symptomatic adults when its three components are considered together. However, negative dipstick analysis should not rule out UTI in adult patients with symptoms suggestive of UTI.

Therefore, urine culture is recommended for these patients for proper diagnosis and management. Dipstick analytical method is a popular speedy laboratory screening tool used by many primary healthcare clinicians to predict UTI in symptomatic patients. It assesses presence of bacteriuria, pyuria, and hematuria associated with UTI. Studies have shown the importance of heterogenicity in dipstick result interpretations (Lifshitz and Kramer 2000).Usually, diagnosis of UTI is based on clinical symptoms, in conjunction with positive urine culture. However, considering cost-effectiveness and the turnaround time (Ige *et al.,* 2023) in urine culture have stirred up the use of other rapid diagnostic means to anticipate UTI. A urine test strip or dipstick is a basic diagnostic tool revealing some biochemical parameters. It is used to ascertain some pathological changes in a patient's urine in convectional urinalysis (Victoria *et al.,* 2020).

(Lehmann, 2021).

A dipstick test checks can determine

Specific Gravity: This determines the urine concentration. That is, showing how concentrated the solute particles are in the urine. A higher than normal concentration often is a result of not drinking enough fluids and this indicates how tedious the kidneys are working to produce urine (Turgeon *et al.,* 2016).

Acidity (pH): The pH level indicates if urine is acidic, basic or neutral. Normal urine ranges from 4.6 to 8.0. The pH level might indicate a kidney or urinary tract disorder. Alkaline urine is an indication of kidney stone while an acidic urine denote urinary tract infections (Howard *et al.,* 2016; Bono *et al.,* 2022). Urine pH varies with diet and a wide range of values occur in healthy subjects, although it is most commonly slightly acidic. Since the kidneys are the major organs concerned in regulating acid-base balance, the urine is typically acidic in people with metabolic or respiratory acidosis and alkaline in those with alkalosis. However, in renal tubular acidosis, the urine pH remains alkaline while the blood is acidic (Mcpherson & Pincus, 2017; Partin *et al.,* 2020).

Protein: Low levels of protein in urine are typical. Small increases in protein in urine usually aren't a cause for concern, but larger amounts might indicate a kidney problem (Guillaume Résimont *et al.,* 2020; Mcpherson & Pincus, 2017; "Tietz Textbook of Clinical Chemistry and Molecular Diagnostics," 2018).

Protein in Urine (Proteinuria): Protein is a macromolecule, composed of one or more polypeptide chains, each possessing

a characteristic amino acid sequence and molecular weight. It has many biologically important functions. Some of the functions are acting as enzyme (e.g. trypsin), transport protein (e.g. hemoglobin, myoglobin) nutrient and storage protein (e.g. ovalbumin (egg), casein (milk), contractile or motile protein (e.g. actin, myosin) structural protein (e.g. keratin, fibroin, collagen), defence protein (e.g. antibodies, fibrinogen), and regulatory protein (e.g. insulin, growth hormone). The presence of protein in the urine is called Proteinuria. It is one of the most important indicator of renal disease. Its presence in the urine depends on the nature of the clinical and pathological disorder and the severity of the specific disease. They may also be present in urine after strenuous exercise and when dehydrated (Centers for Disease Control and Prevention, 2023).

Sugar: The amount of sugar (glucose) in urine is typically too low to be detected. Any detection of sugar on this test usually calls for follow-up testing for diabetes (Mcpherson & Pincus, 2017; "Tietz Textbook of Clinical Chemistry and Molecular Diagnostics," 2018; Partin *et al.,* 2020).

Ketones: As with sugar, any amount of ketones detected in your urine could be a sign of diabetes and requires follow-up testing (Guillaume Résimont et al., 2020; "Tietz Textbook of Clinical Chemistry and Molecular Diagnostics," 2018).

Bilirubin: Bilirubin is a product of red blood cell breakdown. Usually, bilirubin is carried in the blood and passes into your liver, where it's removed and becomes part of bile. Bilirubin in your urine might indicate liver damage or disease (Turgeon *et al.,* 2016).

Nitrites and leukocyte esterase: These are products of white blood cells which indicates evidence of infections like urinary tract infection "Tietz Textbook of Clinical Chemistry and Molecular Diagnostics," 2018).

Blood: Blood in your urine requires additional testing. It may be a sign of kidney damage, infection, kidney or bladder stones, kidney or bladder cancer, or blood disorders (Mcpherson & Pincus, 2017).

Microscopic exam

Sometimes performed as part of a urinalysis, this test involves viewing drops of concentrated urine — urine that's been spun in a machine, under the influence of centrifugal force and view under the microscope (Reynard *et al.,* 2016). If any of the following levels are above average, you might need more tests:

Red blood cells (erythrocytes) might be a sign of kidney disease, a blood disorder or another underlying medical condition, such as bladder cancer (Mcpherson & Pincus, 2017).

White blood cells (leukocytes) might be a sign of an infection (Hitzeman *et al.,* 2022).

Bacteria, yeast or parasites can indicate an infection (Turgeon, 2016).

Casts — tube-shaped proteins — can be a result of kidney disorders (Turgeon, 2016).

Crystals that form from chemicals in urine might be a sign of kidney stones (Brunzel, 2018).

The Culture Method: A urine culture may be performed to identify microorganisms if present, obtain a colony count, and carry out antibiotic sensitivity testing. The colony count helps to distinguish between contamination and infection (Van & Bladh, 2021). Almost all UTIs in outpatients are caused by aerobic and facultative Gram-negative bacteria, making it unnecessary to use a medium that is selective for Gram-positive bacteria. However, for the hospitalized patients, inoculation of Gram-positive bacteria especially cocci should be considered as enterococci is one of the most common causative agents of UTIs in inpatients. So, the media to be used should support growth of both Gram-negative and Gram-positive bacteria (Eltai *et al.,* 2019).

Flow cytometry: Recently flow cytometry is being introduced as a reliable method for fast diagnosis of UTIs by counting the bacteria numbers in the urine specimen. With the improved counting precision over visual counting methods, highly accurate positive results can be obtained by this method. Detection of bacteriuria can be achieved with clinical standards using flow cytometry technology (Moshaver *et al.,* 2016; Cho & Hur, 2019).

New Technological Methods: The modern day technological methods have made way for significant progress in automated urinalysis (Moshaver *et al.,* 2016). Many novel and improved diagnostic technologies and tools are introduced in the market, and some of them are already approved for clinical use and helped significantly in increasing the accuracy and decreasing the time of the test; a good example would be nucleic acid tests and mass spectrometry. Some other technologies show promising future such as the utilization of smartphone for urinalysis (Oyaert & Delanghe, 2019; Wirth *et al.,* 2018; Bakan *et al.,* 2018; Moshaver *et al.,* 2016; Cho & Hur, 2019).

Factors that can Affects Urine Results

While the preparations for a urinalysis are minimal, there are a few things you should know before delivering a sample.

Timing: If urine samples are exposed for an appreciable period of time, bilirubin and urobilinogen may decompose and break-down to their precursors due to their instability under light and temperature. Again, room temperature activates the growth of micro-organisms, like bacteria. An optimal urine sample is usually obtained in the early morning when the concentration is at its highest. If possible, try to schedule the collection for this time and *"hold it in"* until you get there if you can. The collection itself only takes a couple of minutes *(*Witte *et al.,* 2009). For a 24-hour urine collection, you should ideally pick a 24-hour period when you can stay at home so that you don't have to carry the samples with you or miss a collection (Landry and Bazari 2020; Verbalis, 2020).

Location: A urinalysis may be performed at your healthcare provider's office, clinic, or lab, or upon admission to hospital. In some instances, you may be provided a sterile plastic cup

and lid to collect the sample at home, after which you would deliver the sample to the lab within an hour. If performing a 24-hour urine collection, ask your healthcare provider when samples should be dropped off (CDC, 2022).

Food and Drink: Typically, no fasting is required before the collection of a urine sample. The only exception would be if other tests are being performed that do require fasting, such as a cholesterol test or fasting plasma glucose test (Mathew and Tadi 2022). Check with your healthcare provider if you are unsure about the dietary restrictions. The test is obviously easier with a full bladder, so some like to drink liquids beforehand (CDC, 2022; Medline, 2020). Your diet can cause cloudy urine as well. Drinking too much milk (which contains calcium phosphate) can make urine cloudy, and eating foods high in phosphorus (such as meats and dairy products) or consuming high amounts of vitamin D can also cloud urine.

Medications: Most routine medications can be taken before a urinalysis unless your healthcare provider tells you otherwise. It is important, however, to advise your healthcare provider about any and all drugs you may be taking, whether they be prescription, over-the-counter, traditional, homeopathic, or recreational. Since the test involves a visual, chemical, and microscopic examination of the collected urine, certain substances may throw off the results. Examples include:Anthraquinone laxatives (Israni and Kasiske 2007).Azulfidine (sulfasalazine), used to treat ulcerative colitis and rheumatoid arthritis, Levodopa (L-Dopa), a Parkinson's disease drug (Sharp Victoria *et al.,* 2020). Metronidazole, an antibiotic (Revollo *et al.,* 2014), Nitrofurantoin, an antibiotic, Phenazopyridine, used to treat UTIs (Mcpherson *et al.,* 2007), Robaxin (methocarbamol), a muscle relaxant, Vitamin B2 (riboflavin); Vitamin C supplements (Landry and Bazari 2011).Rifampicin, antituberculosis medication (CDC, 1992; CDC, 2003; Sanofi-Aventis, 2007).

Cost and Health Insurance: A urinalysis is a common and relatively inexpensive test (Cavanaugh and Perazella 2019). In Nigeria, the price of standard urine testing panels can range from #2,000 to #5,000 depending on the facilities where the test is being conducted e.g., primary, secondary, tertiary or even private healthcare services. Individual status, nature of one's job, financial status and the likes. All these determines the price, services to be rendered and outcome of the laboratory results to be generated, which may be covered in part or in full by health insurance or the individuals. Therefore, if you registered with an insurance scheme or plan (like National Health Insurance Scheme NHIS), check the terms and conditions of your policy or speak with a customer service representative at your insurance company for complete details, including your deductible and co-pay costs. (Cavanaugh and Perazella 2019; NHIS, 2017).

Exercise: Vigorous exercise and prolonged standing contribute a very drastically impacts on urinalysis results. Exercise may alter the specific gravity and electrolyte concentration of the sample thereby causing an erroneous results.

Preservatives: Although some preservatives are occasionally used which can alter the accuracy and specificities of urine results. Some common examples include:

Thymol: May generate false-positive reactions for albumin.

Formaldehyde: May cause false-positive results for leukocyte esterase, peroxidase reaction, urobilinogen, and glucose if strips are used.

Hydrochloric Acid: Although used to preserve cell structures and determine steroid concentrations, it affects the sample's pH.

Mercury Salts:May produce false-negative results for leukocyte esterase reaction.

Boric Acid: It is sometimes used to preserve bacteria present in urine, which may reduce the sensitivity of the leukocyte reagent on dipsticks and thereby alter original pH components. Moreover, exuberant concentrations may prevent bacterial growth in samples reserved for culture (Wilson, 2005; Utsch and Klaus 2014; Delanghe and Speeckaert 2016).

Some Common Medical Conditions That Urinalysis May Be Used To Detect: Some common medical conditions associated with urinalysis may be used for diagnosing, tracking and detection of other infectious diseases. Many systemic infections other than UTIs can be diagnosed utilizing urine samples. This is applied for viral and bacterial infections. Viruses are directly shed in urine such as human polyomaviruses and congenital cytomegalovirus.

Pregnancy: Whether with an at-home pregnancy test kit or a laboratory test, a urine sample can help detect the human chorionic gonadotrophin hormone (a hormone produced by the placenta during pregnancy) in your urine about a week after you've missed your period. However, note that fertility drugs and some medications that contain HCG might cause a false positive or negative with an at-home pregnancy test, unlike a pregnancy test conducted in a diagnostic centre.(Mcpherson and Pincus (2017).

Kidney disease: Although not a primary reason for a screening urinalysis, clues to the presence of many different types of systemic and renal disease may be incidentally revealed, and abnormal results should be investigated. Given that urine reveals waste contents and its presence in the body, it often gives away the health status of our kidneys. When testing your kidney health using your urine, our lab technician will look for increased protein levels and albumin-creatinine ratio, amongst others (Bono *et al.,* 2022).

Diabetes: Diabetes is a common condition that affects people of all ages. There are several forms of diabetes. Type 2 is the most common. Diabetes is a condition that happens when the blood sugar (glucose) is too high. It develops when the pancreas doesn't make enough insulin or any at all, or when your body isn't responding to the effects of insulin properly. Diabetes affects people of all ages. Most forms of diabetes are chronic (lifelong), and all forms are manageable with medications and/or lifestyle changes (Mcpherson *et al.,* 2007). Diabetes mellitus, often called diabetes, is a group of common endocrine diseases categorized by continuous high blood sugar levels. Diabetes is due to either the pancreas not producing enough insulin, or the cells of the body becoming insensitive to the hormonal effects.People with diabetes may experience

cloudy urine for a number of reasons. Your kidneys have to process excess sugar in your blood, which can cause the dehydration that clouds urine. Kidney damage caused by diabetes can also keep kidneys from filtering urine appropriately (David *et al.,* 2016). A positive dipstick for glucose is suggestive of diabetes. Sometimes, some medical conditions constitute a medically vulnerable population in which realities like lack of awareness, difficulties of navigating complicated health-care systems, and sporadic medical insurance coverage may sway the balance in favor of screening for asymptomatic diabetes. Although urinalysis is inferior to fasting blood glucose, the presence of glucosuria is suggestive of diabetes (Rakel, 2016). A urine sample is also useful in screening for diabetes, revealing ketone, and glucose levels.Glycosuria, or glucose in urine, is a common finding in individuals with uncontrolled diabetes mellitus (Victoria *et al.,* 2020). There is a group of hypoglycemic medications called sodium-glucose co-transporter-2 (SGLT-2) inhibitors (e.g. canagliflozin, empagliflozin, dapagliflozin) that act on the kidneys to promote the excretion of glucose in the urine, and can as well leads to glycosuria (Rakel, 2016; Victoria *et al.,* 2020).

Test for cause of High Blood Pressure: Testing for catecholamines in urine can help identify cases where there is high blood pressure due to excess production of hormones or their metabolites like metanephrine and normetanephrine. This can be seen in conditions like Pheochromocytoma where a tumour in the adrenal gland leads to excessive production of adrenaline and/or noradrenaline and subsequent increase in blood pressure (de Dood *et al.,* 2018).

Drug abuse/use: Since traces of drugs consumed appear in our urine anywhere from a few days to a few weeks after we take them, testing a urine sample is another way to uncover whether a person has been abusing hard drugs and other substances (Mcpherson & Pincus, 2017).

Urinary tract infections (UTIs): Another medical condition that a urine sample analysis can detect is UTIs. This can be done with a microscopic examination of the patient's urine for bacteria, yeast in the urine, or white blood cells which may be causing a UTI. Generally, urinary tract infections (UTI) are the second most common infectious complaint in outpatient in various clinics, both primary, secondary and tertiary healthcare facilities globally and the most common outpatient complaint caused by bacteria (Foxman, 2022). Approximately 2-6% cases of women complaints are due to symptoms suggesting UTI. It has been shown that more than 50% of women will experience a UTI in her lifetime, and about 20% of UTIs are found in men particularly the elderly owing to prostatomegaly and ill-shaped anatomy of the urinary tract (Griebling, 2007). Elementary evidence of UTI include frequency, burning, straining, urgency, and pain during excreting. Patients may also experience hematuria, suprapubic pain or tenderness, and an alteration in the odour of the urine (Medina-Bombardo *et al.,* 2003).

A urinary tract infection (UTI) is an infection that affects part of the urinary tract. When it affects the lower urinary tract it is known as a bladder infection (cystitis) and when it affects the upper urinary tract it is known as a kidney infection (pyeloneohritis) (Lane and Takhar, 2011).

Sexually transmitted diseases (STDs) & infections: A urinalysis can give clues to the presence of sexually transmitted infections (Lane and Takhar 2011). A positive dipstick for leukocyte esterase or increased numbers of white blood cells in the microscopic exam is suggestive of chlamydia or gonoccocal infection. However, because of its low sensitivity this test should not be considered an effective screening method for these infections. Sometimes, the presence of leukocyte esterase can yield upto 61% sensitive for chlamydia infections in males (Workowskiand Bolan, 2015). A urine test is a strong-thriving means to detect bacterial transmitted STDs. Some examples of sexually transmitted diseases & infectionsincludes:Syphilis; Chlamydia; Gonorrhea; Chancroid; Granuloma inguinale/ donovanosis; Lymphogranuloma venereum; Genital herpes; Genital warts; Trichomoniasis; HIV (Willo Pequegnat *et al.,* 2012; Dominguez, 2016).

Cancer Screening and Diagnosis: One of the most popular and affordable cancer screening techniques is a urine test. A urine test can help identify different types of cancers including cancer of the bladder, ureter and kidneys. Furthermore, blood in the urine is a strong sign of an illness in the body, such as a kidney stone, urinary tract infection or perhaps even cancer(de Dood *et al.,* 2018). In most cases, hematuria (blood in the urine) is usually the body's first symptom of organ cancers leading to liver, bladder, ureter, kidney and bile duct damage. As such, urine analysis is inexpensive to detect cancer in the body, although follow-up tests are necessary for confirmation (CDC, 2022).

Microscopic hematuria is frequently associated with comprehensive differential diagnosis, ranging from completely benign causes to potentially invasive malignancy. Inception of hematuria can be classified as glomerular, renal, or urologic. The prevalence of asymptomatic microscopic hematuria varies among populations from 0.18% to 16.1%. The American Urological Association (AUA) defines asymptomatic microscopic hematuria as three or more red blood cells per high-power field in a properly collected specimen in the absence of obvious causes such as infection, menstruation, vigorous exercise, medical renal disease, viral illness, trauma, or a recent urologic procedure. (AUA, 2020; CDC, 2021). Microscopic confirmation of a positive dipstick test for microscopic hematuria is required. Urinalysis assessment can discover urinalysis result interpretations, microscopic hematuria, CT urogram, urinary crystals, indwelling ureteral stent/tube, organ cancers, asymptomatic bacteriuria, and bacteriuria with catheterization (Victoria *et al.,* 2020).

Typhoid: While a blood sample is usually the most common sample collected for a typhoid test, a typhoid diagnosis can also be made with urine or stool culture. Thus, if you are scared of needles, but need a typhoid test, worry no more (de Dood *et al.,* 2018; Victoria *et al.,* 2020).

HIV: Because HIV antibodies can be detected in urine, fluid from the mouth, or blood, a urine test is also a non-invasive way to test for the virus. Nonetheless, it is worthy to note that a blood test is generally preferred for HIV status testing and will be recommended if a fluid test confirms an HIV infection (de Dood *et al.,* 2018; Brill, 2010 and Salvatore, 2011).

Detection of Parasitic Infection: Parasites that can be seen in urine microscopy includes: *Trichomonas vaginalis, Schistosoma haematobium, Wuchereria bancroftie.* Other parasites also may occur due to contamination of the urine with stool. In Africa and the Middle East, *Schistosoma haematobium* is the parasite usually found in urine. Some populations (like people living in endemic areas of Nigeria and Ghana), infection rates may exceed 90% (CDC, 2021). Infection presents with intermittent microcytic or gross hematuria, which may be accompanied by dysuria or increased frequency. Infection is highly associated with squamous cell carcinoma of the bladder.Although the infection is frequently accompanied by an AEC, confirmation is made by schistosomiasis serologic tests and/or urine ova and parasite examination. (de Dood *et al.,* 2018). Urine microscopy and sediment test analysis help in the diagnosis of urinary parasites like *Schistosoma urinary egg detection.* However, egg detection method is below optimum and requires multiple samples; other methods for the detection of parasite in urine are being investigated. PCR shows promising results in this regards, and many papers are advocating for the clinical establishment of this method for detection of parasites such as *S. haematobium*, *Leishmania infantum*, *Trypanosoma* sp., and others (Knopp *et al.,* 2015; Kosala Weerakoon & McManus, 2016; Lodh *et al.,* 2017; Eltai *et al.,* 2019).

Streptococcus pneumonia: *Streptococcus pneumoniae* is the number one causative agent of community-acquired pneumonia both in adult and children. In addition, it is underdiagnosed because of the lack of reliable and sensitive diagnostic method. CAP can be diagnosed using various samples including blood, sputum, and urine. Recently, multiple publications (Elberse *et al.*, 2015) (Saukkoriipi *et al.,* 2016) (Marimuthu *et al.,* 2017) provided evidence showing that urinalysis and urine specimen can be a very helpful in the diagnosis of CAP with relatively highly sensitive results. Urine immunoassay was used by reference laboratories to determine the course of a complicated outbreak of *S. pneumoniae* complicated by influenza A; this clearly indicates the importance of urine as a diagnostic specimen for the detection of S. *pneumonia*(Sheppard *et al.,* 2016; Eltai *et al.,* 2019).

Legionellosis: *Legionella pneumophila* is the most common cause of the life-threatening atypical pneumonia known as legionellosis or Legionnaires' disease. Rapid urinary antigen detection kits are the primary choice for the diagnosis of legionellosis. It is considered to be a reliable diagnostic method for the detection of legionellosis with acceptable sensitivity. New tests and assays such as *Legionella* fluorescence immunoassay have been developed. And they seem promising with papers showing a higher sensitivity results (Avni *et al.,* 2016; Eltai *et al.,* 2019).

Tuberculosis: Tuberculosis is a worldwide health issue. Many factors make tuberculosis hard to control, and one of them is the lack of fast and accurate diagnostic tools. With lipoarabinomannan (cell wall glycolipid of *Mycobacterium tuberculosis*) being secreted in the urine, several assays and tools have been developed to detect this marker of infection. However, no urine test until now is sensitive enough to be adopted for routine use (Shah *et al.,* 2016; Paris *et al.,* 2017;Eltai *et al.,* 2019).

Human Polyomaviruses: Infections with polyomaviruses with clinical significance occur generally only in immunocompromised patients; the virus is shed in urine in large quantities.

The best way to detect the virus is by electronic microscopy, which is highly sensitive, although it is less sensitive than PCR; however, it might be more reliable clinically. That is because a large portion of the adult population are exposed to the virus, and PCR can give positive results to clinically insignificant cases (Goetsch *et al.,* 2018; Eltai *et al.,* 2019).

Congenital cytomegalovirus: Congenital cytomegalovirus is the leading cause of neurological impairment and nongenetic sensorineural hearing loss. The virus can be cultured from urine and diagnosis can be made from various types of specimen which include urine, blood, and saliva (Ross *et al.,* 2015). PCR both quantitative and qualitative is widely used for diagnosis of CMV infection.

Qualitative PCR test is intended to detect CMV DNA in urine, whereas quantitative PCR test is performed to detect quantitatively CMV DNA in urine specimens as an aid in identifying or management of CMV infections.(Ross *et al.,* 2015; Eltai *et al.,* 2019).

Dengue virus: Dengue virus is a mosquito-borne disease affecting more than 50 million people worldwide yearly. Urine specimen can be used for the early detection of this virus, although RT-PCR and ELISA along with other new methods all of which utilizing blood specimen are usually the way to detect dengue virus (Eltai *et al.,* 2019).

Zika virus: Zika virus is another mosquito-borne pathogen, and it is endemic to Africa and Southeast Asia. The detection of Zika virus can be achieved by ELISA, but it is usually detected by reverse transcription PCR (RT-PCR) from a serum sample. Some evidence shows that the virus can be detected from mother urine sample even after 10 days of the onset of the disease, which is not feasible with serum samples. This suggests that detection of Zika virus by real-time RT-PCR from urine specimen can be a valuable diagnostic tool (Gourinat *et al.,* 2015; Eltai *et al.,* 2019).

CONCLUSSION

- Physical observations, chemical analysis, microscopic examination and culture and sensitivity are the very important current methodology in analysing urine samples for complete urinalysis.
- Conventional screening tests for proteinuria, glucosuria, pH, and others using the biochemical method of analysis called dipstick (Comb-3, 4, 9 or 10) sometimes lack sensitivity and have poor specificity, especially for proper diagnosis in the tropical regions where temperature is endemic, since dipstick can oxidized easily and is temperature dependent.
- Proteinuria of renal origin is persistent and associated with a normal non-inflammatory, non-hemorrhagic urine sediment.
- Reducing renal proteinuria is an important treatment goal because of the association between proteinuria and disease progression.

RECOMMENDATION

Primary healthcare providers and family physicians should employ the fast, inexpensive, sensitive dipstick screening to predict UTI in symptomatic and asymptomatic individuals in primary care centres, while assigning the costly, overwhelming urine culture for highly implicative conditions of UTI with negative dipstick screening. Complete urinalysis is recommended for proper and correct interpretations of urinalysis in the diagnosis of some medical conditions in the tropical regions. It is also recommended that urinalysis is performed within two hours of sample collection if the urine is not refrigerated.

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