PROCEDURE
Corewell Health East - Laboratory Examination of Urinary Sediment - Dearborn, Taylor, Trenton, Wayne

This Procedure is Applicable to the following Corewell Health sites:
Corewell Health Dearborn Hospital, Corewell Health Taylor Hospital, Corewell Health Trenton Hospital, Corewell Health Wayne Hospital

Applicability Limited to: N/A

Reference #: 33192

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Functional Area: Clinical Operations, Laboratory

Lab Department Area: Lab - Urinalysis

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1. **Purpose and Objective**
   To provide the necessary information to perform a manual examination of urinary sediment for any urinalysis order with any positive macroscopic result, except urobilinogen.

2. **Principle**
   A. Centrifuged urine sediments may contain formed elements that have filtered through the glomerulus and/ or passed through the tubules of the kidney and lower urinary tract. Exfoliated epithelial cells, erythrocytes, leukocytes, and casts formed in the renal tubules and collecting ducts are the formed elements frequently seen. Organisms (bacteria, fungi, parasites) represent foreign elements. Proper identification of these elements may provide diagnostic clues as to the etiology of urinary system disorders.
   B. Crystals are identified based on urinary pH, morphology, and patient drug therapy history or additional testing.
   C. Contaminants and artifacts must be recognized and differentiated from elements of clinical significance.

3. **Responsibility**
   Personnel who have completed the competency requirements will perform this testing.

4. **Definitions**
   A. Laboratory Information System (LIS)
   B. High Power Field (HPF)
   C. Low Power Field (LPF)

5. **Specimen**
   A. See Laboratory Test Directory (LTD)

B. A freshly voided urine specimen must be examined since cells and casts begin to lyse within two hours. If the urine cannot be examined within one to two hours of voiding, it should be refrigerated at (2-8°C).
   1. Refrigerated specimens greater than 2 hours old may be reported with the following smart phrase comment: ".2HO" (Sample greater than 2 hours old - may be loss of cell casts and other formed elements. Dipstick testing may yield inaccurate results.)
   2. Specimens left at room temp for greater than 2 hours may be reported with the following smart phrase comment: ".UA2H" (Sample >2 hours old and not refrigerated-may be loss of cell casts and other formed elements. Dipstick testing may yield inaccurate results.)

C. Optimal volume: 10 mL
   1. If less than 10 mL of specimen is submitted for analysis, perform the urinalysis. Make a notation of how much sample was received for analysis in the white comment box in the Laboratory Information System (LIS).
   2. If one mL or less of a specimen is submitted for analysis, perform chemical analysis. If a microscopic is indicated and the quantity is not sufficient (QNS) to do the microscopic, report smart phrase comment: ".1qns" (Less than 1 mL specimen received for analysis - QNS for Microscopic.)
   3. If there is enough (a few drops) for an uncentrifuged examination, a microscopic may be done and the smart phrase comment appended: ".1ucent“ (Less than 1 mL specimen received. Microscopic analysis performed on uncentrifuged specimen.) All comments should be added in the white comment box in the LIS

6. Reagent/Equipment Needed

A. Integrated coverslip plastic slide or glass slide and coverslip
B. Transfer Pipette or KOVA Plastics Petter
C. Urine collection tube or plastic centrifuge tube
D. Centrifuge
E. Microscope
F. Sedi-stain or KOVA Stain

7. Procedure

A. Pour 10 mL of a well-mixed urine specimen into a disposable centrifuge tube.
B. Centrifuge at approximately 450 Relative Centrifugal Force (RCF) or 1800 Revolutions Per Minute (RPM) for five minutes.
C. Decant supernatant from centrifuged urine, leaving approximately 1.0 mL total volume in the tube.
D. Re-suspend sediment thoroughly by flicking the tube several times or mixing with a pipette.
   1. **Note**: A KOVA Plastics Petter may be used to decant and mix the remaining sample.
E. Place one drop of resuspended sediment onto an integrated coverslip plastic slide or regular slide and coverslip. The specimen should NOT ooze out from under the coverslip edges if the drop is of a proper size.
F. Scan the slide for even sample distribution using the low power (10x) objective.
G. Change to high power (40x) and examine a minimum of 10 fields. Identify and count red blood cells (RBC), white blood cells (WBC), Epithelial cells, and Bacteria. Average and report as cells per high power field (hpf). See the “Formed Element” section for more detailed information.
H. Return to low power (10x) to examine a minimum of 10 fields. Identify and count Hyaline casts. Average and report as per low power field (lpf). Search for additional formed elements and report as indicated in the “Reportable Ranges” section.
   1. **Note**: Utilize the 10x objective to identify other cast types noted in the “Formed Element” section.
I. If a polarizing microscope is available, polarize any specimen as necessary to aid in the identification of suspected fat, fatty casts, oval fat bodies, and crystals.
J. If chemical and microscopic results do not correlate, repeat the urine chemistry. Centrifuge another aliquot of urine and re-examine the sediment, or request a fresh specimen as appropriate.

K. Bloody Urine Specimen: (See Corewell Health East - Urinalysis Procedure for Analyzing Bloody Specimens - All Beaumont Hospitals)
   1. Examination of a bloody specimen:
      a. Enter the smart phrase comment ".BLDYUA" (Bloody specimen. Urine chemistry testing was performed on the supernatant of a centrifuged specimen. Interpret results cautiously) in the white comment box in the LIS and save.
      b. Pour over a labeled aliquot of the specimen to spin at approximately 1800 rotations per minute (RPM) for 5 minutes to recover the supernatant. A supernatant volume of at least 2 mL is required.
      c. If the supernatant is yellow or dark yellow, then perform the chemistry portion of the urinalysis on a standalone instrument.
      d. If the supernatant remains red, DO NOT perform the chemistry portion of the urinalysis.
         1) Manually enter the color and clarity results.
         2) Perform and report the Specific Gravity by refractometer.
         3) Report "color interference" for Glucose, Bilirubin, Ketone, Blood, pH, Urobilinogen, Nitrite, and Leukocytes.
         4) Perform a manual microscopic exam of the sediment:
         5) Mix one drop of urine sediment and one drop of 3% acetic acid to lyse the red cells to allow better visualization of other formed elements.

L. Turbid Urine Sample:
   1. In the case of extremely turbid samples, it may be necessary to dilute the sediment to properly identify formed elements in the sample.
   2. Make an appropriate dilution and observe the specimen utilizing the steps above. Results for formed elements will need to be multiplied by the dilution factor, prior to reporting in the LIS.

M. Sedi-stain or KOVA Stain may be used as an aid in the differentiation of cellular elements.
   1. Add one drop of stain to 1 mL of urine sediment.
   2. Re-suspend the sediment and stain until a homogenous mixture is obtained.
   3. Perform microscopic analysis. See E-H above.
   4. See attachment "Microscopic Characteristics of Stained Sediment" for staining characteristics of each microscopic element.

8. Reporting Results

A. Open the Urinalysis outstanding list in the LIS.
B. Select patient specimen.
C. Click edit.
D. Enter results in the manual resulting fields.
E. Required fields are:
   1. WBC
   2. RBC
   3. Bacteria
   4. Squamous epithelial cells
   5. Hyaline Casts
F. Review and final verify results.
G. See Lab - Resulting Clinical Pathology (CP) Specimens for Epic step by step guidance.

9. Formed Elements

A. The following is a glossary of elements that may be found in urine sediment. It is not meant to be all-inclusive. Any items which cannot be identified by laboratory technical personnel should be referred to a Lead, Supervisor, Manager or Pathologist.
B. Low power:
   1. **Hyaline Casts:** Should be enumerated on low power but may have to be identified on high power. Hyaline casts are colorless, homogeneous, translucent and have a low refractive index. They have a smooth or finely wrinkled surface and may appear tortuous or coiled. Inclusion granules may occasionally be seen in the cast matrix. These casts are usually

present in small numbers in normal urine but may be more prevalent after strenuous physical exercise or psychological stress.

C. High Power:
   1. **Squamous Epithelial Cells:** These large (30 to 50 mm), flat cells are derived from the lining of the female urethra, the distal male urethra, or from external skin. Large numbers of squamous epithelial cells in urine suggest perineal, vaginal, or foreskin contamination. They may also be seen in males with prostatic disease, or after the administration of estrogen. In wet preparations, squamous cells are about five to seven times as large as a red cell and larger that most transitional epithelial cells. A single, small, condensed, round, polygonal or oval central nucleus about the size of a small lymphocyte (10 to 12 mm) is seen in flat, round, or rectangular cells. Binucleation occurs, although less frequently than in transitional epithelial cells, and is often associated with reactive or inflammatory changes. The cell membrane is usually well-defined, with occasional curled or folded edges, and there may be fine cytoplasmic granulation. Degenerating squamous cells have granular swollen cytoplasm with a frayed cell border and a pyknotic nucleus. Sheets of squamous epithelial cells, accompanied by many rod-shaped bacteria and/or yeast, occur with contamination of the urine by vaginal secretion or exudates. Columnar or polyhedral cuboidal epithelial cells, with or without cilia, are occasionally found in urine and cannot be distinguished from RTE cells. They originate in the prostate gland, seminal vesicles, or peri-urethral glands. Columnar epithelial cells from gut mucosa can also be found in urine containing fecal material.
   2. **Erythrocyte:** Under high power, unstained red blood cells in wet preparations appear as pale yellow-orange discs. They vary in size but are usually about 8 mm in diameter. With dissolution of hemoglobin in old or hypotonic specimens, cells may appear as faint, colorless circles or “ghosts”. These ghost membranes are more defined with phase contrast microscopy. Red blood cells may become crenated in hypertonic urine and appear as small, rough cells with irregular edges and surfaces. Smooth, shrunken and crenated cells may all be seen in the same urine specimen. Surface crenation on erythrocytes may suggest the presence of granules and the cells may be confused with small granulocytes. Red blood cells may be confused with oil droplets or yeast cells. Oil droplets (mineral oil or vaginal creams) show a great variation in size and are usually highly refractile. Endogenous lipid droplets also vary in size. Yeast cells are oval to round, generally smaller than erythrocytes, nearly colorless, and often show budding. Small numbers of erythrocytes, less than three per high power field, may be found in the urine sediment of otherwise normal patients. Hematuria, or the presence of increased numbers of RBCs in the urine, suggests possible disease anywhere in the kidney or urinary tract. Generalized bleeding disorders, trauma, and the use of anticoagulants also may produce hematuria.
   3. **Leukocytes:** Although the leukocytes are described individually, they are reported as “WBCs per HPF”.
      a. **Neutrophil, Unstained:** In unstained wet preparations, neutrophil leukocytes appear as colorless granular cells about two to three times the size of a red cell. Dense granular neutrophils, not much larger than a red cell, and large swollen neutrophils may occur in the same specimen. Ingested bacteria or yeast in the cytoplasm occasionally crowds the nucleus and enlarges the cell by two to three times. In freshly voided urine, nuclear detail is well- defined. With cellular degeneration, nuclear segments fuse into a single, round nucleus, and cytoplasmic granules may be lost, making distinction from renal tubular cells difficult or impossible. In dilute or hypotonic urine, neutrophils swell. There also may be small intracytoplasmic vacuoles and loss of nuclear segmentation. Cytoplasmic granules wiggle or “dance” due to Brownian movement. Neutrophils containing these refractile “dancing” granules are called “glitter” cells. Neutrophils are actively phagocytic and can often be seen to extend pseudopods and show ameboid motion. These cells stain poorly. Increased numbers of leukocytes in the urine, principally neutrophils, are seen in most urinary tract disorders. Leukocytes from secretions of the male and female genital tracts can also be present. The presence of many neutrophils and/or clumps of leukocytes in

the sediment are strongly suggestive of acute infection. However, small numbers of neutrophils, usually less than one per high power field, may be found in normal persons.

b. **Neutrophil, Stained:** The neutrophil is usually easy to identify. The nucleus often is segmented or lobulated into two to five lobes which are connected by a thin filament of chromatin. The abundant, pale pink cytoplasm contains many fine, lilac-colored granules. The nuclear lobes may appear eccentric, and the cytoplasm may be vacuolated. Nuclear pyknosis and fragmentation in degenerating neutrophils can make recognition difficult.

c. **Eosinophil:** In unstained wet preparations, eosinophils appear slightly larger than neutrophils and may be oval or elongated. Cytoplasmic granules are less prominent. In fresh specimens, two or three large nuclear segments are apparent. Stained eosinophils are recognized by their characteristic bright orange-red spherical granules. These granules are larger than primary or secondary granules in neutrophils. The nucleus typically has two or more lobes separated by a thin filament. Increase numbers (greater than 1%) are found in patients with interstitial nephritis.

d. **Lymphocyte:** A few small lymphocytes are normally present in urine but are difficult to recognize. Only slightly larger than erythrocytes, they have round nuclei and a small amount of smooth non-granulated cytoplasm. Increased number of small lymphocytes may occur in the urine during the first few weeks after renal transplant rejection. Plasma cells are rare in urine. Normal, stained lymphocytes are small cells with dense chromatin. Their round to ovoid nuclei may be notched or slightly indented. The scant to moderately abundant light blue cytoplasm may contain a few fine azurophilic granules.

e. **Other Mononuclear Cells:** Unstained Monocytes, histiocytes, and macrophages are phagocytic cells of variable size. In urine sediment, monocytes are slightly larger than neutrophils. The nucleus is often indented and may be oval or round. Cytoplasm is usually abundant, sometimes frayed, and usually contains vacuoles and granules. Histiocytes may be large and multinucleated. They occur in the presence of chronic inflammation and with radiation therapy. Macrophages may show evidence of ingested lipid, hemosiderin, red cells, or crystals. The nucleus is oval, indented, relatively small, and sometimes pyknotic. Granular cytoplasm may be filled with multiple vacuoles, creating a foamy appearance that obscures the nucleus. The cell border is often indistinct and irregular when compared with transitional or squamous epithelial cells. Disintegrating macrophages without a nucleus contain particles that resemble ingested nuclei. Macrophages containing lipid globules may form “oval fat bodies” identical to those formed by renal tubular cells. The continuum of stained Monocytes/Macrophages morphology can range from the typical blood monocyte to the vacuolated, activated stage of a macrophage. The cells are usually large (14 to 30 mm), with abundant blue-gray cytoplasm containing sparse azurophilic granules. The nucleus may be round or oval, indented, lobulated, band-like, or folded. The chromatin is fine and lacy and may contain small nucleoli. Binucleated forms may be seen. Sometimes there is evidence of active phagocytosis, such as ingested material, post ingestion vacuole, or remnants of digested products. Occasionally, a single, large cytoplasmic vacuole displaces the nucleus, suggesting the signet ring appearance of some tumor cells.

4. **Bacteria:** Graded as single entity

a. **Rod-shaped bacteria (bacilli):** Rod-shaped bacteria are most commonly Gram-negative enteric organisms identified in wet mounts as rod-shaped organisms of medium size. Large, longer bacilli seen in urine are likely to be Gram positive lactobacilli from vaginal or fecal contamination. Abnormal elongated bacillary forms about the size of yeast cells with swollen centers, are occasionally seen in urine. Their appearance is due to bacterial cell wall damage induced by antibiotics, typically of the penicillin group, in patients being treated for urinary tract infections.

b. **Cocci:** Cocci, spherical bacteria, are more difficult to identify in wet mounts and must be distinguished from amorphous phosphates and amorphous urates.

D. Identified on High Power and Reported as Present:

1. **Yeast/Fungi:**

a. **Candida albicans:** Characteristically a colorless ovoid form with a single bud. The 5 to 7 mm thick- walled cells stain poorly with aqueous stains in wet preparations. Candida species form elongated cells (pseudo hyphae) up to about 50 mm long, resembling mycelia. They are branched and may have terminal budding forms. These pseudo mycelia may be found in urine from immunocompromised patients, urinary tract infections, vaginitis, diabetes or those with other serious underlying illnesses.

2. **Renal Tubular Epithelial (RTE) Cell:** RTE cells are derived from the epithelium lining all segments of the nephron. They vary in size from approximately three to five times the size of red cells and up to twice as large as a neutrophil (20 to 35 mm). Typically, they are polyhedral in shape and elongated or ovoid with granular cytoplasm. The single nucleus is round and sometimes eccentric. Renal tubular cells originating from the proximal tubule may show a microvillous border, which is visible with brightfield microscopy. Disintegrating RTE cells become swollen and frayed, and the cytoplasm is often indistinct. In wet preparations, RTE cells may be difficult to distinguish from degenerating neutrophils, mononuclear leukocytes, or transitional epithelial cells. Increased numbers of RTE cells are found in many diseases affecting the kidney, especially in cases of acute tubular necrosis, viral infections involving the kidney, and in renal transplant rejection. In viral infections, such as rubella and herpes, RTE cells may contain inclusion bodies. Especially large intranuclear inclusions are seen in cytomegalovirus disease. Cytoplasmic inclusions may be found in cases of lead poisoning. These inclusions are most obvious in Papanicolaou-stained preparations.
3. **Transitional Epithelial Cells (Urothelial Cell):** Urothelial cells line the urinary tract from the renal pelvis to the distal part of the urethra in the male, and to the base of the bladder in the female. They vary in size, averaging about four to six times the size of a red cell. The nucleus is well defined, oval or round, usually central. Binucleate cells may occur. Transitional epithelial cells can occur singly, in pairs, or in small groups (syncytia). In wet preparations, they appear smaller and plumper than squamous epithelial cells and have a well-defined cell border. They may be spherical, ovoid, or polyhedral. The smaller cells resemble renal tubular epithelial cells. Some, called “tadpole cells”, have elongated cytoplasmic processes, indicating a direct attachment to the basement membrane. Small vacuole and/or cytoplasmic inclusions may be present in degenerating cells. Small numbers of transitional epithelial cells are normally present in the urine. Increased numbers, usually accompanied by neutrophils, are seen with infection. Clusters or sheets of transitional cells are found after urethral catheterization or with urinary tract lesions.
4. **Granular Cast:** Granular casts may contain many fine or coarse granules that are most often evenly dispersed over the cast but may be confined to one area or loosely scattered. They may also include degenerated cell remnants. Distinctions between coarse and fine granular casts have no clinical relevance. Granular casts are found in normal urine as well as in urine from individuals with renal disease.
5. **White Blood Cell Cast:** These cellular casts are most prevalent in pyelonephritis. The cast may be crowded with cells or have a few clearly defined cells present in the matrix, often at one end. They contain predominately intact segmented neutrophils, with cell membranes and nuclei clearly visible in most of the cells. The nucleus of the segmented neutrophil may be degenerated and rounded, precluding categorization of the cell.
6. **Red Blood Cell Cast:** The predominant cells are intact erythrocytes, densely or loosely covering the hyaline or granular matrix. The red cells may be shrunken or crenated when compared with those in the surrounding urine. A yellow or red-brown color is seen when many red cells fill the cast. Red cells are uniform size within the cast, as opposed to fat globules which vary in size. Numerous causes of acute nephritis, particularly with glomerular injury, may produce blood casts or red blood cell casts.
7. **Waxy Cast:** Waxy casts are usually broad and stubby, with blunt ends that may appear “broken-off”. They have well-defined parallel margins that may be serrated or notched. The colorless or waxy yellow interior is dense and homogeneous. They are thought to arise from the degeneration of cellular casts and are frequently associated with severe or progressive renal disease.

8. **Fatty Cast:** Fatty casts contain large numbers of spherical, highly refractile fat droplets of varying size in the cast matrix or within oval fat bodies in the cast. Fat may be stained with Sudan stain or examined with polarized light to demonstrate the birefringent “Maltese-Cross” pattern of cholesterol esters. Fatty casts often are associated with marked proteinuria and nephrotic syndrome.
9. **Crystals:** Crystals are maintained in the urine in a supersaturated state which is a complex process but in part includes temperature and pH. After urine has been voided and allowed to stand, these factors, which have prevented crystal formation, are partially removed and crystal formation occurs. Abnormal crystals indicated by “*”
    a. Acid pH:
        1) **Uric Acid Crystals:** Uric Acid crystals occur at low acid pH. They are usually yellow to brown in color and birefringent. Common forms are four-sided, flat, and whetstone. They vary in size and shape, including six-sided plates, needles, spears or clubs, wedge-shapes, and stars.
        2) **Amorphous Urate Crystals:** Amorphous Urate Crystals are often referred to as “brick dust” These colorless or red-brown aggregates of granular material occur in cooled standing urine and must be distinguished from bacteria.
        3) *** Cystine crystals:** Cystine crystals are clear, colorless, and hexagonal. There may be a wide variation in crystal size. Sometimes they are pitted, and occasionally twinned or laminated. They demonstrate weak birefringence when viewed with polarized light. The reduction of cysteine to cystine in the cyanide-nitroprusside test produces a cherry-red color, supporting the crystal morphology. However, the nitroprusside test is also positive with cysteine and homocysteine, and urines with large amounts of ketones, although the latter generally produces a dark red color.
        4) **Radiographic Contrast Media:** Meglumine or sodium diatrizoate may be transiently excreted in the urine after radiographic procedures. The urine typically has a high specific gravity, often exceeding 1.040. These crystals form long, slender prisms or rectangles, but also may be flat, clear, colorless rectangular plates, sometimes notched or with rounded corners. Because this flat “plate” form can easily be confused with cholesterol crystals, the high specific gravity is an important diagnostic feature.
        5) **Sulfonamide Crystals:** Sulfonamide crystals may form renal calculi, especially in a dehydrated patient, but with the use of water-soluble sulfonamides, this is infrequently seen today. They are colorless to yellow-brown or green-brown and precipitate at low acid pH. Small brown acid urate crystals found in slightly acid pH may be confused with sulfonamide crystals. Sulfadiazine crystals appear as bundles of long needles with eccentric bindings that resemble stacked wheat sheaves, fan shapes, or spherical clumps with radiating spikes. Sulfamethoxazole crystals are dark brown, divided or fractured spheres.
    b. Neutral or Acid pH:
        1) *** Bilirubin Crystals:** Bilirubin crystals are occasionally seen in urine containing large amounts of bilirubin and usually accompany bile-stained cells. Small brown needles cluster in clumps or spheres, or on cell or hyaline casts.
        2) **Calcium Oxalate Crystals:** Calcium oxalate crystals vary in size and may be much smaller than red blood cells. The dihydrate form appears as small colorless octahedrons that resemble “stars” or “envelopes”. They are sometimes described as two pyramids joined at the base. Larger crystals sometimes clump together. Oval, elliptical, or dumbbell monohydrate forms are less commonly seen. All calcium oxalate are birefringent. Patients who consume foods rich in oxalic acid, such as tomatoes, apples, asparagus, oranges, or carbonated beverages, may have large numbers of calcium oxalate crystals in their urine. Although oxalate crystals are usually not an abnormal finding, they may suggest the cause of renal calculi.
        3) *** Cholesterol Crystals:** Cholesterol crystals are large, flat, clear, colorless rectangular plates or rhomboids that often have one notched corner. They are

frequently accompanied by fatty casts and oval fat bodies. Cholesterol crystals polarize brightly, producing a mixture of many brilliant hues within each crystal. They may be confused with radiographic contrast media but are not associated with a high urinary specific gravity.

4) *** Hippuric Acid:** Hippuric acid crystals are a rare component of acid urine. They are typically found in persons who eat a diet rich in benzoic acid, such as one rich in vegetables, but may also be seen in patients with acute febrile illnesses or liver disease. Hippuric acid crystals are colorless to pale yellow and, unlike uric acid, may occur as hexagonal, prism, needles, or rhombic plates. They are birefringent when examined with polarized light but lack the interference colors usually seen with uric acid. While both types of crystals are soluble in Sodium Hydroxide (NaOH), only hippuric acid is also soluble in alcohol.
5) *** Leucine Crystals:** Leucine crystals may be found in the urine in hereditary disorders of amino acid metabolism and in sever liver disease. These highly refractile, brown, spherical crystals have a central nucleus and “spoke-like” striations extending to the periphery. Leucine spherules are birefringent, demonstrating a pseudo “Maltese cross” appearance with polarized light.
6) *** Tyrosine Crystals:** Tyrosine crystals may be seen in heredity tyrosinosis or with hepatic failure. They appear as silky and fine, colorless to black needles, depending on focusing. Clumps or sheaves form after refrigeration.

c. Neutral to Alkaline pH:
1) **Ammonium Biurate Crystals:** Ammonium biurate crystals may be associated with phosphate crystals in alkaline urine. Biurate crystals appear as crystalline yellow-brown smooth spheres, with radial or concentric striations. The “thorn apple” variety has projecting horns. These crystals should not be confused with sulfonamide crystals.
2) **Amorphous Phosphate Crystals:** Amorphous phosphate crystals form colorless or brown granular aggregates. They are similar in appearance to amorphous urates, but occur in alkaline, rather than acid, urine.
3) **Ammonium Magnesium (Triple) Phosphate Crystals:** Ammonium magnesium (triple) phosphate crystals are typically colorless, often large monoclinic crystals with a “coffin-lid” appearance. Triple phosphate crystals assume a characteristic four-armed, feathery appearance as they dissolve. They are birefringent and are often accompanied by amorphous phosphates and bacteria.

10. **Protozoa:** Trichomonas vaginalis: Trichomonas vaginalis primarily causes vaginal infections, but is also capable of infecting the urethra, periurethral glands, bladder, and prostate. The normal habitat of T. vaginalis is the vagina in women and the prostate in men. This protozoan flagellate has only a trophozoite stage. It is pyriform, or pear-shaped with a length of 7 to 23 mm. There is a single nucleus and a stout central axostyle protruding from the posterior end of the body. Additional morphologic features include four anterior flagella and an undulating membrane in the anterior half, from which projects a single posterior flagellum. In wet mounts, it demonstrates a jerky, rotating, nondirectional leaf-like motion. “Rippling” of the undulating membrane can be seen for several hours after cessation of motility. Degenerating forms resemble large oval cells.
11. **Helminths:** Schistosoma haematobium: Schistosoma haematobium is a trematode that inhabits the veins of the bladder, prostate, vagina, and uterus. It is most often present in the urine of patients from Africa and the Middle East who have schistosomiasis. Large oval eggs, about 150 mm long, with a distinct terminal spine, accumulate in the bladder wall. Eggs containing embryos eventually pass into the urinary bladder, usually accompanied by neutrophils and many red blood cells.
12. **Sperm:** Refer to the Corewell Heath East -Sperm Reporting Workflow.

E. Miscellaneous:

1. **Fat droplets:** Free, highly refractile droplets in urine or stool are seen as dark spherules under low power, and clear spheres or varying size under high power. Fat droplets may represent endogenous triglycerides, neutral fats, cholesterol esters, or combinations of all three. In urine, they may be observed in association with fat laden cells or casts and are usually seen in patients with the nephrotic syndrome.
2. **Fecal Contamination of Urine:** Fecal material in the urine may be due to a fistula between the colon and the urinary tract or caused by contamination of the urine with feces during collection. Plant structure, muscle fibers, and micro-organism can be seen. Plant material may include aggregates of starch granules, each about 10 mm in diameter; larger vegetable fibers with a regular spiral structure; multiple thick-walled plant cells; or leaf cells that are somewhat similar in structure to wood applicator stick fibers. There may also be small smooth single plant cells, pollen grains, and vegetable hairs. Vegetable hairs are long (30 mm or greater), slender, and pointed at one end, and have a long thin central canal. Skeletal muscle fiber, yellow brown in color, often is seen as remnants of undigested meat in stool specimens. They are two to four times the size of a broad waxy cast and may show distinctive cross-striations or appear smooth and amorphous. Columnar cells have a distinct cell border, round nucleus, smooth cytoplasm, and may be vacuolated. Neutrophils and macrophages also can originate in the intestine. Bacteria and yeast are frequently present. Ileal urinary bladders are formed from a segment of ileum to which the ureters are attached. Ileal bladder urine usually contains large numbers of degenerating columnar cells, neutrophils, macrophages, and bacteria. Cells are not stained yellow brown as in urine contaminated with fecal material.
3. **Fibers:** Hair and synthetic and natural fibers from clothing, cotton ball, dressing, and disposable diapers can be found in urine or stool specimens. Most fibers are large, long, and sometimes twisted. Short cellulose fibers from disposable diapers resemble large, broad, waxy casts but, unlike waxy casts, they are birefringent. Fibers are well-defined, flat, refractile, and colorless and often contain fissures, pits or cross-striations.
4. **Pollen Grains:** Pollen grains contaminate urine and urine containers, often on a seasonal basis. They are usually large, about 20 mm or greater in diameter, tend to be rounded or regularly shaped, and have a well-defined thick cell wall. They may have short, regular, thorny projections. Some are yellowish tan. They may resemble worm ova.
5. **Starch Granules:** Starch granules from surgical gloves or other sources are a frequent contaminant of body fluids. Granule size varies from that of a red cell to four to six times larger. The usual form is colorless and irregularly rounded with a central slit or indentation, often described as looking like a “beach ball”. With crossed polarizing filters, the granules form white “Maltese crosses” against a black background.
6. **Stain:** Crystal violet-safranin and similar stains, such as the Sternheimer-Malbin, which are used for wet urinary sediments, crystallize, especially at alkaline pH. They form brown to purple needle-shaped crystals that sometimes aggregate in star-shaped clusters.
7. **Mucus:** Mucus strands or threads arising from glands in the lower urinary and vaginal tracts are frequently found in urinary sediments. Translucent delicate strands may form long, wavy, intertwined aggregates. They constitute the background material in the field and are more obvious with phase microscopy.

10. Reportable Ranges

A. All Results will be reported in the Laboratory Information System.
   1. Microscopic Results
      a. RBC are reported as cells counted per HPF; 0-2, 3-5, 6-10,11-20, >20
      b. WBC are reported as cells counted per HPF; 0-5, 6-10, 11-20, 21-50, 51-100, >100
      c. Squamous Epithelial cells are reported as cells counted per HPF; 0-2, 3-5, 6-10, 11-20, >20.
      d. Transitional and Renal Epithelial cells are reported as Present.
      e. Hyaline casts are reported as number counted per LPF; 0-2, 3-5, 6-10, 11-20, >20

All other Casts are reported by type, and as Present if >0	
Granular	White Blood Cell
Red Blood Cell	Waxy
Broad	Fatty
Epithelial	Cellular

Crystals are reported by type, and as Present if >0	
Calcium Carbonate	Calcium Oxalate
Calcium Phosphate	Cystine
Leucine	Triple Phosphate
Tyrosine	Uric Acid
Amorphous	

f. Bacteria are reported semi-quantitatively as; Negative, Occasional, 1+, 2+, 3+, and 4+.
g. Yeast (Budding or Hyphae) is reported as Present.
h. Sperm is reported as present. (See Confirmation Testing below).
i. Trichomonas must be motile to report as present.

2. Confirmation Testing
   a. Sperm in urine for males <10 years old and all females must be confirmed by a second technologist. This should be indicated by typing “Rechecked and verified by Last Name, First Initial or Tech Code” in the white comment box in the LIS or follow site specific workflow for documenting the second review. Review Corewell Health East - Sperm Reporting Workflow - Dearborn, Taylor, Trenton, Wayne for more information.

11. Values

A. Expected Values
   1. RBC = 0-2/HPF
   2. WBC =0-5/HPF
   3. Squamous Epithelial Cells = 0-2/HPF
   4. Bacteria = Negative
   5. Hyaline Casts = 0-2/LPF
   6. Crystals = None Seen
   7. Other Casts = None Seen

B. Critical Values:
   1. The following must be called to a caregiver for both Hospital and Outreach patients:
      a. Sperm present in males < 10 years old
   2. The following must be called to a caregiver for Outreach patients only:
      a. Ketones ≥ 80 milligrams per deciliter (mg/dL)
      b. Sperm present in females <16 years of age
      c. Sperm present in females in a nursing home
   3. The following must be called to a caregiver for Hospital patients only:
      a. Sperm present in females of all ages
      b. Ketones ≥ 80 milligrams per deciliter (mg/dL)
      c. **Note**: Critical call notification is waived for patients in the Emergency Center (EC)

C. All calls to caregivers must be documented per The Corewell Health East - Communicating Critical Laboratory Results procedure.

12. Notes

A. Cells and casts begin to lyse within 1 hour after urine collection. Bacteria will multiply and destroy formed elements. Refrigeration suppresses bacterial growth and helps to maintain acid pH, which helps to preserve formed elements.

B. Urines centrifuged at higher speed or for longer time than in the procedure are apt to break up cellular casts.
C. Correlation of Macroscopic and Microscopic results are required. If the urine chemistry is repeated because there is questionable correlation, add “test repeated on same specimen” to the questioned result comment field in the LIS.
    1. Protein appears in urine in excessive muscular exertion, exposure to cold, in several kidney diseases such as acute glomerulonephritis, pyelonephritis, malignant hypertension, toxemia of pregnancy, congestive heart failure, and diabetes mellitus. Positive protein results should be followed by a careful examination of urine sediment for casts. Likewise, when casts are found microscopically, the urine should be carefully examined for protein.
    2. Up to 2 RBCs per HPF is normal in urine. Blood in urine may be present in three different forms: Hematuria-whole erythrocytes. Hemoglobinuria-destroyed, hemolyzed RBCs and Myoglobinuria- myoglobin from muscle tissue. Hematuria can be observed macroscopically and microscopically. In large concentrations, hemoglobinuria and myoglobinuria can be seen macroscopically. However, in lesser amounts, only a blood chemical test can detect the presence of blood.
        a. **Note**: The ”.BLDRBC” smart phrase comment may be utilized to denote when samples have a positive result for blood but no RBCs are present in the microscopic examination.
    3. A positive nitrite reaction macroscopically is an indication of the presence of bacteria in the specimen. A negative result, however, does not indicate the absence of bacteria. Negative results occur when urinary tract infections are caused by organisms that do not contain reductase to convert nitrate to nitrite, when the urine has not been retained in the bladder for four hours or more for reduction to occur, or when dietary nitrate is absent.
    4. A positive or repeated trace result for leukocyte esterase indicates the presence of granulocytic leukocytes in the urine specimen.

13. Limitations

Microscopic examination of urinary sediment by this method is a semi-quantitative procedure.

14. Revisions

Corewell Health reserves the right to alter, amend, modify or eliminate this document at any time without prior written notice.

15. Procedure Development and Approval

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16. Keywords

Not Set