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| **SOP Number:** |  | **Effective Date** |  |
| **Department & Section:** | Hematology | **Revision Date(s):** |  |
| **Author:** | K.Clark MT.(ASCP)K. Miller MT.(ASCP) | **Version:** |  |

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| Applicable Standards |  | Version History |
| Standard | Organization  |  | Version | Effective Date | Retired Date |
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| Review History (Up to the Last 15 Occurrences) |
| Date | Version | Revision Type | Review By/Initials & Date |
|  |  | Major Revision | System Laboratory Medical Director, Joe A. Lewis, M.D., F.C.A.P. |
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**Principle:**

Centrifuge urine sediment contains all insoluble material, known as formed elements that have accumulated in the urine in the process of glomerular filtration and during passage of fluid through the tubules of the kidney and lower urinary tract. Cells found in the urine come from two sources: (1) desquamation or spontaneous exfoliation of epithelial cells lining the upper and lower urinary tract and adjacent structures, and (2) cells of the circulating blood. Casts formed in the renal tubules and collecting ducts are the other formed elements frequently seen.

Organisms such as bacteria, fungi, parasites and viral inclusion cells as well as neoplastic cells are all foreign elements to the urinary system. Proper identification of these elements is helpful in providing important diagnostic clues as to the etiology of certain urinary system disorders.

In order to provide results to a clinician that is comparable with those used at other institutions it is necessary to use a standardized procedure. To achieve standardization, a constant specimen volume, centrifugal force and sediment volume must be maintained. This is accomplished using the Count -10 Centrifuge tube for standardized urinalysis. The volume used is 12 mL, which is centrifuged at 2000 RPM’s for 5 minutes. The final volume of sediment from which the microscopic examination is made is 1.0 mL.

***SPECIMEN:***

**Patient Preparation:**

 No special patient preparation is required.

**Type:**

The ideal specimen for this test is a freshly voided, early morning specimen collected in a clean, sterile container. Specimen may be collected by random voiding, clean catch midstream technique or catheretization. See **SPECIMEN COLLECTION, HANDLING, REJECTION, AND LABELING** procedure for proper collection technique.

**Handling Conditions:**

The specimen should be transported to the laboratory within 2 hours of collection and must be accompanied by a requisition bearing the date and time of collection. If a specimen cannot be delivered to the laboratory with 2 hours, the specimen may be refrigerated at 2-8 oC for up to 24 hours.

**EQUIPMENT AND MATERIALS:**

**Equipment:**

1. Microscope
2. Centrifuge

**Materials:**

1. Count-10 Centrifuge Tubes
2. Kova Petter transfer pipette
3. Count-10 System slides
4. MAS Liquid Urinalysis Controls, Level 1 and 3

**Preparation:**

No reagent preparation is required for this procedure

**CALIBRATION:**

 There are no calibration requirements for this procedure.

**QUALITY CONTROL:**

MAS Liquid Urinalysis Controls Level I and 3 are examined daily for microscopic particles. These controls are documented in the laboratory LIS system.

**Procedure-Stepwise:**

1. Mix the specimen well, and transfer approximately 12 mL of to a Count-10 Centrifuge tube.
2. Perform the macroscopic urinalysis of the specimen as described in the Urine Macroscopic procedure.
3. Centrifuge the specimen for 5 minutes at 2000 RPM’s.
4. Remove the tube from the centrifuge being careful not to disturb or dislodge the sediment.
5. Insert the Kova petter firmly into each tube.
6. If needed, the supernatant in the tube can be used for additional confirmatory tests (i.e. Ictotest, SSA, or Clinitest).
7. Decant the supernatant, retaining 1.0 mL of in the bottom of the tube.
8. Mix the sediment into a homogenous mixture by rapidly squeezing the petter bulb.
9. Using the petter, transfer one drop to a chamber on the Count-10 slide.
10. Allow the Count-10 slide to stand for one minute to allow the specimen to settle.
11. Place the Count-10 slide on the microscope stage and complete the examination using subdued light.
12. Scan 10 fields using the 10x objective to enumerate casts and epithelial cells. Use the LIS Result Entry Screen (Laboratory, Specimen Desktop, Entry Screen, U) Option to enter and release results.
13. Scan 10 to 20 fields using the 40x objective to result the average range for the number of cell, bacteria, yeast, etc. in the specimen. Use the LIS Result Entry Screen (Laboratory, Specimen Desktop, Entry Screen, U) Option to enter and release results.

**CALCULATIONS:**

No calculations are required for this procedure.

**REPORTING RESULTS:**

Microscopic sediment examinations are no longer done routinely on all urinalyses. A microscopic examination is done on a routine UA only when one or more of the following positive findings are noted on gross inspection of specimen and/or on the dipstick evaluation:

 1. Leukocyte esterase positive (trace or greater)

 2. Nitrite positive

 3. Protein positive ( >25mg/dl or greater )

 4. Occult blood: (trace or greater: males)

 (moderate or greater: females)

5. Glucose of ≥150 mg/dL (CSHCC-Memorial Laboratory ONLY)

6. Abnormal coloration of urine consistent with drug interference (most commonly pyridium) which may invalidate accurate reading of dipsticks.

A microscopic sediment examination is also done, no matter what the dipstick results, when "directly" requested by the physician Physicians have been encouraged to request "directed" microscopic examination in the following cases:

1. Patient on second and third generation cephalosporins or aminoglycosides - may give false negative results for leukocyte esterase.

2. Patient on high dose oral or parental ascorbic acid therapy (Vitamin C) may give false negative for occult blood.

 3. Leukopenic patients and newborns.

**REFERENCE RANGES:**

The normal range for the urine microscopic analysis is listed in the table below:

**Table U-30-1**

|  |  |  |  |
| --- | --- | --- | --- |
| **CELLS/FORMED ELEMENT/ORGANISMS** | **SEX** | **REFERENCE RANGE** | **UNITS** |
|  |  |  |  |
| RBC | ALL | 0-5 | /hpf |
|  |  |  |  |
| WBC | ALL | 0-5 | /hpf |
|  |  |  |  |
| SQUAMOUS EPITHELIALS | F | NEG - 2+(Mod) | /lpf |
| SQUAMOUS EPITHELIALS | M | NEG - 1+ (Few) | /lpf |
|  |  |  |  |
| TRANSITIONAL EPITHELIALS | ALL | 0-1+ (Few) | /lpf |
|  |  |  |  |
| RENAL TUBULAR EPITHELIALS | ALL | 0-RARE | /lpf |
|  |  |  |  |
| ALL CRYSTALS | ALL | 0 | /hpf |
|  |  |  |  |
| BACTERIA | F | NEG-TRACE(2-5) | /hpf |
| BACTERIA | M | NEG | /hpf |
|  |  |  |  |
| YEAST | ALL | NEG | /hpf |
|  |  |  |  |
| HYALINE CASTS | ALL | 0-2 | /lpf |
|  |  |  |  |
| FINE GRANULAR CASTS | ALL | 0 | /lpf |
|  |  |  |  |
| COARSE GRANULAR CASTS | ALL | 0 | /lpf |
|  |  |  |  |
| WAXY CASTS | ALL | 0 | /lpf |
|  |  |  |  |
| RBC CASTS | ALL | 0 | /lpf |
|  |  |  |  |
| WBC CASTS | ALL | 0 | /lpf |
|  |  |  |  |
| MUCOUS | ALL | NEG |  |
|  |  |  |  |
| TRICHOMONAS | ALL | NEG | /hpf |
|  |  |  |  |
| OVAL FAT BODIES | ALL | 0 |  |

**Reporting Format:**

The various cells, organisms or formed elements in urine are reported out in number ranges per high power field (hpf) or low power field (LPF). All reporting should be performed according to thisprocedure. Cell, organism and formed element descriptions and specifics on reporting are as follows:

**RBC’s:** Erythrocytes in urine may originate in any part of the urinary tract from the glomerulus to the urethral meatus, and may also be the result of menstrual contamination. They can appear in many forms depending upon the environment of the urine. These cells appear as pale yellow-orange discs. They vary in size but average 8 microns in diameter. With dilution of hemoglobin in old or hypotonic specimens, cells may appear as faint, colorless circles or “ghosts”. Red blood cells may become crenated in hypertonic urine and appear as small, rough cells with irregular edges and surfaces. Surface crenations may suggest the presence of granules and the cells may be confused with small granulocytes. Red cells may also be confused with oil droplets or yeast cells. Yeast cells are oval to round and are generally smaller than erythrocytes, nearly colorless and often show budding. Less than 5 RBC’s per high power field may be found in the urine sediment of normal patients. Report in the LIS at the UARBC prompt as a numeric range per high powered field using the chart below:

**Table U-30-2**

|  |  |
| --- | --- |
| **CELLS/HPF** | **RESULT MNEMONIC** |
|  |  |
| 0-5 | 0 |
| 5-10 | 5 |
| 10-20 | 10 |
| 20-50 | 20 |
| 50-150 | 50 |
| NONE | N |
| RARE | R |
| TOO NUMEROUS TO COUNT | TNTC |

**WBC’s:** Leukocytes can enter the urinary tract anywhere from the glomerulus to the urethra. They are 10 to 12 microns in diameter, making them larger than red cells but smaller than renal epithelial cells. Most of the white cells in urine are neutrophils and can easily be identified by their characteristic granules or by the lobulations of the nucleus. Leukocytes shrink in hypertonic urine and swell up or are rapidly lysed in hypotonic or alkaline urine. When white cells expand in dilute or hypotonic urine, their granules may demonstrate Brownian movements. Cells which develop this characteristic are called glitter cells. These glitter cells are not specific for pyelonephritis, as previously thought, but can occur in a variety of conditions if the cells are exposed to hypotonic environment. An increase of leukocytes in urine is usually associated with an inflammatory process in or adjacent to the urinary tract. The presence of many white cells in urine, especially when they occur in clumps, is strongly suggestive of acute infection such as pyelonephritis, cystitis, or urethritis. Report in the LIS at the UAWBC prompt as a numeric range per high powered field using **Table U-30-2** above.

**Squamous Epithelia Cells:** There are basically three types of epithelial cells that may be found in urine. The most common type of epithelial cell is the squamous epithelial cell which ranges in size from 30 to 50 microns in diameter and line much of the female urethra and the terminal of the male urethra. These cells are large and flat with abundant cytoplasm and small round central nuclei. Their margins are folded. 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 administration of estrogen. Report in the LIS at the UASQUAMES prompt using the chart below:

**Table U-30-3**

|  |  |  |
| --- | --- | --- |
| **AMOUNT SEEN** | **GRADE** | **RESULT MNEMONIC** |
|  |  |  |
| NONE SEEN | NP | NP |
| Present in every field | 1+ (Few) | 1 or **Few** |
| Large amount every field | 2+ (Mod) | 2 or **mod** |
| Full Field | 3+ (Many) | 3 or **M** |
| Packed Field | 4+ (packed) | 4 or **P** |

**Transitional Epithelial Cells (Urothelial Cells):** These 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 but rarely exceed 15 microns in diameter. The nucleus is well defined, oval or round, usually central. Binucleate cells may also occur. Transitional epithelial cells can occur singly, on pairs or in small groups. They may be ovoid, spheroid or polyhedral in shape. The small cells resemble renal tubular epithelial cells. Some, called "tadpole" cells have elongated cytoplasmic processes, indicating a direct attachment to the basement membrane. Small vacuoles and/or cytoplasmic inclusions may be present in degenerating cells. Small numbers of urothelial cells are normally present in the urine. Increased numbers, usually accompanied by neutrophils, are seen with infection. Clusters or sheets of these cells are usually seen after urethral catherizitaion or with urinary tract lesions. Report in the LIS at the UATRANS prompt as per low powered field using **Table U-30-4** below:

**Table U-30-4**

|  |  |  |
| --- | --- | --- |
| **AMOUNT SEEN** | **GRADE** | **RESULT MNEMONIC** |
|  |  |  |
| NONE SEEN | NP | NP |
| Present in every field | 1+ (Few) | 1 or **F** |
| Lg amt every field | 2+ (Mod) | 2 or **Mod** |
| Full field | 3+ (Many) | 3 or **M** |
| Packed field | 4+ (Packed) | 4 or **P** |

**Renal Tubular Epithelial Cells:** These 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 a red cell up to twice as large as a neutrophil (20 to 35 microns). 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. Increased numbers may be found in many diseases affecting the kidney, especially in cases of acute tubular necrosis, viral infections involving the kidney, and in renal transplant rejection. Report in the LIS at the UARTE prompt per low powered field using **Table U-30-4** above.

**Oval Fat Bodies:** The glomerular filtrate of patients with nephrosis or lipiduria contains large amounts of lipids, such as cholesterol and/or triglycerides, which are partially reabsorbed by the renal tubular cells. These lipids are toxic and accumulate in the cytoplasm of degenerating tubular epithelial cells. Enlarged, lipid-laden RTE cells are called oval fat bodies. Spherical intracytoplasmic lipid droplets, rich in cholesterol esters, forma a "Maltese cross" when viewed with the polarizing microscope. Triglyceride0rich fat droplets stain positively with Oil Red O or Sudan dyes. Report in the LIS at the UAOVALFAT prompt per low powered field using **Table U-30-4** above.

**Calcium Oxalate Crystals:** These crystals may be seen at neutral or acid pH. They vary in size and may be much smaller than red blood cells. The di-hydrate form appears as small colorless octahedrons that resemble "stars" or "envelopes". Oval, elliptical or dumbbell monohydrate forms are less commonly seen. All calcium oxalate crystals are birefringent. They are not usually an abnormal finding, but they may suggest the cause of renal calculi when present in large numbers. Report in the LIS at the UACAOX prompt per low powered field using **Table U-30-4** above.

**Uric Acid Crystals:** These crystals occur at low acid pH. They are usually yellow 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. Report in the LIS at the UAURIC prompt per low powered field using **Table U-30-4** above.

**Triple Phosphate Crystals (Ammonium Magnesium Phosphate):** These crystals occur at neutral to alkaline pH. They are typically colorless, often large monoclinic crystals with a "coffin-lid" appearance. They may assume a characteristic four-armed, feathery appearance as they dissolve. They are birefringent and are often accompanied by amorphous phosphates and bacteria. Report in the LIS at the UATRIPHOS prompt as per low powered field using **Table U-30-4** above.

**PATHOLOGICAL CRYSTALS:**

**Cystine Crystals:** These crystals will appear in acid pH urines. They appear as clear, colorless and hexagonal in shape. There may be a wide variation in crystal size. They are occasionally pitted, and sometimes twinned or laminated. They demonstrate weak birefringence when viewed with polarized light. These pathologic crystals are present in patients with cystinosis, a congenital autosomal recessive condition that has a homozygous incidence of about 1:10,000 to 1:13,000. It is the most common cause of aminoaciduria. The presence of these crystals **must be confirmed by a pathologist prior to reporting.** Report in the LIS at the UACYST prompt per low powered field using **Table U-30-4** above.

**Tyrosine Crystals:** These crystals may be found in neutral or acid pH urines. They are seen in cases of hereditary tyrosinosis or with hepatic failure. They appear as silky and fine, colorless to black needles, depending on focusing. Clumps or sheaves form after refrigeration. . The presence of these crystals **must be confirmed by a pathologist prior to reporting.** Report in the LIS at the UATYRO prompt per low powered field using **Table U-30-4** above.

**Leucine Crystals:** These crystals are found in neutral or acid pH urines. They are found in the urine of patients with hereditary disorders of amino acid metabolism and in severe liver disease. These highly refractile brown, spherical crystals have a central nidus and "spokelike" striations extending to the periphery. Leucine spherules are birefringent, demonstrating a pseudo "Maltese cross" appearance with polarized light. The presence of these crystals **must be confirmed by a pathologist prior to reporting.** Report in the LIS at the UALEUC prompt per low powered field using **Table U-30-4** above.

**Bacteria:** The urine is normally free of bacteria while in the kidney and bladder but contamination may occur from bacteria present in the urethra or vagina or from other external sources. They significance of bacteria is dependent on the method of collection and how soon after collection of the specimen the examination takes place. When a properly collected, freshly voided specimen contains large number of bacteria, especially in the presence of many leukocytes, it is usually indicative of a urinary tract infection. The most commonly seen bacteria are Gram negative enteric organism, usually rod-shaped of medium size. Large, longer bacilli seen in urine are likely to be Gram positive lactobacilli from vaginal or fecal contamination. Cocci are more difficult to identify because they must be distinguished from amorphous phosphates and urates. Report in the LIS at the UABACT prompt per high powered field using **Table U-30-5.**1 below.

**U-30-5**

|  |  |  |
| --- | --- | --- |
| **AMOUNT SEEN** | **GRADE** | **RESULT MNEMONIC** |
|  |  |  |
| Present in occ. fields | 2-5/hpf (Trace) | 2 or TR |
| Present in every field | 5-10/hpf (1+) | 5 or 1 |
| Lg amt every field | 10-20/hpf(2+) | 10 or 2 |
| Full field | >20/hpf (3+) | > or 3 |
| Packed field | Packed (4+) |  P or 4 |

**Hyaline Casts:** Urinary casts are formed in the lumen of the kidney tubules. Casts form as the result of the precipitation or gelation of Tamm-Horsfall mucoprotein, the clumping of cells or other material within a protein matrix, the adherence of cells or material to the matrix or by conglutination of material within the lumen. Tamm-Horsfall protein is a mucoprotein secreted by the renal tubules and is believed to form the basic matrix of all casts. 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. Report in the LIS at the UAHYAL prompt as a numeric range per low powered field using the chart **Table U-30-6** below:

**Fine Granular Casts or Coarse Granular Casts:** Granular casts are either the result of degeneration of cellular casts or they may represent the direct, aggregation of serum proteins into a matrix of Tamm-Horsfall mucoprotein. The granules are initially large and coarse but as urine stasis is prolonged, the granules break down for fine granules. Granular casts almost always indicate significant renal disease. There is no clinical importance to be derived in differentiating the type of granular cast. Report in the LIS at the appropriate prompt (UAFINEGRAN or UACOARSEGR) per low powered field using **Table U15-6**  below.

**Waxy Cast:** These 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. They colorless or waxy yellow interior is dense and homogeneous. They are through to arise from the degeneration of cellular casts, and are frequently associated with severe or progressive renal disease. . Report in the LIS at the UAWAXY prompt per low powered field using **Table U-30-6** below.

**RBC Cell Cast:** These casts appear brown to almost colorless and contain predominantly 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. Red cells are of 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. Report in the LIS at the UARBCCST prompt per low powered field using **Table U-30-6** below.

**WBC Cast:** These cellular casts are most prevalent in pyelonephritis but may also be seen in interstitial nephritis and lupus nephritis and in glomerular disease. The cast may be crowded with cells or have only a few clearly defined cells present in the matrix, usually at one end. They contain predominantly 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 identification of the cell. Report in the LIS at the UAWBCCST prompt per low powered field using **Table U-30-6** below.

**Other Casts:** Other types of casts may also be present. Report in the LIS at the UAHCASTS prompt per low powered field using **Table U-30-6** below. Use an attached result comment to indicate the cast type by means of a free text comment. Listed below is a brief description of the different cast types.

**Bacterial Casts:** These casts are often misclassified as granular or cellular casts. Bacterial forms can be seen on close inspection using phase or differential interference contrast. Most of these casts will contain segmented neutrophils. Yeast forms may be seen in casts from patients with fungal pyelonephritis.

**RTE Cell Casts:** These casts contain RTE cells within their matrix that are usually intact and irregularly dispersed over the surface. RTE cells are found in a wide variety of kidney diseases, but are most prominent in diseases that cause damage to the kidney tubules.

**Crystalline Cast:** Crystalline casts are rare and have no clinical importance. They arise from adherence of crystals to a pre-existent hyaline cast matrix.

**Fatty Cast:** These 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. They are often associated with marked proteinuria and the nephrotic syndrome.

**Table U-30-6**

|  |  |
| --- | --- |
| **CASTS/LPF** | **RESULT MNEMONIC** |
|  |  |
| NONE SEEN | NP |
| 0-2 | 0 |
| 1-2 | 1 |
| 2-5 | 2 |
| 5-10 | 5 |
| 10-25 | 10 |
| 25-50 | 25 |
| 50+ | 50 |

**Trichomonas:** The protozoan *Trichomonas vaginalis* causes vaginal infections, but is also capable of infecting the urethra, peri-urethral glands, bladder and prostate. It is pyriform, or pear-shaped, with a length of 7 to 23 microns. 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. This is a required diagnostic. Report in the LIS at the UATRICH prompt per high powered field using **Table U-30-7** below.

**Yeast:** The most common type of yeast seen in urine is *Candida albicans.* It is characteristically a colorless ovoid form with a single bud. They may form pseudohyphae up to 50 microns in length resembling mycelia. They are branched and may have a terminal budding form. These pseudomycelia may be found in urine from immunocompromised patients or those with serious underlying illnesses. **Budding forms** must be seen in order to report the presence of yeast. Report in the LIS at the UAYEAST prompt per high powered field using **Table U-30-7** below.

**Amorphous:** Various types of amorphous crystals may been seen. Report in the LIS at the UAMORPH prompt per high powered field using **Table U-30** below**.**

**Table U-30-7**

|  |  |  |
| --- | --- | --- |
| **AMOUNT SEEN** | **GRADE** | **RESULT MNEMONIC** |
|  |  |  |
| NONE SEEN | NONE SEEN | NP |
| RARE  | TRACE | T |
| PRESENT IN OCC. FIELDS | 1+ (Few) | 1 or F |
| PRESENT IN EVERY FIELD | 2+ (Mod) | 2 or Mod |
| LARGE AMOUNT EVERY FIELD | 3+ (Many) | 3 or M |
| FULL FIELD, PACKED | 4+ (Packed) | 4 or P |

**Critical Values:** There are no critical values for urinalysis.

**Specimens that must be referred to a Pathologist:**

1. WBC or RBC casts in any number.
2. Large numbers of granular or waxy casts.
3. Fatty casts in any number
4. Tyrosine and/or Leucine crystals.
5. Crystals suspicious for cysteine.
6. Presence of sperm in young females, under the age of puberty (14 years or younger). **DO NOT REPORT** in Meditech, but alert a pathologist who should then notify patient’s physician of apparent statutory rape. If pathologist is not available, refrigerate the specimen until a pathologist is available. Do not report to the floor and DO NOT call the on-call pathologist.

**Adding a Culture to Urines with a Reflex Culture order**

The following criteria must be met before a culture order will be generated.

1. The presence of yeast in any amount. If yeast is absent proceed to step 2.
2. The microscopic examination indicates the following:
* >/= 5-10 WBC’s per HPF
* >/= 5-10 (1+) bacteria per HPF
* </= 2+(Moderate) Squamous epithelial cells per LPF

The Laboratory LIS system will evaluate the criteria. If they are met, a culture order will be generated

**PROCEDURE NOTES:**

1. 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, and in fluid from ileal "bladders".

2. In viral infections such as rubella and herpes, RTE cells may contain inclusion bodies. Large intranuclear inclusions are seen in cytomegalovirus disease.

3. Several days after an episode of hemoglobinuria, RTE cells may contain orange-yellow to colorless intracytoplasmic hemosiderin granules.

4. Calcium oxalate may be seen in patients who consume foods rich in oxalic acid such as tomatoes, apples, asparagus, oranges or carbonated beverages.

5. Defective jejunal and proximal renal tubular amino acid transport interferes with reabsorption of cystine, lysine, ornithine, and arginine by the kidney and increased amounts are excreted in the urine.

6. Cast formation usually takes place in the distal and collecting tubules where the urine reaches maximum concentration and acidification. Formation is stimulated by marked decrease in urine flow, increased acidity, high solute concentration and the presence of abnormal ionic or protein constituents. They are always renal in origin and are important indicators of intrinsic renal disease. They may be present in glomerular damage, tubular damage, renal inflammation and renal infection. They are classified on the appearance and the cellular components which they may contain.

7. Urine containing large numbers of WBC's and granular or WBC casts is pathognomonic for acute pyelonephritis and should be carefully examined for the presence of bacterial casts.

8. The cast matrix may be scant or difficult to visualize due to overlying RTE cells but it must be present in order to diagnose a cast.

9. Spermatoza may be present in the urine of men after epileptic convulsions, nocturnal emissions, and diseases of genital organs and in spermatorrhea. They may also be found in the urine of both sexes after coitus

10. *Enterobius vermicularis* (pinworm) ova and an occasional female adult may be found in the urine. The ova are very characteristic in shape, having one flat and one rounded side. The developing larva can usually be observed through the transparent shell of the egg. Their presence should be noted by using a result comment at the UAOTHER prompt.

11*. Schistosoma haematobium* is a blood fluke that inhabits the veins in the wall of the urinary bladder. The adult deposits eggs in the capillaries of the mucosa. Abscesses develop around the eggs and then they can be found in the urine accompanied by RBC's and WBC's. The ovum has a characteristic terminal spine and measures about 50 by 150 microns in diameter. Their presence should be noted by using a result comment at the UAOTHER prompt.

12. For descriptions of other non-pathologic crystals or artifact material, consult the reference books listed below..

***REFERENCES:***

* Henry M.D., John Benard, Todd, Sanford, Davidsohn, Clinical Diagnosis and Management by Laboratory Methods, W.B. Saunders Co., 1979, pp. 612-630.
* Graff, Sister Laurine, A Handbook of Routine Urinalysis, J.B. Lippincott Company, 1983, pp 74-132.
* College of American Pathologists, Surveys Hematology Glossary, College of American Pathologists, 2005.