Guthrie Medical Group
POLICY & PROCEDURE

SECTION: Department	SUBJECT: **PPM Procedure – Urine Sediment**	DEPT. Point-of-Care Testing Regional Labs
EFFECTIVE: 7/26/16		POLICY# GMG-700-2021
SUPERCEDES: 3/04		PAGE # 1 of 11
DISTRIBUTION: PPM permitted offices		

I. INTENDED USE:

Provider-performed microscopy (PPM) is a testing modality that requires the use of a microscope and is performed by physicians and/or nonphysician practitioners during the patient's visit. Urine sediment examination is used for the detection and identification of formed elements in the urine. The test involves the collection of urine and microscopic examination of the urine sediment for formed elements such as cells, casts, crystals, and microorganisms. Specimens not obtained by "clean catch" methods often contain elements from other sources other than the urinary tract. The microscopic examination is a valuable diagnostic tool for the detection of renal and urinary tract disorders.

II. EQUIPMENT, REAGENTS and SUPPLIES

Product	Epro #	Vendor	Manufacturer
Glass Slides, Frosted	11611	Cardinal Health	Cardinal
Glass Coverslip (glasses) 22x22	12236	Cardinal Health	Cardinal
Conical Centrifuge Tube	42141	Cardinal Health	Cardinal
Transfer Pipets	2221	Cardinal Health	Cardinal
Gloves			
Sharps Container			
Centrifuge	Contact the Regional Office Lab Coordinator		
Microscope	Contact the Regional Office Lab Coordinator		

III. QUALITY CONTROL:

Microscopic urine sediment analysis and urine dipstick test results should be compatible. If there is a difference between the two results repeat testing. Staff competency assessment and proficiency will be used to verify reliability of patient test results.

IV. SPECIMEN COLLECTION:

Patient Preparation

1. Provide patients with instructions on how to perform a clean-catch urine specimen collection. Refer to procedure GMG-708-0010.
2. Label a clean, dry container free of lint and debris with patient identifiers, date, and time of collection.
3. Obtain a midstream, clean-catch urine specimen. Concentrated first morning specimens are preferred.

V. URINE PROCESSING:

Prior to collecting specimens, perform hand hygiene and put on gloves. Standard precautions should be taken when collecting and handling blood or body fluid specimens.

1. Label a clean, dry container free of lint and debris with patient identifiers, date, and time of collection.
2. Obtain a midstream, clean-catch urine specimen. Concentrated first morning specimens are preferred.
3. Examine the specimen within 2 hours of collection or 4 hours if refrigerated. Otherwise, bacteria may proliferate, casts and crystals may dissolve, and particulate matter may settle out.
4. Place 12–15 ml of urine in a conical centrifuge tube labeled with the patient identifiers.
5. Centrifuge at 1500-2200 rpm for 5 minutes. To prevent re-suspension of urine sediment, do not apply brake at the end of centrifugation. Higher centrifugation rates and longer centrifugation times may result in denigration of cellular casts.
6. Decant the supernatant carefully into a biohazard-designated sink or receptacle leaving approximately 1 ml in the tube.
7. Resuspend the sediment by gently tapping the bottom of the tube or using a pipet to mix.

VI. URINE SEDIMENT PROCEDURE

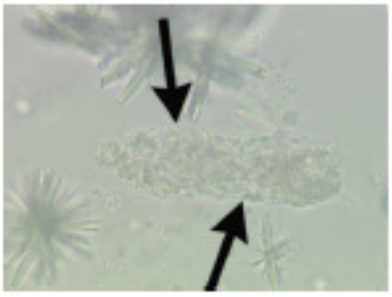
1. Label a clean microscope slide with specimen identification.
2. Using a sterile transfer pipette or dropper, gently mix the specimen.
3. Remove specimen from the tube and place one drop (10 µl) on the labeled microscope slide.
4. Immediately put a coverslip over the specimen for examination.
5. Allow urine to settle for 30–60 seconds before examination
6. Examine the slide to verify that it is not overfilled and leaking once the cover slip is in place.
7. Place slide under the microscope for examination.
8. Focus using low power (10X) and low light.
9. Scan the entire slide.
10. Read at least 10 fields using an “S” shaped viewing pattern.
11. Record the presence of crystals, casts, and squamous epithelial cells using semi-quantitative terms such as rare, few, moderate, or many and report results following laboratory procedure.
12. Identify objects using high power (40X).
13. Record the presence of red blood cells, white blood cells, and renal tubular cells. Quantitate the average number of elements per high power field and report results following laboratory procedure.
14. Note the presence of bacteria, yeast, trichomonads, and mucus.

VII. URINE SEDIMENT INTERPRETATION:

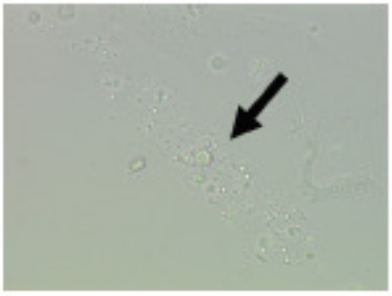
Casts

Urinary casts are small cylindrical structures that can be found in urine. Casts are formed by the solidification of proteins in the lumen of the kidney tubules and vary in size and shape according to the tubules where they were formed. The presence of casts in urine is associated with various pathologic conditions such as glomerular or tubular damage, renal inflammation or infection.

Hyaline casts are the most frequently seen urinary casts and a few may be seen in healthy individuals. They have a smooth texture and their refractive index is close to that of their surroundings. Increased numbers of hyaline casts are usually caused by dehydration, exercise, or diuretic medicines and may be associated with some renal diseases. An example of a hyaline cast is indicated by the arrow.

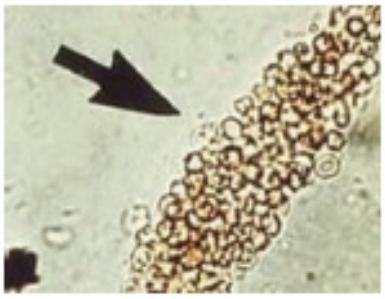


Granular casts may be course to fine in appearance. Granular casts are a sign of many types of kidney diseases and may often indicate significant renal disease. An example of a granular cast is indicated by the arrows.

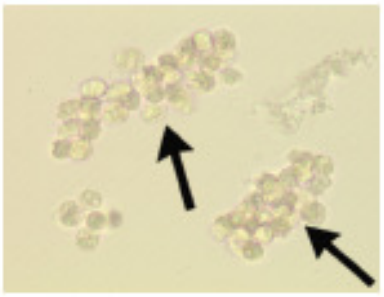


Fatty casts contain refractile liquid droplets within the cast. Fatty casts are seen in people who have lipids in urine, usually as a complication of nephrotic syndrome and diabetes mellitus. An example of a fatty cast is indicated by the arrow.

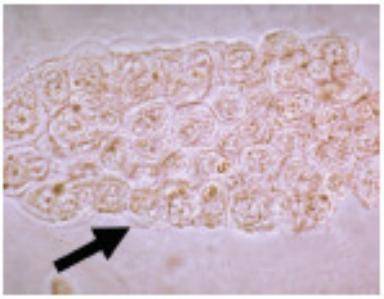
Casts



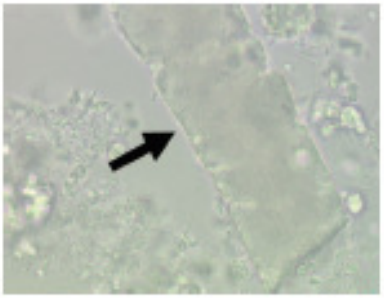
Red blood cell casts are granular cylinders composed of a matrix of red cells in various stages of degradation. Red blood cell casts are indicative of bleeding into the kidney and may be present in many kidney diseases such as glomerulonephritis or vasculitis. Red blood cell casts may also be present in lupus nephritis, Goodpasture syndrome, and subacute bacterial endocarditis. An example of a red blood cell cast is indicated by the arrow.



White blood cell casts contain leukocytes in the cast matrix. White blood cell casts are common with acute kidney infections and may be present in renal infection, glomerular disease, pyenlonephritis and interstitial nephritis. Examples of white blood cell casts are indicated by the arrows.



Renal tubular epithelial cell casts contain renal tubular epithelial cells in the cast matrix. Individual cells may appear randomly in or they can align as fragments of the tubular lining within the cast. These casts are seen in conditions such as renal tubular necrosis, viral disease (such as CMV nephritis), and kidney transplant rejection. Examples of renal tubular epithelial cell casts are indicated by the arrow.



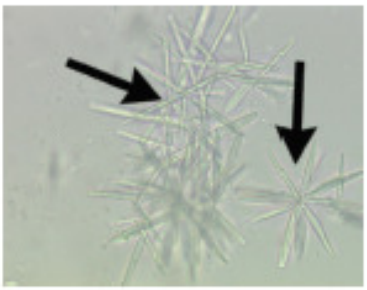
Waxy casts have smooth edges with squared off ends and do not have inclusions present. Waxy casts can be found in persons with advanced kidney disease and chronic kidney failure. An example of a waxy cast is indicated by the arrow.

Crystals

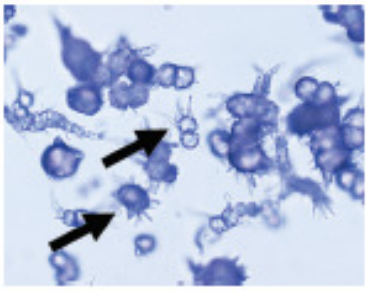
The presence of trace crystals in urine is often of no clinical significance in healthy individuals. The presence of a large number of crystals may indicate underlying health issues. It is import to differentiate between crystals frequently found in the urine and abnormal crystals whose appearance is pathological. The pH of fresh urine aids in the identification of crystals. Crystals found in the urine at an alkaline pH are usually considered normal. Abnormal crystals precipitate in the urine at an acidic pH. Other biochemical tests may be needed to confirm the identification of abnormal crystals.

Alkaline Crystals

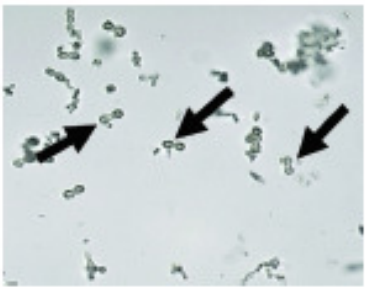
Triple phosphate crystals are colorless with a "coffin-lid" appearance. Although considered normal, they may be associated with urinary tract infections when found in freshly voided morning specimens. An examples of a triple phosphate crystal is indicated by the arrow.



Calcium phosphate crystals are large wedge-shaped prisms that may appear as rosettes. They may be associated with kidney stone formation. Examples of calcium phosphate crystals are indicated by the arrows.



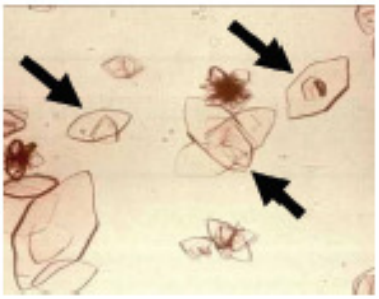
Ammonium biurate crystals often appear as a "thorn apple" shape. The presence of these crystals in urine with a pH 9.0 or higher usually indicates an old specimen. Examples of ammonium biurate crystals are indicated by the arrows.



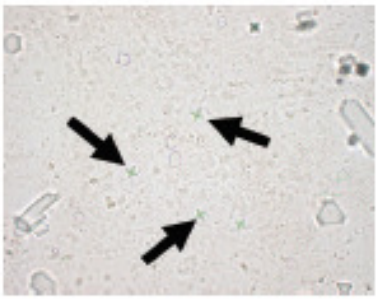
Calcium carbonate crystals appear as small, colorless, and dumbbell shaped. When dissolved in acetic acid, these crystals give off bubbles of gas (effervesce). Examples of calcium carbonate crystals are indicated by the arrows.

Crystals

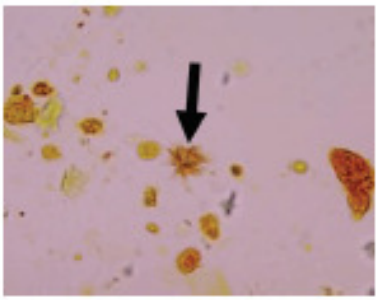
Acidic Crystals



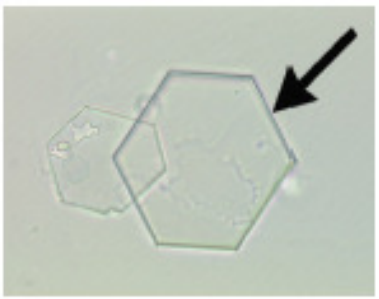
Uric acid crystals vary in size and shape and are often yellow-brown in color. They may be associated with kidney stone formation. Uric acid crystals are often seen in patients with Gout, Lesch-Nyhan syndrome, and leukemia. Examples of uric acid crystals are indicated by the arrows.



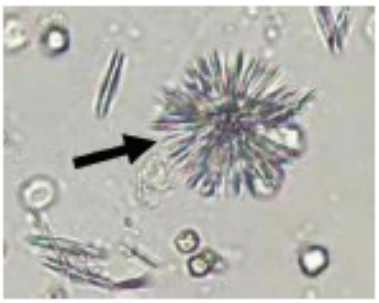
Calcium oxalate crystals are colorless and appear in many forms. The dihydrate form appears "envelope shaped" with a highly refractile cross connecting the corners. The monohydrate form can appear as dumbbell, ovoid, or rectangular in shape. Calcium oxalate crystals are associated with kidney failure due to ethylene glycol (antifreeze) poisoning. Examples of the dihydrate form of calcium oxalate crystals are indicated by the arrows.



Bilirubin crystals appear as yellow-brown needles or granules. These crystals are considered abnormal in urine and may be associated with several hepatic disorders. An example of a bilirubin crystal is indicated by the arrow.

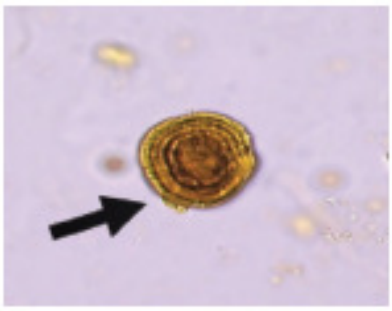


Cystine crystals appear as colorless, hexagonal plates. These crystals are considered abnormal in urine may be associated with cystinuria. Cystine crystals are a frequent cause of kidney stones in children. An example of a cystine crystal is indicated by the arrow.

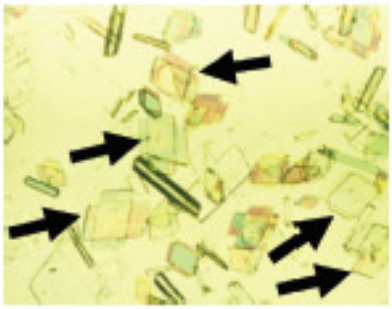


Tyrosine crystals appear as colorless to yellow-brown needles arranged in radiating sheaves. These crystals are considered abnormal in urine and may be seen in tyrosinemia and in some liver disorders when there is impairment to amino acid metabolism. An example of a tyrosine crystal is indicated by the arrow.

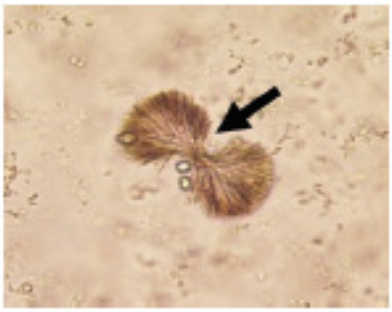
Crystals



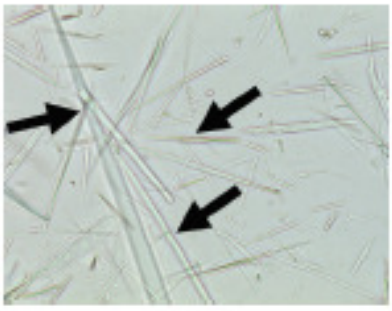
Leucine crystals appear as yellow-brown needles or granules. These crystals are considered abnormal in urine and may be associated with several hepatic disorders. An example of a leucine crystal is indicated by the arrow.



Cholesterol crystals appear as clear, flat plates with notched corners. These crystals are considered abnormal in urine and may be associated with nephrotic syndrome. Examples of cholesterol crystals are indicated by the arrows.



Sulfonamide crystals have a varied appearance including flat needles, sheaves of small needles, and spheres. These crystals are considered abnormal in urine and may indicate presence of a sulfonamide drug and may be associated with kidney stone formation. An example of a sulfonamide crystal is indicated by the arrow.

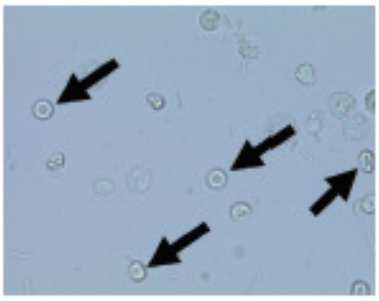


Radiopaque dye crystals appear as flat needles. These crystals are considered abnormal in urine and are associated with very high specific gravity results by refractometry. Examples of radiopaque dye crystals are indicated by the arrows.

Other Microscopic Findings

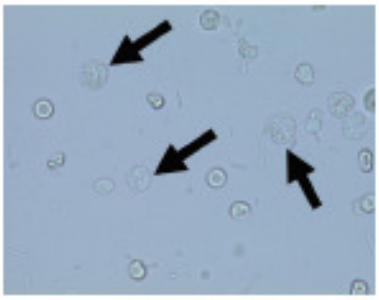
Mucus

The presence of mucus threads is often a benign situation. Large amounts of mucus in the urine most often indicates a urinary tract infection but may also be associated with irritable bowel syndrome, kidney stones, and some cases of malignant tumors of the urinary tract. An example of a mucus thread is indicated by the arrow.



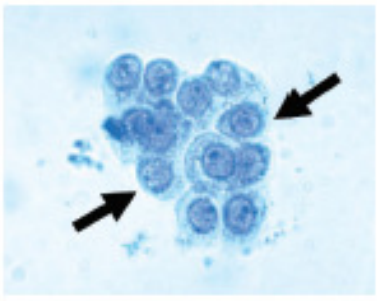
Red Blood Cells

In fresh urine, normal red blood cells appear as biconcave discs with distinct, dark, smooth cell walls. Red blood cells may be present in less than 5 cells per high power field in normal urine. In hypotonic urine, the red blood cells swell and lyse resulting in cells that appear as an empty shell. In hypertonic urine, the red blood cells crenate and form jagged cell walls. High red blood cell counts are associated with urinary tract disease such as glomerulonephritis. Examples of red blood cells are indicated by the arrows.



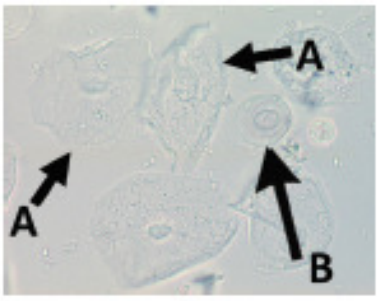
White Blood Cells

The presence of up to five white blood cells per high powered field may be seen in normal urine. High neutrophil counts suggest inflammation or infection within the urinary tract. Examples of white blood cells are indicated by the arrows.



Renal Tubular Epithelial Cells

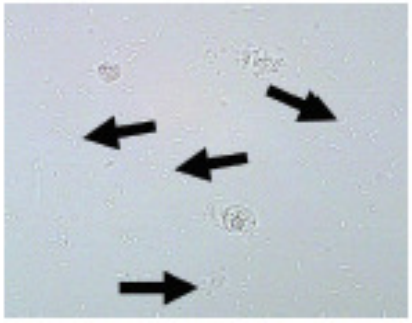
Renal tubular epithelial cells are large and have a distinct single round nucleus. The presence of more than 15 renal tubular epithelial cells per high power field may be indicative of renal disease or tubular injury. Examples of renal tubular epithelial cells are indicated by the arrows.



Epithelial Cells

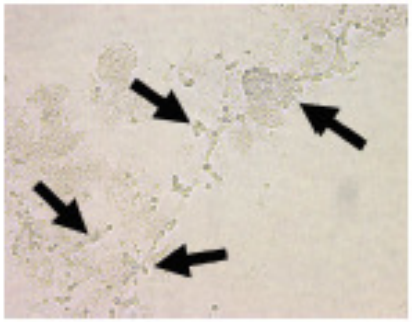
Squamous epithelial cells (indicated by "A" in the image) are flat with an irregular border. A large number of squamous epithelial cells present may indicate a contaminated specimen. Transitional epithelial cells (indicated by "B" in the image) from the skin surface or from the outer urethra can appear in normal urine. Increased numbers may indicate infection and transitional cell carcinoma.

Other Microscopic Findings



Bacteria

The presence of bacteria in urine usually indicates a contaminated specimen and is of little significance except in fresh catheterized specimens. The presence of high numbers of one organism with a high white blood cell count may be indicative of a urinary tract infection. The presence of bacteria without a high number of white blood cells may indicate a contaminated specimen.



Yeast

The presence of yeast in urine sediment of females is often a result of vaginal contamination from a yeast infection. Yeast is also associated with diabetes mellitus due to the presence of urinary glucose. Examples of yeast cells are indicated by the arrows.

VIII. RESULTS REPORTING

Record finding the patient's electronic medical record using the enter / edit Epic activity. Refer to procedure GMG-700-2030.

- **WBC**: None, 0-2, 3-6, 4-8, 5-10, 10-20, 20-40, 30-60, >100 Packed (per HPF). Also report WBC clumps.
- **RBC**: None, 0-2, 3-6, 4-8, 5-10, 10-20, 20-40, 30-60, >100 Packed (per HPF). Grossly bloody samples should be forwarded to the Clinical Laboratory evaluation.
- **Epithelial cells**: Few, Moderate, or Many (per HPF).
- **Crystals**: Amorphous, uric acid, calcium oxalate, triple phosphate, tyrosine, cystine, unidentified. In amounts: Few, Moderate, or Many (per LPF).
- **Bacteria**: Few, Moderate, or Many (per HPF).
- **Casts** (read under low power): Hyaline, Granular, WBC, Epithelial, RBC, Hgb, Broad, Waxy, or Mixed.: 0-5, 5-10, 10-20, 20-50, 50-100, >100 per LPF).
- **Yeast**: Few, Moderate, or Many.
- **Mucus:** If present
- **Other:** Report any additional information

Reference Ranges:

- **WBC**: Negative. Occasional (<5/hpf)
- **RBC**: Negative. Occasional (<5/hpf)
- **Epithelial**: Negative. Few may be present in urine from males, larger numbers in urine from females.
- **Crystals**: Negative. Some crystals precipitate after the sample cools. Crystals are of little clinical
- significance except for cystine, leucine, tyrosine and cholesterol. The type of crystal depends
- largely upon the pH of the freshly voided urine.
- **Bacteria**: Negative. Bacteria are of little significance except in fresh or catheterized specimens. Gram
- stain and culture may be utilized for identification.
- **Casts**: Negative.
- **Yeast:** Negative.

IX. LIMITATIONS

An inaccurate reading may be caused by one of several of the following errors made in specimen collection or technique:

1. Specimen not obtained by “clean catch” method and thus contains elements from sources other than the urinary tract (e.g. vaginal discharge, penile discharge)
2. Specimen that are held unrefrigerated for more than 2 hours
3. Specimens not centrifuged long enough or longer than 5 minutes
4. Urine extremely dilute so no sediment obtained, or not enough elements available in amount of urine tested.
5. Specimen not examined with proper lighting or focusing
6. Microscope not functioning properly, e.g. lens dirty
7. Examiner fails to recognize the elements on the slide

X. REFERENCES:

1. CLSI Physician and Nonphysician Provider-Performed Microscopy Testing: Approved Guideline-Second Edition POCT 10-A2 ; 2011
2. Wisconsin State Laboratory of Hygiene, Proficiency Test Photos, 2012
3. Bauer, John M.D. Clinical Laboratory Methods, 8th ed. C.V. Mosby Company, St. Louis, 1974: 50-60.
4. Todd, Sanford and Davidsohn, Clinical Diagnosis and Management by Laboratory Methods, 16th ed. W.B. Saunders Co. Philadelphia, 1985: 559-629
5. OnFocus, internet site, accessed 8/4/2014 http://onfocus-laboratories.software.informer.com/
6. CMS Provider Performed Microscopy Procedures, A Focus on Quality Practices, Feb. 2016

Procedure written by: Sabena Lukasavage BS
Regional Laboratory Coordinator
Guthrie Medical Group Laboratories
Date: 3/3/2004, revised images 8/4/2014, 6/10/2016, 6/30/2016

Revised by Tonya Wilhelm, MT 7/26/2016

Key Contact: POCT Coordinator, Laboratory Medical Director

Reviewed and Approved by: _____ _____
Laboratory Medical Director* Date

Reviewed and Approved by: _____ _____
Laboratory Medical Director* Date

Reviewed and Approved by: _____ _____
Laboratory Medical Director* Date

Reviewed and Approved by: _____ _____
Laboratory Medical Director* Date

*Original signed document is available in the Regional Laboratory Coordinator's Office