Urinalysis
Manual Microscopic

Technical Procedure 3346

Principle

Intended Use

A routine urinalysis consists of a macroscopic exam for color and clarity; specific gravity determination, chemical analysis for pH, blood, glucose, protein, ketone bodies, bilirubin, leukocyte esterase, nitrite, and urobilinogen, and a microscopic examination (when indicated by sieve criteria) to detect the possible presence of red and white blood cells, casts, microorganisms, mucus, epithelial cells, crystals, and various other formed elements.

When a urine sample submitted is less than 3 mL, an automated microscopic analysis by the IRIS IQ200 will be performed by dilution. If the volume submitted is less than 1 mL, the microscopic analysis, if indicated, must be performed manually. Samples that are unacceptable for automated microscopy (grossly bloody, grossly turbid, mucoid, etc.) will be performed by dilution if possible, or will be performed manually. Reference intervals for manual microscopy are based on submission of 8 mL urine, and are not established for lower volumes.

Clinical Significance

In healthy people, the urine contains small numbers of cells and other formed elements from the entire urinary tract, and epithelial cells from the kidney, ureter, bladder, and urethra. In renal disease, the urine often contains increased numbers of substances and/or elements discharged from the kidney that are otherwise accessible only by biopsy or surgery. A microscopic examination of urine sediment detects the presence and amounts of: RBCs, WBCs, epithelial cells, casts, crystals, bacteria, and other formed elements.

Urine sediment is assessed under a high power field (HPF) using brightfield or phase lighting for the presence of red and white blood cells. Hematuria, the presence of abnormal numbers of red blood cells in the urine, may be due to: glomerular disease, tumors that erode any part of the urinary tract, kidney trauma, renal infarcts, acute tubular necrosis, upper and lower urinary tract infections, nephrotoxins, traumatic catheterization, passage of renal stones, physical stress, or by contamination (vaginal, hemorrhoids,etc.). The presence of dysmorphic red blood cells in the urine is considered quite specific for hematuria associated with glomerulonephritis. Dysmorphic red blood cells exhibit cytoplasmic bulges or projections (“Mickey Mouse ears”) thought to be caused by passage through a damaged glomerular basement membrane. High concentrations of uric acid, as well as exposure to hypotonic osmotic solutions that mimic those found in the tubules of the nephron, may also induce dysmorphic changes. Red blood cells may appear crenated in hypertonic urine, or as ghost cells in hypotonic urine.

Neutrophils enter the urine from any point along the urinary tract. Pyuria, the presence of abnormal number of white blood cells may indicate acute infection, non-infectious inflammation within the urinary tract, or renal disease.

It is important that urine is also examined for bacteria, casts, crystals, and epithelial cells.

Urine stored in the bladder is normally free of bacteria or yeast. However, bacteria are commonly found in urine specimens because of the abundant normal microbial flora of the vagina or external urinary meatus coupled with the ability of bacteria to multiply rapidly in unpreserved urine standing at room temperature. Bacteria and yeast noted on a microscopic examination should be interpreted in view of clinical signs and symptoms of urinary tract infection. Few bacteria may be clinically insignificant; confirmation of clinically significant bacteriuria in a patient with a suspected urinary tract infection requires a urine culture and sensitivity.
Casts are collections of protein, cells, and debris that are formed in the tubules of the kidneys. Casts that form in the collecting tubules tend to be very broad. Broad casts usually indicate a significant reduction in the functional capacity of the nephron and indicate severe renal damage or "end stage" renal disease. A few hyaline casts are normal, but all other casts need to be clinically evaluated. When cellular casts remain in the nephrons for some time before being flushed into the bladder urine, the cells may first degenerate to a

coarsely granular cast, then to a finely granular cast, and eventually, to a waxy cast. Granular and waxy casts are believed to be derived from renal tubular casts. Transient presence of hyaline and granular casts may be normal. Persistent proteinuria and presence of many types of casts may be associated with renal disease, chronic glomerulonephritis, diabetic nephrosclerosis, malignant hypertension and renal amyloidosis.

The urinary tract is lined by several types of epithelial cells. Squamous cells line the female urethra, the distal portion of the male urethra and part of the bladder; they also line the vagina. If squamous cells are present in large numbers, they indicate that the specimen is not an ideal clean-catch specimen. Transitional or urothelial cells line the urinary tract from the bladder to the pelvis of the kidney in females, and from the first part of the urethra to the pelvis of the kidney in males. Small numbers of normal transitional cells have no clinical significance. Large clusters and sheets are common after catheterization or cystoscopy. Increased numbers of transitional cells occur with infection or inflammatory conditions. Renal tubular epithelial cells line the proximal and distal convoluted tubules and the collecting ducts. Renal tubular cells are the most clinically significant epithelial cell seen in the urine, although small numbers are not clinically significant. Increased numbers of renal tubular cells are seen in acute tubular necrosis, drug/heavy metal toxicity, viral infections involving the kidney, and renal transplant rejection. Oval fat bodies are renal tubular cells containing lipids, and are seen in nephrosis or lipiduria.

The following crystals may be seen in normal or abnormal urine.

Normal	
Acid urine	Alkaline Urine
Amorphous Urates (Acid, neutral)	Amorphous Phosphates (Neutral alkaline)
Uric Acid (Acid)	Triple Phosphate (Neutral alkaline)
Calcium Oxalate (Acid, neutral, slightly alkaline)	Ammonium Biurate (Alkaline)
Hippuric Acid (Acid, neutral, slightly alkaline)	Calcium Phosphate (Slightly acid, neutral, alkaline)
	Calcium Carbonate (Neutral alkaline)
Abnormal	
Acid urine	Alkaline Urine
Cystine (Acid)	None
Tyrosine (Acid)	
Leucine (Acid)	
Sulfonamide (Sulfadiazine) (Acid)	
Cholesterol (Acid, neutral)	
Bilirubin (Acid)	
Hippuric acid (Acid, neutral, slightly alkaline)	

Acceptable Samples

Urine in Sterile collection cups, infant bags, syringes
Urine in BD yellow top urinalysis tubes
Urine in BD tiger top urinalysis tubes with preservative

Unacceptable Samples

Urine in Grey Top Na-Borate/culture tubes
Cotton balls soaked in urine

Specimen Collection

A clean freshly voided midstream specimen should be collected in a clean container for routine analysis, and a sterile container for UACII requests. Infant bag collections are acceptable for children ≤ 2 years of age. Other acceptable specimens include catheterized specimens, suprapubic and ostomy collections, as well as kidney or bladder collections from the operating room.

BD tiger top urinalysis preservative tubes must be filled to a level between the marked minimum and maximum lines on the tubes (7-9 mL). Under-filled or over-filled tubes are unacceptable.

For best results, BD yellow top urinalysis tubes without preservative require eight (8) mL for UA or UACII. Urine specimens with a volume < 3 mL will be diluted for microscopic analysis, if possible. Urine specimens with a volume < 1 mL may not have enough volume for microscopic analysis.

Sample Stability and Handling

1. Urine collected without preservative at room temperature must be delivered to the lab within 1 hour of collection.
2. Urine collected without preservative and immediately placed on ice must be delivered within 4 hours of collection.
3. Urine collected in BD urinalysis preservative tubes will be accepted up to 48 hours after collection.

All specimens should be handled using the principles of Universal Precautions, and must be capped tightly.

Specimens that leak are unacceptable for analysis.

Reagents and Supplies

1. Sedi-Stain, BD, Sparks, MD
2. 2% Acetic Acid
3. 1 N HCL
4. 2% NaOH
5. 0.9% NaCl
6. 20% Sulfosalicylic Acid. Harleco, Gibbstown, NJ.
7. HYCOR Kova® Petters
8. HYCOR Kova® Slide II

Reagent Preparation

Reagents listed above are in ready to use bottles.

NOTICE

All reagents must be dated when opened or aliquoted. See individual procedures for safety and special considerations.

Reagent Storage and Stability

The following are stable for 1 week after aliquoting into “in use” bottles at room temperature: 2% Acetic Acid, 1N HCL, 2% NaOH and 0.9% saline.

Equipment

1. Microscope - for brightfield, phase contrast and polarizing microscopy with 10X and 40X objective lenses
2. Centrifuge - capable of centrifuging urine tubes for 5 minutes at 400 RCF
3. Vortex mixer - variable speed (set to low) to re-suspend urine sediment

Quality Control

At least two levels of control material should be analyzed daily.

The following controls should be prepared and used in accordance with the package inserts. Quality Control results should be evaluated and handled with respect to the Clinical Chemistry Quality Control Procedure #3000.T. Control results are documented on the UA Confirmatory and Microscopic UA QC Sheet. Reagent lot changes are documented on the back of the UA QC Sheet.

Quality Control Material

Control	Storage
MAS Liquid UA Abnormal Control 1	+2°C to +8°C*
MAS Liquid UA Normal Control 3	+2°C to +8°C*

*Urine controls are received and stored at 2°C to 8°C. Bottles of controls in use are stored at +2°C to +8°C and are good for 30 days

The controls are treated in the same manner as patients (see procedure below). The normal and abnormal samples are centrifuged, decanted and plated. Perform microscopic analysis and document on manual QC sheet. Compare to acceptable ranges. Repeat if out of control. Simulated RBCs and WBCs may be used in the control products

Procedure

Urinalysis Procedure

Only color, clarity, and chemical analysis are routinely performed. A microscopic analysis is only performed when the sieve criteria are met. These include:

Color - other than Yellow or none
Clarity - other than clear
Leukocyte Esterase ≥ trace
Nitrite - positive
Blood ≥ trace
Protein ≥ trace

Using these conservative criteria, our study, conducted in 1995 with 689 study specimens, showed that less than one percent of clinically significant microscopic elements would be missed, and up to forty percent of microscopic examinations could be eliminated. The microscopic examination is ordered reflexively by the LIS as indicated by the sieve criteria.

Manual Method

Urine chemistries and specific gravity are performed on uncentrifuged urine.

Eight (8) mL is required for an accurate manual microscopic examination. Only note volumes less than eight (8) mL if you review the urine with the microscope. The comment “Reference intervals not established on urine < 8 mL in volume” will be appended to the volume. The mnemonic “**LT8**” may also be used.

If manual microscopic evaluation is required, urine specimens with volumes > 1 mL are centrifuged, and the microscopic examination is performed on the sediment.

If < 1mL urine is submitted, do not centrifuge. Perform microscopic on unspun urine. The comment “Volume ≤ 1 mL. Microscopic performed on unspun urine” will be appended if the volume entered is less than 1 mL. The mnemonic “**UNSPUN**” may also be used.
Specimens exhibiting gross hematuria cannot be tested undiluted on the iQ Series. Gross hematuria may cause incorrect results in subsequent samples due to carryover.

Samples requiring microscopic analysis will be performed manually if the sample:

a. Is less than 1 mL,
b. Is mucoid,
c. Contains gross/visible particulate matter, or
d. Demonstrates IRIS Flow or other sampling errors.

1. Centrifuge urine samples for five (5) minutes at 400 RCF.
2. After centrifugation, insert a Kova® Petter into the urine tube, and carefully push it to the bottom of the tube. Pour off the supernatant, leaving approximately 1 mL of concentrated urine sediment. The sediment can be re-suspended by using the Kova® Petter to gently re-suspend the sediment. Alternatively the vortex mixer can be used to gently mix the sediment well. Make sure the vortex is set to mix at a low speed. Avoid violent and prolonged mixing with the vortex as this can destroy some cellular elements.

Microscopic Examination

At the beginning of each shift, be sure the microscope has been adjusted correctly with Kohler Illumination, and the vortex mixer is set to a low mixing speed. (Attachment A)

1. Withdraw a small well-mixed sample via Kova® Petter or transfer pipette.
2. Transfer specimen to a KOVA® Slide II by placing pipette on the open recessed area adjacent to the covered chamber. Allow to fill by capillary action.
3. Allow to stand for at least one minute before performing microscopic examination.
4. Examine the sediment using Phase 1, or low power (10X) and low light, for casts and mucus. Using the phase contrast will help to visualize these elements more easily. Scan 10-15 fields and count the number and types of casts seen per low power field and record the average number casts/LPF. Cells within the cast matrix should be identified, if possible. Also from scanning, determine the amount of mucus if present.
5. Examine the sediment using high power (40X) and Phase 2, or moderate light, for WBC's, RBC's, epithelial cells (squamous, transitional, renal) and bacteria. using the phase contrast will help visualize internal structure of cells more easily. Scan 10-15 fields and count the number of each cell type seen per field and record the average number of cells/HPF. If WBC clumps and/or dysmorphic RBCs are seen, report as present.
6. While still under high power, scan 10-15 fields and look for the presence of and identify crystals, sperm, yeast, *Trichomonas sp.*, amorphous sediment and any other elements.
7. Be sure to correlate macroscopic findings with microscopic and chemical findings. See *Urinalysis Correlation* chart. (Attachment B)
8. If you are unable to identify a microscopic finding, request assistance from another technologist, a supervisor, or a specialist.
9. Write your findings on the manual results slip. See *Manual Microscopic Result Form.* (Attachment C) Make sure the patient label on the slip matches the label on the urine sample tube.

Calculations

If elements are too numerous to count, a saline dilution is required. Multiply average number of elements counted by the dilution factor.

Example: ~30 RBC/HPF x 5 (dilution factor) = ~ 150 RBC; Report >100/HPF

Result Entry

1. Enter results into the LIS via the UA coded keyboard that is built into the result entry fields. See *Urinalysis Keyboard Entry* chart. (Attachment D)
2. Check the results before filing to make sure all necessary information has been included.
3. Manually recorded and entered results must be reviewed by another CLS in the LIS for accuracy of manually entered results and clinical correlation in accordance with Technical Procedure 3005, Reporting and Review of Results.

Standard Reporting Format

VOLUME	number of mL if < 8 mL submitted AND manual microscopic performed append canned text "**LT8**" to Volume reported ("Reference intervals not established on urine < 8 mL in volume.")
WBC/HPF	negative, 0-5, 6-25, 26-100, >100, packed append canned text "**UHW**" ("Unable to perform microscopic due to presence of very large numbers of white blood cells.") Note: Report clumping
RBC/HPF	negative, 0-5, 6-25, 26-100, >100, packed append canned text "**UHR**" ("Unable to perform microscopic due to presence of very large numbers of red blood cells.") Note: Report clumping Report dysmorphic RBCs
BACTERIA/HPF	few = approximately 1-10/HPF moderate = approximately 11-100/HPF many = approximately greater than 100/HPF Note: Each chain or cluster should be counted as one.
CRYSTALS/HPF	few, moderate, many Note: Identify using references and biochemical tests as necessary. If unable to identify, crystals should be reported as CRYSTALS, OTHER, and a description that includes shape, solubility, birefringence, other identifying characteristics included as a comment.
EPITHELIAL CELLS/HPF	negative, 0-5, 6-25, 26-100, >100, packed Identify as squamous, transitional, or renal tubular cells.
MUCUS/HPF	few, moderate, many
CASTS/LPF	negative, 0-5, 6-25, 26-100, >100, packed Identify casts by type seen. Note: Suspected cellular casts must be classified by cell type. If unable to do so, report number/LPF and add the LIS mnemonic "**NODIST**" ("Unable to distinguish cell type.") as a comment. Mixed cell casts must have cell types noted in a result comment.
SPERM, TRICHOMONAS, AMORPHOUS SEDIMENT	Report as PRESENT if seen.
YEAST	Report as PRESENT if seen. Report as BUDDING and/or HYPHAE yeast.
OTHER	Report quantity, note/identify/describe miscellaneous sediment as a comment.

* Definition of ranges for reporting bacteria are based on a study from CAP April 2001 Q&A regarding grading of bacteria. (Attachment E)

Microscopic Reference Intervals

WBC	0-5/HPF
WBC Clumps	Absent
RBC	0-5/HPF
RBC Clumps	Absent
Dysmorphic RBC	Absent
Bacteria	Negative-Few/HPF
Squamous Epithelial Cells	0-5/HPF
Transitional Epithelial Cells	0-5/HPF
Renal Epithelial Cells	0-5/HPF
Mucus	Negative-Few/LPF
CASTS	
Hyaline Casts	0-5/LPF
Granular Casts	Negative/LPF
WBC Casts	Negative/LPF
RBC Cast	Negative/LPF
Epithelial Cell Casts	Negative/LPF
Cellular Casts (ID if possible)	Negative/LPF
Mixed Cell Casts (ID cells)	Negative/LPF
Waxy Casts	Negative/LPF
Broad Casts	Negative/LPF
Fatty Casts	Negative/LPF
CRYSTALS	
Amorphous	Absent/Present
Calcium Oxalate	Negative-Few/HPF
Uric Acid	Negative-Few/HPF
Triple Phosphate	Negative-Few/HPF
Calcium carbonate	Negative-Few/HPF
Calcium Phosphate	Negative-Few/HPF
Leucine	Negative/HPF
Cystine	Negative/HPF
Tyrosine	Negative/HPF
Budding Yeast	Absent
Hyphae Yeast	Absent
Oval Fat Bodies	Negative/HPF
Trichomonas sp.	Absent
Sperm	Absent

These ranges are generally accepted and taken from reference (1) and have been briefly confirmed with local populations.

References

1. Tietz, N.W., Fundamentals of Clinical Chemistry. W.B. Saunders, Philadelphia, 1976.
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3. Free, A. and Free, H., Urinalysis in Clinical Laboratory Practice. CRC Press, 1976.
4. Subtopic 3: Microscopic Examination of Urine Sediment.http://texascollaborative.org/spencer_urinalysis/ds_-sub3.htm
5. Schumann, B.G., Urine Sediment Examination, Williams & Wilkins Co, Baltimore, Maryland, 1980.
6. Holen, Meryl H., MD, A Primer of Microscopic Urinalysis, ICL Scientific, pp. 15-17.
7. Microscopic Examination of Urine procedure, Oregon Health & science University, Revised 12/14/10
8. Haber, Meryl H., Urinary Sediment: A Textbook Atlas, Educational Products Division, ASCP Press, Chicago, 1981
9. Haber, Meryl H., Blomber, David, Galagan, Katherine, Glass, F. Eric, Ward, C.J. Patrick, editors, Color Atlas of the Urinary Sediment: An Illustrated Field Guide Based on Proficiency Testing. CAP Press, Northfield, IL, 2010.

Prepared By	Date Adopted	Supersedes Procedure #
kdagang	09/07/2014	3445

Revision Date	Type of Revision	Revised by	Review/Annual Review Date	Reviewed By
08/19/2014	New procedure	kdagang	09/12/2014	J. Gregg
12/01/2014	modifications, updates	kdagang		

Kohler Illumination Guidelines

Köhler ("kō-ler") alignment is a method of illumination that was first developed in 1893 by August Köhler. He devised this to optimize the microscope's optical system, aligning and focusing the beam of light to produce homogenously bright light.

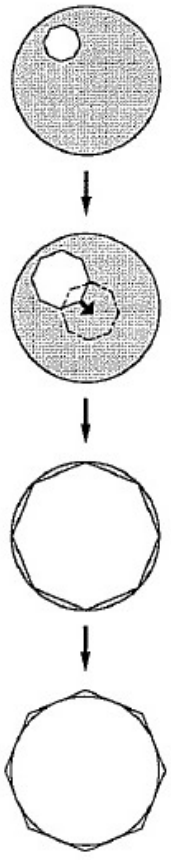
This simple, quick procedure should be performed at the beginning of each shift.

Advantages Of Köhler Illumination

- Even illumination of the specimen
- High contrast and resolution
- Reduced specimen heating
- Elimination of reflection and glare

A Few Simple Steps To Köhler Illumination

(See Figure 1, next page, for Microscopic Component Identification.)



1. Switch on the microscope.
2. Prepare a slide to focus on. A glass slide with a wax pencil or Sharpie line can be used. Place your slide on the microscope stage. Secure it in place using the spring-loaded slide holder. Focus on the slide using the 10x objective.
3. Close the field iris diaphragm ① (rotate it fully counter-clockwise – see Figure 2, next page) to produce the smallest diameter field of light.
4. Locate the condenser height adjustment knob ② that moves the condenser up and down. Turn it slowly until the edge of the field diaphragm appears in sharp definition against the light. Ensure the edges are in focus. As you focus, there may be a red fringe on one side, and a blue fringe on the other. Use the two condenser centering screws ③ to move the image to the center of the field of view.
5. Gradually rotate the diaphragm clockwise to open it so that its edges are just inside the field of view. Use the two condenser centering screws ③ to center the image.
6. Rotate the diaphragm clockwise to open it a little more so that its edges are just beyond the field of view.
7. The focus should now be in alignment and you will be able to view an evenly illuminated microscopic field.

FIGURE 1

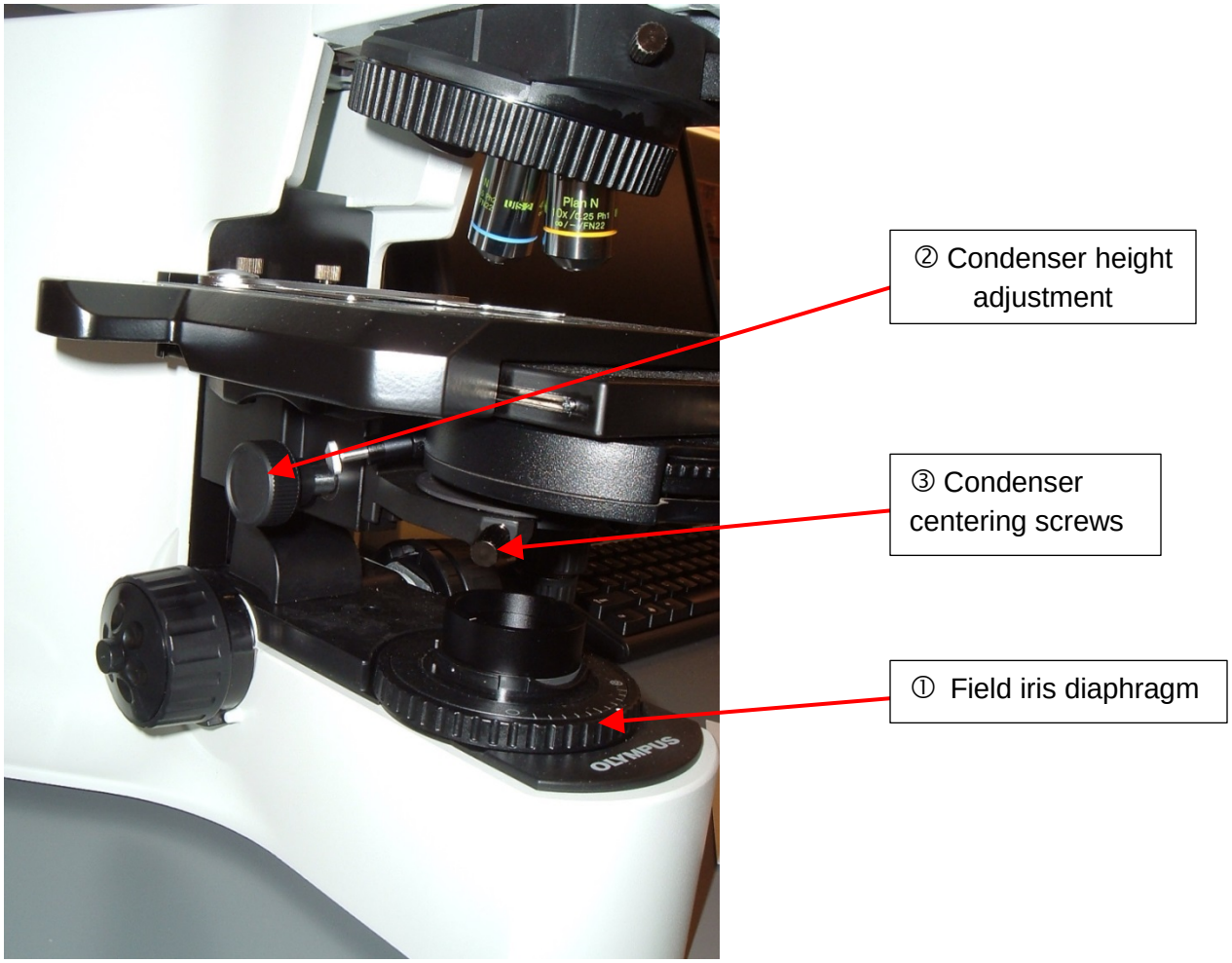


FIGURE 2

URINALYSIS CORRELATION

COLOR VERIFY ABNORMAL COLOR	CORRELATIONS
amber, orange	positive bilirubin pyridium (thick orange pigment, interferes with strip readings) other medications: acriflavine, nitrofurantoin, phenindione
yellow-green/brown	bilirubin oxidized to biliverdin=false negative test for bilirubin
green, blue-green	pseudomonas infection drugs/ingestibles: amitriptyline, robasin, indicant, methylene blue, phenol
pink, red	RBCs, hemoglobin, myoglobin, porphyrins, menstrual contamination, rectal bleeding, ingestibles: rifampin, beets
brown, black	positive blood = RBCs or hemoglobin oxidized to methemoglobin melanin, melanogen, homogentisic acid, phenol derivatives, methyldopa, levodopa, flagyl (often darken on standing)

CLARITY	CORRELATIONS
clear, slightly turbid, turbid, opaque	be sure clarity correlates to particle count/verify visually

REAGENT STRIP TEST	CORRELATIONS
blood	sensitivity = ~10 RBC/uL (~2-3 RBC/HPF), check for RBCs more sensitive to lysed RBCs **FALSE +**: peroxidases (vegetable, bacterial), oxidizing agents (e.g., bleach) **FALSE –**: ascorbic acid, elevated specific gravity, elevated protein
leukocyte esterase	sensitivity = ~25 wbc/uL (~5 wbc/HPF), check for wbcs **FALSE +**: formaldehyde **FALSE –**: glucose >500 mg/dL, protein > 300 mg/dL, low pH, increased specific gravity
nitrite	sensitivity = ~10^5 organisms/mL (nitrate reducing), look for bacteria around squamous cell and mucus images **FALSE +**: old specimen, highly pigmented urine **FALSE –**: non-nitrate-reducing bacteria, ascorbic acid, elevated specific gravity, urine not in bladder at least 4 hours, inadequate nitrate in diet, large numbers of bacteria reduce nitrates to nitrite and then to nitrogen, antibiotics
protein	sensitivity = 10 mg/dL, most sensitive to ALBUMIN, check for casts **FALSE +**: ph > 8.0 (old urine, bacteria), large hemoglobin, disinfectants (quaternary ammonium compounds), contrast media **FALSE –**: pH < 3.0 (physiologically impossible/due to contamination)
glucose	**FALSE +**: oxidizing compounds, pH < 4 **FALSE –**: ascorbic acid

MICROSCOPIC IMAGES	CORRELATIONS and POSSIBLE CONFUSIONS
red blood cells	positive blood, color and turbidity **?? CALCIUM OXALATE, YEAST, AIR BUBBLES, OIL DROPLETS**
white blood cells	positive leukocyte esterase, turbidity check nitrite, check for bacteria, look for trich images check pH and specific gravity (wbcs lyse rapidly in dilute alkaline urine, swell in hypotonic urine) **?? RENAL TUBULAR CELLS, TRICHOMONAS IF LARGE LEUKOCYTE ESTERASE AND FEW WBCS**
squamous epithelial cells	turbidity **?? FOLDED CELLS MAY RESEMBLE CASTS**
transitional epithelial cells (urothelial cells)	**?? SPHERICAL CELL FORMS MAY RESEMBLE RENAL TUBULAR CELLS** **CONFIRM UNDER SCOPE**
renal tubular cells	check leukocyte esterase, nitrite (pyelonephritis) **?? SPHERICAL TRANSITIONAL EPITHELIAL CELLS, WBCs, GRANULAR CASTS** **CONFIRM UNDER SCOPE**
oval fat bodies	turbidity, protein, free fat globules and/or fatty casts **CONFIRM UNDER POLARIZING SCOPE –** maltese cross
hyaline casts	protein **?? MUCUS, FIBERS, HAIR,** use phase, polarizer for fibers
granular casts	protein, check for cellular casts, RBCs, wbc. **?? CLUMPS OF SMALL CRYSTALS ON MUCUS STRAND, AMORPHOUS CRYSTALS ON HYALINE CASTS, COLUMNAR RENAL TUBULAR CELLS** **CONFIRM UNDER SCOPE**
waxy casts	protein, check for other casts, wbcs, RBCs **?? FIBERS, FECAL MATERIAL** **CONFIRM UNDER SCOPE**
RBC casts	blood, protein, RBCs **?? RBC CLUMPS** **CONFIRM UNDER SCOPE**
WBC casts	leukocyte esterase, protein, wbcs, check for bacteria **?? WBC CLUMPS** **CONFIRM UNDER SCOPE**
epithelial cells casts	protein, renal tubular cells **?? WBC CAST**
fatty casts	MUST have large protein, check for free fat, oval fat bodies **?? FECAL MATERIAL** **CONFIRM, POLARIZING SCOPE**
bacteria	nitrite, leukocyte esterase, check pH, wbcs **?? AMORPHOUS CRYSTALS, CHECK IN SQUAMOUS/MUCUS IMAGES** **CONFIRM UNDER SCOPE**
yeast	leukocyte esterase, check glucose and pH, look for wbcs **?? RBCs, CALCIUM OXALATE** **CONFIRM UNDER SCOPE, VERIFY RBC COUNT**
trichomonas	leukocyte esterase, LOOK CAREFULLY IN WBC IMAGES if discrepancy **?? WBCs, RENAL TUBULAR CELLS** **CONFIRM UNDER SCOPE**

IF YOU GET…	BE SURE TO CHECK FOR…
positive blood	red blood cells, if none/few seen, check for low specific gravity
positive LE	white blood cells, bacteria; if no wbc/few wbc seen, check for *Trichomonas sp*. (especially if many squamous cells present)
positive nitrite	bacteria
positive glucose, low pH	yeast
moderate-large protein	casts
red blood cells	positive blood (sensitivity ~2-3/HPF)
white blood cells	positive leukocyte esterase (sensitivity ~5/HPF)
casts	positive protein
red blood cell casts	positive blood, positive protein, red blood cells
white blood cell casts	positive leukocyte esterase, protein, white blood cells
epithelial cell casts	positive protein, renal tubular cells
If you see CELLULAR CASTS, you typically will see the SAME TYPE OF CELLS ELSEWHERE IN THE URINE. If you think you are looking at white blood cell casts, but only renal tubular cells are in the urine sediment, it's more likely to be a renal tubular cell cast. Do not quantify casts under the "cellular casts" category in LIS. IDENTIFY THE CELLS IN THE CASTS, and then quantify the casts in the proper category. Using phase-contrast microscopy and/or Sedi-Stain can be very helpful. If you absolutely cannot identify the cells within the casts, quantify Cellular Casts/HPF and append the canned text comment "**NODIST**" – "Unable to distinguish cell type."	
oval fat bodies, fatty casts	MUST have large protein, maltese cross with polarized light
cholesterol crystals	MUST have large protein, check for fatty casts, oval fat bodies

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Attachment C

Manual Microscopic Result Form

CONFIRMATION TESTS	
SULFOSAL ACID	
CLINITEST	
ICTO TEST	

Preg test	

MICROSCOPIC		
WBC/HPF		
RBC/HPF		
BACTERIA/HPF		
EPITHELIAL/HPF		
RENAL CELLS/HPF		
TRANSITIONAL CELLS/HPF		
MUCUS/LPF		
HYLAINE CASTS/LPF		
GRANULAR CASTS/LPF		
URATES	PHOSPHATES	AMORHOUS
CRYSTALS		
TRICHOMONAS		SPERM
YEAST:	BUDDING	HYPHAE
OTHER:		

University of California, Davis Health System
Department of Pathology and Laboratory Medicine
Automated Chemistry/Urinalysis

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Attachment D

URINALYSIS KEYBOARD ENTRY

KEY/RESULT		USE FOR RESULTING:	
MICROSCOPIC RESULTS			
A	0-5	WBC	Hyaline Casts
S	6-25	RBC	Granular Casts
Q	26-100	Squamous Epithelial Cells	WBC Casts
W	>100	Transitional Epithelial Cells	RBC Casts
N	Packed	Renal Epithelial Cells	Renal Epithelial Cell Casts
			Cellular Casts
			Mixed Cell Casts
			Waxy Casts
			Fatty Casts

F	Few	Mucus	Ammonium Urate
M	Moderate	Bacteria	Calcium Phosphate
, (comma)	Many	Calcium Oxalate	Calcium Carbonate
		Uric Acid	Sulfa, other medications
		Triple Phosphate	Crystals, other (describe in result comments)

P	Present	WBC Clumps	Budding Yeast
N	Absent	RBC Clumps	Hyphae Yeast
		Dysmorphic RBCs	*Trichomonas sp.*
		Amorphous Crystals	Sperm

P	Positive	Leucine
N	Negative	Cystine
		Tyrosine

STRIP/CHEMISTRY RESULTS		
P	Positive	Sulfosalicylic Acid
N	Negative	

T	Trace	Occult Blood
S	Small	Bilirubin
M	Moderate	Leukoctye Esterase
L	Large	Nitrites

Numeric Result	
	Specific Gravity
	pH
	Urobilinogen

[F9] Look-Up		
	Collection	Glucose
	Color	Ketones
	Clarity	

April 2001

Q. Our laboratory reports bacteria in the urine microscopic as rare, 1+, 2+, 3+, and 4+. As our hospital system includes many individual laboratories, I would like to standardize this evaluation by stating the actual number of bacteria/hpf that would be seen at each level. Can you provide references that give the actual number of bacteria/hpf that would be expected at each of these levels?

A. Urine can be evaluated a number of ways for the presence of bacteria. The literature contains studies that evaluate uncentrifuged and centrifuged urine, both unstained and stained with Gram stain.

Since you indicate you are using a 1+ to 4+ system, it appears safe to assume you are referring to evaluation of centrifuged urine, as most studies using uncentrifuged urine simply evaluate for the presence of any bacteria per high power or oil immersion field. The most commonly used relation between the qualitative 1+ to 4+ systems and quantitative bacteria/hpf method in centrifuged urines is: 1+ = one to 10 bacteria/hpf; 2+ = 11 to 100 bacteria/hpf; 3+ = >100 bacteria/hpf; and 4+ = field packed with organisms.

The utility of either qualitative or quantitative reporting is its ability to predict the presence of a urine culture with $>10^6$ organisms, performed using standard methods. Several studies have reported the relation of the various bacteria/hpf levels in terms of how well it detects the presence of any positive urine culture (sensitivity) or how well it screens out urines that will not yield a positive culture (specificity). Using ≥1 bacteria/hpf (1+ or more) as a cutoff, sensitivity is 93 percent to 97 percent and the specificity 50 percent to 88 percent. Studies using the cutoff >10 bacteria/hpf (2+ or more) report sensitivity of 85 percent to 95 percent and specificity of 78 percent to 99 percent. Use of a cutoff of >100 bacteria/hpf (3+ or more) results in a sensitivity of 66 percent to 85 percent. Given the above data, using the following reporting system should provide clinicians with optimal information: one to 10 bacteria/hpf, 11 to 100 bacteria/hpf, and >100 bacteria/hpf.

It goes without saying that in addition to standardizing your reporting you need to standardize your sediment preparation and evaluation. Things that must be standardized are the volume analyzed, the rate of centrifugation, the duration of centrifugation, the volume of urine used to resuspend the sedimented pellet, the depth of the chamber used for evaluation, and the magnification used for examination.

Bibliography

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