Urinalysis

Cloudy/milky
- Phosphaturia (commonest – crystal precipitate in high pH)
- Pyuria
- Chyluria

Red
- Hematuria
- Hemoglobinuria/myoglobinuria
- Anthocyanin in beets and blackberries
- Chronic lead and mercury poisoning
- Phenolphthalein (in bowel evacuants)
- Phenothiazines
- Rifampin

Orange
- Dehydration
- Phenazopyridine (Pyridium)
- Sulfasalazine (Azulfidine)

Yellow
- Normal
- Phenacetin
- Riboflavin

Green-blue
- Biliverdin
- Indicanuria (tryptophan indole metabolites)
- Amitriptyline (Elavil)
- Indigo carmine
- Methylene blue
- Phenois (e.g., IV cimetidine [Tagamet], IV promethazine [Phenergan])
- Resorcinol
- Triamterene (Dyrenium)

Brown
- Urobilinogen
- Porphyria
- Aloe, fava beans, and rhubarb
- Chloroquine and primaquine
- Furazolidone (Furoxone)
- Metronidazole (Flagyl)
- Nitrofurantoin (Furadantin)

Brown-black
- Alcaptonuria (homogentisic acid)
- Hemorrhage
- Melanin
- Tyrosinosis (hydroxyphenylpyruvic acid)
- Cascara, senna (laxatives)
- Methocarbamol (Robaxin)
- Methyldopa (Aldomet)
- Sorbitol
<table>
<thead>
<tr>
<th>Variable</th>
<th>Normal value</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific gravity*</td>
<td>1.001 – 1.035</td>
<td>&gt;1.020</td>
<td>&lt;1.008</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dehydration</td>
<td>Overhydration</td>
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<tr>
<td></td>
<td></td>
<td>Diuretics</td>
<td>Impaired conc.</td>
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<tr>
<td></td>
<td></td>
<td>DM</td>
<td>DI</td>
</tr>
<tr>
<td>Urine osmolality</td>
<td>50 – 1200 mosm/l</td>
<td>As above</td>
<td>As above</td>
</tr>
<tr>
<td>pH</td>
<td>5.5 – 6.5</td>
<td>&gt;6.5</td>
<td>&lt;5.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Proteus</td>
<td>Cystinuria</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA 1 and 2</td>
<td>Uricosuria</td>
</tr>
<tr>
<td>Protein</td>
<td>&lt; 20 mg/dl</td>
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<td></td>
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</tbody>
</table>

* can be measured on dipstick/ osmolality cannot

Haematuria

> 3RBCs/hpf suggestive of significant haematuria on microscopy

Dipstick testing

- Detects haematuria, haemoglobinuria and myoglobinuria
- Cells lysed on contact with reagent strip.
- Peroxidase activity of haemoglobin/ myoglobin utilised vs. organic peroxidase substrate (orthotolidine).
- Oxidation of chromagen substrate indicates presence of haemoglobin of myoglobin
- Overall sensitivities 90-100% c.f. microscopy (2-5 rbc's/ hpf)
  [Woolhandler JAMA 1989]; Overall specificities 65-99% cf. microscopy

False positives:
- Menstrual bleeding
- Dehydration
- Haemoglobin
- Myoglobin
- Oxidised reagent strips

False negatives:
- Vitamin C

No studies directly compare dipstick positivity with presence of significant urological disease.

Incidence of urological malignancy with microscopic haematuria:
- Asymptomatic overall ~ 0.5 - 2.0%
- Asymptomatic > 50 yrs ~ 5%
- Symptomatic > 50 yrs ~ 10%
- Macroscopic haematuria ~ 25%

Screening for haematuria not recommended at present as PPV too low (0.5%)

NB. haematuria/RBC casts and proteinuria ( >100mg/dL or 2+) indicative of renal glomerular disease. Top 3:
- IgA nephropathy (Berger’s disease) 30%
- Mesangiproliferative GN 14%
- Focal segmental proliferative GN 13%

Proteinuria

Normally 80-150mg protein excreted in urine per day
- 30% albumin; 30% globulin; 40% TH protein
Concentration rarely exceeds 20mg/dl (not detected on dipstick)
Dipstick contains tetrabromophenol – turns blue with albumin
Positive when protein conc > 20mg/dl
High specificity; low sensitivity
False negatives:
  High urinary pH
  Dilute urine
  Non-albumin proteinuria (Bence-Jones proteins in myeloma)

Urine dipstick testing for UTI
Urinary nitrite and leukocyte esterase surrogates for bacteria and WBC respectively. Reference bacteruria > $10^5$ orgs/ml
Early morning urine has increased sensitivity

Urinary Nitrite
Dietary nitrates - urinary nitrates - nitrate reducing bacteria
(enterobacteria) - urinary nitrates - react with amine-impregnated dipstix reagent - pink diazonium compound
Sensitivity = 35-85%, Specificity = 92-100%
False positives:
  Contamination
False negatives:
  Non-enteric bacteria
  Dilute urine/ frequent voiding
  Vitamin C
  High osmolality/ urinary H+
  Urobilinogen

Urinary Leukocyte Esterase
LE from neutrophil/ basophil granules reacts with reagent strip - indoxyl moeity produces colour changes by oxidation of diazouion salt
Sensitivity = 72-97%, Specificity = 64-82%
False positives:
  Specimen contamination
False negatives:
  Old specimen (leucocyte lysis)
  High osmolality/specific gravity
  Vitamin C
  Urobilinogen
When Nitrite and LE combined; Sensitivity = 70-100%, Specificity = 60-98%

Glucose and Ketones
Double oxidation reaction: glucose – gluconoic acid and hydrogen peroxidase – colour change
Very sensitive for any glucose in urine (corresponds to renal threshold of 180mg/dL)
Specific for glucose – not other sugars
Ketone testing specific for acetoacetic acid, not acetone or hydroxybutyrate
Urinalysis

**Urine microscopy and culture**

Clean catch MSU specimen
First voided morning specimen – examine within one hour
Centrifuged samples 5 mins at 3000rpm – resuspend
Examine at low power (100x) and high power (400x) 1 hpf = 1/20,000 ml
Routine examination for:

- **RBCs**
  - Up to 3/hpf normal
- **RBC casts**
  - Glomerulonephritis
- **WBCs**
  - > 10wbc/hpf = significant inflammation
  - 1-2/hpf normal in men
  - Up to 5/hpf normal in women
- **WBC casts**
  - Pyelonephritis
- **Bacteria**
  - 5/hpf = 100,000/ml

![Urine crystals images](attachment:image.png)