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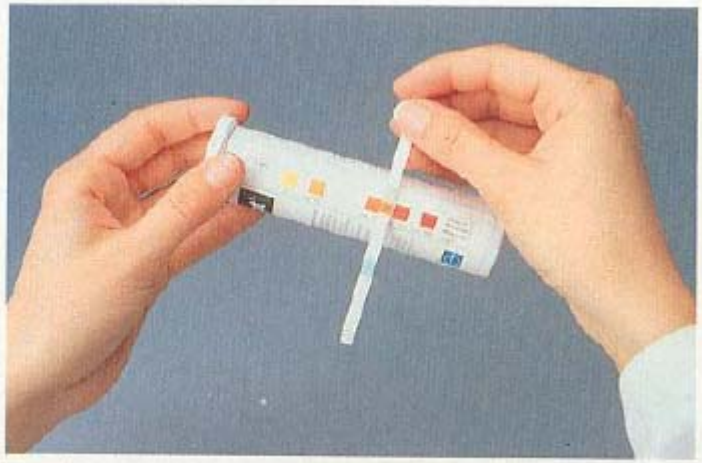
Urinary testing with strips

Urinary strips since 1950

Procedure

Immerse for 5 seconds

Place on dry, non-absorptive surface



Read colouring after exactly 5 minutes

Urinary tests with strips are easy to perform. However, false results may be obtained with inappropriate methods

- Expired or inappropriately stored strip (storage: cool and dried place, tightly capped containers)
- Color code is not read correctly
- Bad technique
- Strip is turned upside down during testing
- Insufficient time is allowed for reaction
- Reagent pads are touched

Henry's Clinical Diagnosis and Management by laboratory methods, 22.Ed

Urinary strip testing is easy to perform, but

- You should inspect the sample before testing:

- Fresh samples should be used
- Samples should be kept on room temperatures
- Appropriately mixed sample should be used

Before strip: inspect the sample

Feature	Cause	Note
No color	Diluted samples	polyuria; artefact (?)
Turbid	Salts, crystals, cells, semen, mucin, pus, contaminated with stool, contrast agent	
Milky	pus, lipiduria, chyluria, paraffine	Vaginal gels
Orange	Concentrated urine, urobilin or bilirubin	Dehydration, fever; yellow foam in case of high bilirubin
Greenish-yellow, Brownish-yellow	bilirubin-biliverdin	yellow foam
Red	hemoglobin, RBC, myoglobin	Strip indicates
	Porphyrin, fuscin, anilinf dye	Strip does not indicate
Brownish black	Methemoglobin	Acidic urine
	Melanin, homogentizin acid	Unfresh sample

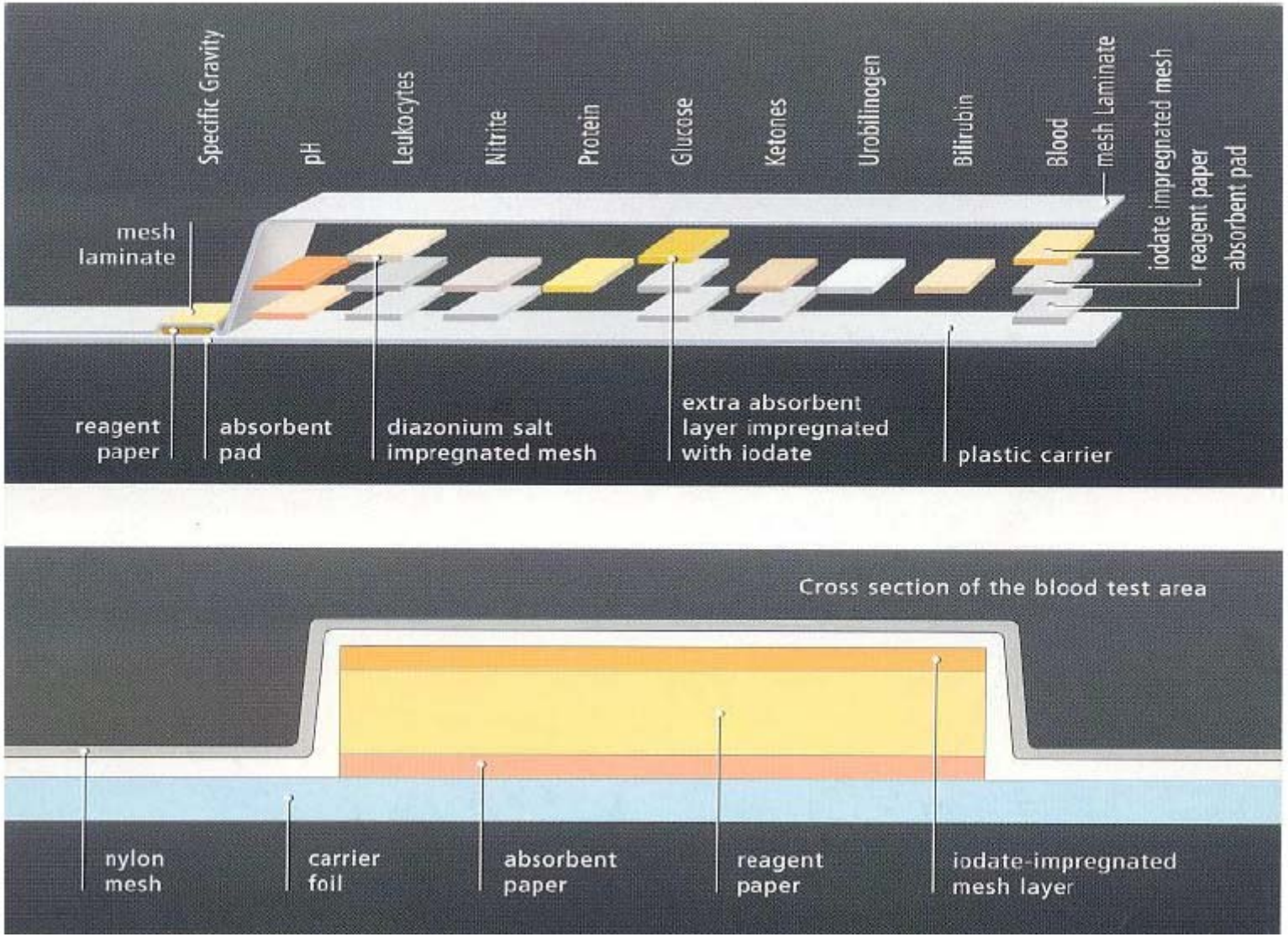
Drugs discoloring the urine

Drug	Color
Ethanol	Light (diuresis)
Senna (anthraquinone laxative)	alkaline: red; acidic : yellowish brown
Deferoxamine mesilate (iron chelator)	Red
Etoxazan (urinary analgetics)	orange, red
Fluorescein-sodium (IV)	Yellow
Nitrofurantoin (antibacterial agent)	Brownish yellow
Indigocarmine (cystoscope, renal function testing)	Blue
Iron sorbitol (supplement)	Brown after a while
Levodopa (anti-Parkinsonian)	Red, then brown

Drugs discoloring the urine

Drug	Color
Metildopa	darkening; reddish brown in the presence of oxidising agents
Metronidazol (antibacterial)	Dark; reddish prown
Phenazopiridin (urinary analgetics)	Reddish-yellow (acidic pH)
Fenindion (anticoagulant)	Orange (alkaline pH)
Fenfolftalein (laxative)	Red-purple (alkaline pH)
Rifampin	Light orange – yellow
Ribaflavin (multivitamin)	Light yellow
Sulfasalazin (ulcerous colitis)	Orange – yellow (Alkaline pH)

Structure of urinary strip



Analytes present on strip

Specific gravity 1,003 – 1,035

Components responsible for SG:

- Urea: 20%
- NaCl: 25%
- Sulphate & phosphate salts

Principle:

- Polyelectrolyte, indicator and buffer.
- Acidification proportionally to ionic strengths
- pH dependent indicator

Limitations / notes:

- Not altered by glucose, protein, contrast agents

Analytes present on strip

- **pH**

Acidic: consumption of meat, some fruits (blueberry); sleeping (compensating of ventilatory acidosis); NH4Cl, methionin, metenamin-mandelate [used for phosphate and calcium-carbonate stones]

Alkaline: citrus fruit, after a meal, NaHCO3, citrate, acetasolamide [used for uric acid, cistin, calcium-oxalate stones, potentiation of neomicin, canamicin, streptomicin effect, therapy of salicilate intoxication], renal tubular acidosis

Principle:

Indicator: methyl red and bromotimol-blue (orange, green & blue)

Interference: higher with storage (CO2 levels decrease, NH4

Analytes present on strip

- **protein**

Normal: Max. 150 mg/day, 200 different species; 1/3 albumin, 1/3 uromucoid [Tamm-Horsfall glycoprotein produced by distal tubular cells], remnant: globulins, IgA, cellular fragments, WBC.

Principle:

Tetrabromphenol blue, acidic pH: pH increased in the presence of proteins; blue color in the presence of protein, indicates level above 100 mg/l

Interference: false negative in very thin urine. false positive: concentrated & alkaline urine, quaterner ammonium or chlorhexidin; NO interference with drug, contrast agent or turbidity

note: particularly sensitive for albumin

Analytes present on strip

- **Microalbuminuria**

Principle immune reaction [Micral II]

- Oxytetracycline increases the level; no intereference with pH

Color reaction [Clinitek]

- Interference with Tamm-Horsfall protein

Analytes present on strip

- **glucose**

Principle:

glucose + O2 ---- glucose oxidase→ gluconic acid + H2O2

H2O2 + chromogenic ----peroxidase → oxidized chromogenic + H2O

Interference:

false positive: oxidising agents (detergents in container), low gravity

false negative: high gravity, ascorbic acid, ketones, salicylates, L-DOPA, sodium-fluorid, bacteria

NO interference with other sugars

Analytes present on strip

- **Ketone** (acetacetate, 20%, acetone 2%, 3-hydroxy-butirate, 78%)

Principle:

Color reaction of acetacetate and acetone with nitroprusside

Interference:

false positive: ftaleins (sulphobromoftalein, phenolsulphonftalein dye), phenylketonuria, L-dopa, antihypertensive agents: methyldopa and captopril

Analytes present on strip

- **Blood (hem)**

Principle: based on hem peroxidase activity

RBCs are lysed

H_2O_2 + chromogenic --→ oxidized chromogenic + H_2O

(tetramethylbenzidine: green)

10 RBC/HPF [3 mg/l]

Detects the presence of both hemoglobin and myoglobin

Interference: RBCs may sediment. Sensitivity decreased: high gravity, high protein content

false negative: ascorbic acid, formalin

Nitrit: reaction is delayed

false positive: hypochlorite, iodine, bacteria (peroxidase)

Jaundice

result	**normal**	**Biliary obstruction**	**Hemolysis, hemolyticus anemia**	**Liver damage, hepatitis, cholestasis**
urinary bilirubin	No	Increased in dark urine	No	In the beginning increased
urinary urobilinogen	Detectable	Tumor —low or absent; Stone – varying	increased	In the beginning decreased; then increased
Color of the stool	Dark	Light; in the presence of biliary stones intermittant; persisting in presence of tumor	Dark	In the beginning light, then dark (hepatitis); light (cholestasis)

Analytes present on strip

- **Bilirubin**

Principle: chromogenic reaction (diazonium salt)

Interference: levels decrease in unfresh urine / light exposure, high ascorbic acid levels, high nitrit levels, red urinary sample

Levels increase: rifampin and chorpromazine

No interference: urobilinogen

Analytes present on strip

- **Urobilinogen**

Principle: chromogenic reaction (Ehrlich-aldehid reaction, or diazonium-salt)

Interference: interference with red drug metabolites; decrease in unfresh urine

Analytes present on strip

- **Nitrit**

Nitrit producing bacteria: E. coli, Klebsiella, Enterobacter, Proteus, Staphylococcus, Pseudomonas species

At least 4 hours are required to produce a sufficient amount of nitrits by bacteria → first specimen in the morning

NO NITRIT POSITIVE: *Enterococcus*

In general, 70% sensitivity

In hospital infection it is more frequent that this test is negative

Principle: chromogenic reaction

Interference:

false positive: unfresh urine, urinary coloring agents (phenazopiridine)

false negative: ascorbic acid, urobilinogen, low pH (<6), random sample (sample from catheters), insufficient amount of nitrate in diet

Analytes present on strip

- **WBC (leukocyte esterase)** also detects cell fragments

Principle: Neutrophyl esterases hydrolyse esters; the generated alcohol is detected by chromogenic reaction

Interference:

Decreased by: high urinary gravity, protein, glucose, ascorbic acid

Increased by: vaginal discharge (presence of squamous cells and bacteria), oxidising agents and formalin

Analytes present on strip

- **ascorbic acid**

Interferes with glucose, blood, bilirubin, nitrit, and leukocytes tests

Principle: chromogenic reaction

phosphomolibdate → molibden-blue, 50 mg/l. Interference: gentisin acid and L-DOPA

or:

Methylene green → dyscoloration. Interference: alkaline pH, bilirubin

Take home message

In general, test results obtained with urinary strips are interferred by:

- Color of urine
- pH
- Presence of reducing or oxidising agents (ascorbic acid & detergents)