

**LECTURE MODULE 3;**  
**PHYSICAL EXAMINATION**  
**OF URINE**

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**Topic Objectives**

- 1. Identify the colors which commonly associated with abnormal urine.
- 2. State two possible causes for urine turbidity in a sample that is not fresh.
- 3. Identify possible causes for abnormal urinary foam.
- 4. Identify the odors commonly associated with abnormal urine.
- 5. Differentiate between the following abnormalities of urine volume:
  - Polyuria
  - Oliguria
  - Anuria
  - Nocturia
- 6. Define specific gravity of urine.
- 7. Define refractive index of a solution.
- 8. Identify possible causes of abnormal specific gravities of urine.
- 9. Compare and contrast Diabetes Mellitus with Diabetes Insipidus.

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**Physical Examination**

- Appearance**
  - Color
  - Transparency
  - Foam
- Odor**
- Specific Gravity**
- Volume**

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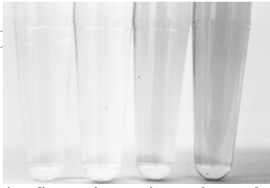
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## Color



- When an examiner first receives a urine specimen, color is observed and recorded.
- Normal urine usually ranges from a light yellow to a dark amber color.
- The normal metabolic products which are excreted from the body contribute to this color.
- Urochrome is the chief urinary pigment.
- Urinary color may vary, depending on concentration, dietary pigments, drugs, metabolites, and the presence or absence of blood.
- A pale color generally indicates dilute urine with low specific gravity.
- Occasionally, a pale urine with high specific gravity is seen in a diabetic patient.

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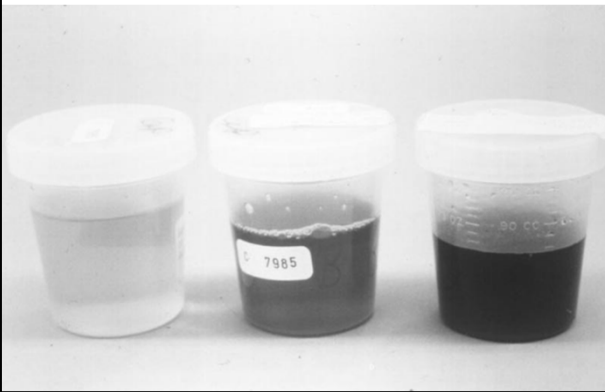
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## Color



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- In many diseases, urinary color may drastically change. In liver disease, bile pigments may produce a yellow-brown or greenish tinge in the urine.
- Pink, red, or brown urine usually indicates the presence of blood, but porphyrins may also cause a pink or red urine.
- Since drugs, dyes and certain foods may alter urine color, the patient's drug list and diet intake should be checked.
- This listing can aid the examiner in assessing whether abnormal urinary color is due to disease or to substances the patient has ingested
- For example, pyridium may cause a yellow-orange color; beets may turn urine red in some people; and ingestion of riboflavin may cause a bright yellow color.

□ 1. Identify the colors which commonly associated with abnormal urine.

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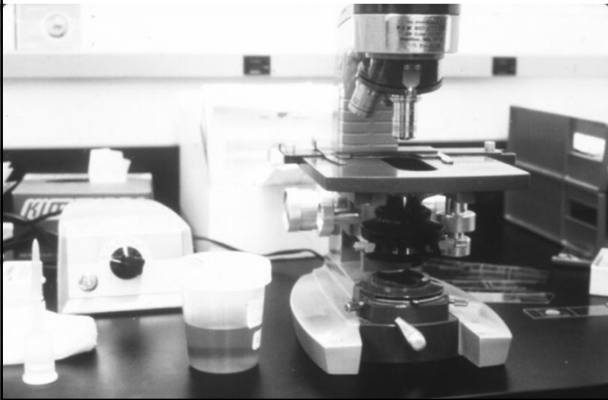
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### Color Correlation



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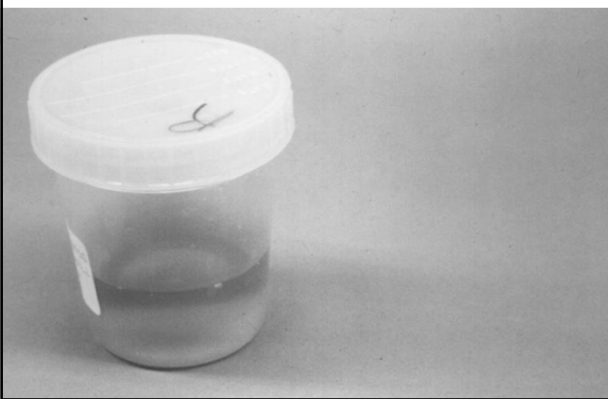
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### Transparency or Clarity



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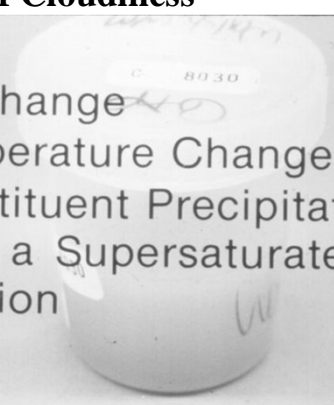
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### Cause of Cloudiness

- pH Change
- Temperature Change
- Constituent Precipitation From a Supersaturated Solution



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## CLOUDINESS MUST BE RECORDED

- **Urine turbidity may be caused by a number of factors.**
  - Urine turns cloudy when soluble constituents become insoluble due to pH changes in the urine, temperature changes, and/or because of constituent precipitation from a supersaturated solution.
  - If the specimen is alkaline, cloudiness may result from the presence of precipitated phosphates or carbonates. This turbidity should disappear when the urine is acidified.
  - The presence of urates in acid urine often causes a pinkish turbidity which is usually not diagnostically significant.
    - Urates disappear with heating at 37°C.
  - In certain other disease states, cloudiness may be due to blood, other cells, mucus, or crystalline deposits.
  - When observing urine transparency, the examiner must remember that any specimen which is exposed to room temperature for more than an hour or two may become cloudy due to bacterial growth and/or precipitation of amorphous phosphates or urates.

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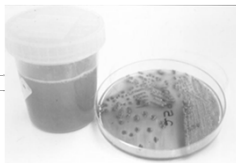
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## Cause of Cloudiness



- Abnormal cloudiness in fresh urine may accompany urinary tract infections. This turbidity may be caused by one or several factors.
- In urinary tract infections, bacteria from the infected sites appear in the urine and reduce the urea to ammonia, creating an alkaline urine, which enhances the precipitation of alkaline phosphates.
- In addition, the turbidity may be caused by the presence of excessive white blood cells and/or bacteria.

□ 2. State two possible causes for urine turbidity in a sample that is not fresh.

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## White Foam

- White foam = presence of albumin
- Possible renal disease



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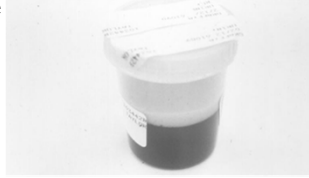
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## Yellow Foam

- **Yellow foam = presence of bilirubin or pyridium**
- **Potential liver disease**



- 3. Identify possible causes for abnormal urinary foam.

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- **URINE ODOR** is another physical property that is not routinely recorded.
- If the odor is significantly altered, however, it should be noted. Normal urine is characteristically aromatic.
- This odor is attributed primarily to the small amounts of esters that are constantly excreted by the kidneys.
- There is currently no sophisticated technique to record the extent of odor abnormality.
  - Nevertheless, the mere fact that the odor is abnormal may be significant.
- This point is exemplified by the fact that phenylketonuria was initially discovered in Oslo, Norway by a mother who noticed that the odor of her mentally retarded children's urine was unusual.
  - These children were subsequently diagnosed as having a genetic defect, today known as phenylketonuria.

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## Odor



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## Words Commonly Used In Reference to Urine Odor

- Pungent
- Fruity or sweet
- Foul-smelling
- Putrid
- Ammoniacal

4. Identify the odors commonly associated with abnormal urine.

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- Urine volume is the final physical property that may or may not be measured in a routine urinalysis.
- When the physician requires volume determination, a graduated cylinder or some other measuring container is used.
- A measurement of urine volume may be fairly critical in 1-hour clearance studies.
- When such a study is undertaken, the patient must be sure to empty the bladder completely during each voiding.
- Measurement of 24-hour urine volume is usually less critical.
- Normally, it can be made with no greater accuracy requirement than 20 to 50 ml.

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## Volume Terminology

- Oliguria
  - A decrease in the normal daily urine volume
- Anuria
  - Cessation of urine flow
- Nocturia
  - Increase in nocturnal excretion
- Polyuria
  - Increase in daily urine volume
- Polydipsia
  - Increase ingestion of water.

5. Differentiate between the abnormalities of urine volume.

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## Specific Gravity

- Urine Specific gravity (SG) reflects the functional ability of the kidney to concentrate or dilute urine.
  - With healthy kidneys the SG is normally directly proportional to urine volume.
- Definition: SG is a measure of the weight of a substance compared with an equal volume of pure solute-free water.
  - The SG of pure water = 1.000
- The SG of urine is a measure of the density of the urine based on the number and size of particles present.
- The physiological range of urine SG ranges between 1.003 – 1.035.
- The only cause of SG > 1.035 is the presence of radiographic dyes present in the urine.

□ 6. Define specific gravity of urine.

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## Refractory Index

- Refractory Index (RI) is very similar to SG and is defined as the ratio of the velocity of light in air to the velocity of light in a solution.
  - The velocity of light in a solution (ie, a urine) depends on the number of solutes dissolved in the solution and determines the angle at which light passes through the urine.
- For most urines, the RI is equal to the SG.
- There are 3 basic ways to measure the SG of urine;
  - 1. The Urinometer; rarely used anymore but compares SG to volume displacement of the urine sample in a graduated cylinder.
  - 2. A Refractometer; directly measures the RI of a urine.
  - 3. Reagent chemical dip strips; measure the concentration of ions in the urine to give an indirect measure of SG.

□ 7. Define refractive index of a solution.

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## SG in Disease

- A diseased kidney may have lost the ability to concentrate or dilute urine.
  - Isosthenuria can result in a failing kidney and is a constant fixed SG at 1.010 which is similar to the initial plasma filtrate concentration of the glomerulus.
- The measurement of SG is also important in diagnosing a patient with diabetes.

□ 8. Identify possible causes of abnormal specific gravities of urine.

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## Diabetes Mellitus vs. Diabetes Insipidus

- **Diabetes mellitus**
  - Caused by defect either in the pancreatic production of insulin or in the function of insulin that results in an increased body glucose concentration
  - Kidneys do not reabsorb excess glucose, necessitating the excretion of increased amounts of water to remove the dissolved glucose
  - Although appearing to be dilute, a urine specimen from a patient with diabetes mellitus will have a high specific gravity because of the increase glucose content
- **Diabetes Insipidus**
  - Result from a decrease in the production or function of antidiuretic hormones; thus the water necessary for adequate body hydration is not reabsorbed from the plasma filtrate
  - Urine will be truly dilute and will have a low specific gravity
- **Fluid loss in both diseases is compensated for by increased ingestion of water, producing an even greater urine volume. Polyuria accompanied by increased fluid intake is often the first symptom of either disease.**

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## Diabetes Mellitus vs. Diabetes Insipidus

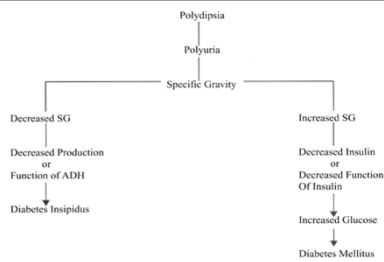


FIGURE 3-4 Differentiation between diabetes mellitus and diabetes insipidus.

- **9. Compare and contrast Diabetes Mellitus with Diabetes Insipidus.**

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