ETHIOPIAN PHARMACEUTICAL ASSOCIATION
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An Independent review of
Pharmaceutical News and Issues

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Ethiopian Pharmaceutical Association (EPA)

In this Issue

Message from the president of EPA

Dear EPA Members,

About 30 pharmacisis who graduated from the then newly established home based school of pharmacy and few others who graduated from foreign universities took the initiative to start the Ethiopian Pharmaceutical Association (EPA) in the early 1970's. The number of pharmacists trained under different conditions and practicing in the country is now over 2000. Since the start of pharmacy higher education in Ethiopia some 50 years back, the curriculum has been steadily changing to go together with the advances in pharmaceutical sciences and the growing role of pharmacists in the health care delivery system.

To keep the knowledge of practicing pharmacists in line with the changing curriculum and type of pharmaceutical services expected of professionals, the Ethiopian Pharmaceutical Association has been organizing series of workshops, continuing education sessions and publication of educational materials such as pharma news, and pharma-forum. The knowledge gap filling efforts through publications and face to face activities has been made possible through the continued support of many stakeholders. I take this opportunity to thank all those who helped the association in achieving its aim of updating its members. I also wish to thank members of the editorial committee for a job well done.

I invite all EPA members and practicing pharmacists to make an appropriate use of the materials in this publication.

Ariaya Hymete (PhD)
Preesident, EPA

Message from Editors

One of the communication media between the Ethiopian pharmacy association and its members is Pharma Forum. The Editorial committee is devoted to give pharmacy related information through publications like pharma news and pharma forum bulletin. This year we were able to publish two issues of both until now.

The hard copies of those publications were distributed to the members by the EPA office and the editorial committee forwarded the soft copies via E-mail addresses of members.

The editorial committee would like to use this opportunity to thank those members who made contribution in this publication and our esteemed readers. We would also like to invite all our colleagues in pharmacy to make their effort in the future in the form of articles submission, suggestions on the issues and to give their ideas and comments that will help us to improve the bulletins.

We hope to hear from you.

Pharma Forum Editorial Committee

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1. News

Antimicrobial Resistance Day Marked on 15 June 2005 by the Ethiopian Pharmaceutical Association and Ethiopian Pharmaceutical Students' Association in collaboration with the Federal Ministry of Health, Food Medicine and Healthcare Administration and Control Authority of Ethiopia, Pharmaceutical Fund and Supply Agency, USAID/SIAPS and WHO

Debre Damo Hotel, Addis Ababa, Ethiopia

The Ethiopian Pharmaceutical Association together with Ethiopian pharmaceutical students Association celebrates Antimicrobial Resistance day on June 15. The collaborators were MOH, FMHACA, PFSA, USAID/SIAPS, WHO, different pharmaceutical industries, institutions and hospitals. Please inser pictures and more news about the presentations.

The workshop was officially opened by Mr Mengsteab Weldearegay, deputy director general of the Food Medicine and Healthcare Administration and Control Authority of Ethiopa. Mr Mengsteab stressd that antimicrobial resistance is currently a serious and hot issue because of the economic and health impacts that it ensues. He pointed out that if the issue is not properly addressed now, it is evident that we will be left with no treatment options in the near future. Finally he concluded by recommending a concerted effort by health professionals and the general public in the fight against antimicrobial resistance to significantly reduce the burden of AMR in the country.

The epedemology of Antimicrobial Resistance was presented by Dr Ephrem Engdawork. He presented the national and global epidemiology of antimicrobial resistance (AMR), the concepts of AMR, mechanisms of resistance development to antimicrobials, the underlying factors and the main consequences Finally he described the strategies to curb the emergence of antimicrobial resistance.

Mr Seid Ali. gave the presentation on Economic and Health impacts of AMR. He described the impact of Resistance on Antibiotic use, incremental cost of treatment practice due antimicrobials, the escalating costs of treatment as 1st line antibiotics lose effectiveness, the burden of morbidity and mortality among patients due to AMR, treatment failure caused by antimicrobial resistance, the increased disease incidence because of antimicrobial resistance and the *macroeconomic impact of AMR*. Finally he described AMR as a threat to health security, and damages trade and economies.

Proposed solutions by participants and panelists

- A lot has to be done on professionals ethics to reduce the prevalence of AMR
- Regulatory authority has to be more strict and punish unethical practitioners
- Quality of pharmacy training particularly in private colleges has to be given a great attention.
- AMR awareness creation programs have to be scaled up nationwide to bring all citizens and professionals to the same page with regard to AMR.
- Patient, prescriber and dispenser have to work together to solve the problem.
- Prescriber- dispenser trust has also a positive impact on the fight against AMR.
- Prescribers do not know laboratory principle and hence the course has to be given to the to avoid wrong interpretation of results which leads to improper use drugs which in turn leads to drug resistance.
- Professionals have to avoid double standard while they work in public and private health facilities
- Westerns are doing research for their patients, why do not do for ours?
- The parallel (illegal) market is swallowing the legal one. Hence a solution has to be sought
- Qualifying exam has to be given to professionals

- Let us sort out drugs which are not imported by the private importers and advocate to be imported by PFSA
- Let us work for the regulatory authority to be strict
- Let us integrate this program with medicine students

2. Current Issues

Health Regulatory Information Center (HRIC) Established by Ethiopian, Food, Medicine, Healthcare Administration and Control Authority

Contributed by Aida Arefayne

The Food, Medicine and Health care Administration and Control Authority of Ethiopia (FMHACA) has a mission to protect the public health by ensuring the safety and quality of food , quality , safety & efficacy of medicine and health services through registration, inspection and licensing of health professionals, alternative or complementary medical practitioners, medicines as well as food establishments and health care institutions. Besides it regulates provision of up-to-date information while promoting rational medicine use.

Therefore, to protect the public health, it is critical to assure the provision of continuous and up-to-date regulatory information. Rational use of drugs requires access to objective drug information. Health professionals need a good understanding of the therapeutic action, the possible hazards of drugs they prescribe. Hence, the public need to know the do's and don'ts and the general principles of drug use and storage. Because of this it has been shown from field experience that, the gap of information exchange between the health professionals and the Authority, among health professionals and the public and between the public and the Authority are far from being narrowed.

It is believed that the health regulatory information center will have a significant role in solving the above mentioned problem. Establishment of health regulatory information centers benefits regions where delivery of regulatory health information are affected by distance and lack of local information sources.

The Health Regulatory Information Center provides any regulatory and related information concerning food safety and quality, also safety, quality and efficacy of medicines and their rational use, practices of health care providers and alternative or complementary and traditional

medical practitioners. This will be done by receiving enquiries via 8482 free telephone line, fax, e-mail, postal delivery or by walk-in- methods.. This line is also used to receive tip offs in relation to health issues. The center will be run by a well trained team with a professional composition of health officer, pharmacists and food technologist. The team uses standardized procedures and current and reliable reference materials in order to provide factual information to enquirers.

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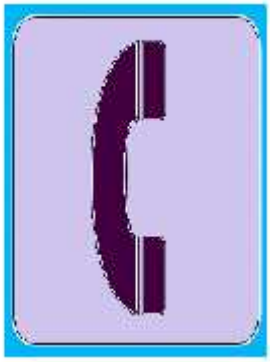

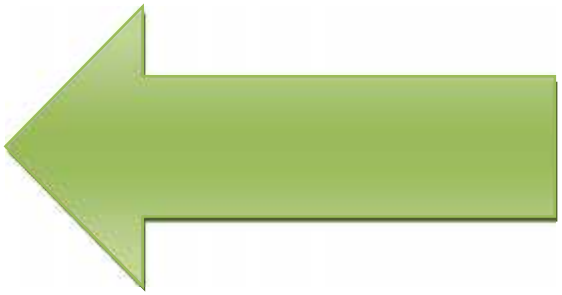

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Food, Medicine and Health Care Administration and Control Authority of Ethiopia
(FMHACA)

Poster for Health Regulatory Information Center

3. Pharmacy practice

ASHP Statement on the Role of the Medication Safety Leader

The American Society of Health-System Pharmacists (ASHP) believes that medication safety is a fundamental responsibility of all members of the profession of pharmacy.

Hospital and health-system pharmacists have improved pharmacy systems over the past 60 years to reduce the risk that medications could harm patients. Medication safety was at the heart of such historic innovations in pharmacy services as unit-dose systems, decentralized clinical pharmacy services, and intravenous admixture services. The crucial leadership role of pharmacists in medication safety has been summarized as follows: Pharmacy leadership is the core of a successful medication safety program. Pharmacists can play an important role as leaders to reduce patient safety risks, optimize the safe function of medication management systems, and align pharmacy services with national initiatives that measure and reward quality performance.

The medication safety leader (also referred to as a medication safety officer, medication safety manager, or medication safety coordinator, among other titles) is a clinical practitioner designated by an organization to serve as the authoritative expert in safe medication use. Traditionally, the medication safety leader has been a clinical pharmacist or manager within the department of pharmacy, although the position is sometimes filled by a nurse or physician. The medication safety leader may report to the organization's risk management department, its office of quality, or to a senior administrator (e.g., hospital vice president, chief medical officer, or chief executive officer). Reporting outside the pharmacy department may foster interdisciplinary approaches to medication safety. Medication safety leadership may

encompass a single hospital or a group of organizations (e.g., spanning a health system or at a corporate level of a larger organization). Regardless of organization size, it is critical that the fundamentals of medication safety are the central component of the medication safety leader's job function. Although medication safety leaders may have other responsibilities in smaller institutions, medication safety should remain their core responsibility, and they must be strategically positioned and empowered to lead efforts to reduce the risks of medication use.

The scope of a medication safety leader's responsibilities reaches into every corner of the health care system and encompasses many roles, such as educator, preceptor, mentor, detective, compliance officer, risk manager, engineer, accountant, statistician, computer analyst, and counselor. A typical day may include attending safety rounds, precepting pharmacy students and residents, writing policies, reviewing adverse drug reactions and medication error reports, developing error-prevention strategies, leading process improvement teams, implementing action items, reviewing smart pump libraries, ensuring safe use of automated medication dispensing systems, assessing the safety of replacement drug products during drug shortages, orienting new professional staff, assisting with medication reconciliation, conducting tracers to ensure compliance with accreditation standards, working with practitioners to resolve acute events, attending medical staff meetings, or educating the corporate board on the culture of safety. Most medication safety leaders quickly find themselves involved in many projects and committees as well as serving as the contact person when nursing, pharmacy, or medical staff have questions or problems. The medication safety leader needs a solid understanding of patient safety principles and must have the ability to prioritize work activities to have a positive impact on the safety of patient care. The medication safety leader should strive to acquire additional skills crucial to success, such as presentation and communications skills, as well as expertise in process improvement methodologies.

Responsibilities of Medication Safety Leaders

Medication safety leaders must collaborate with all types of health care professionals, support staff, and management, and consider all components of the

medication-use process in both inpatient and clinic settings in order to improve medication safety. The medication safety leader's role includes responsibility for leadership, medication safety expertise, influencing practice change, research, and education.

Conclusion

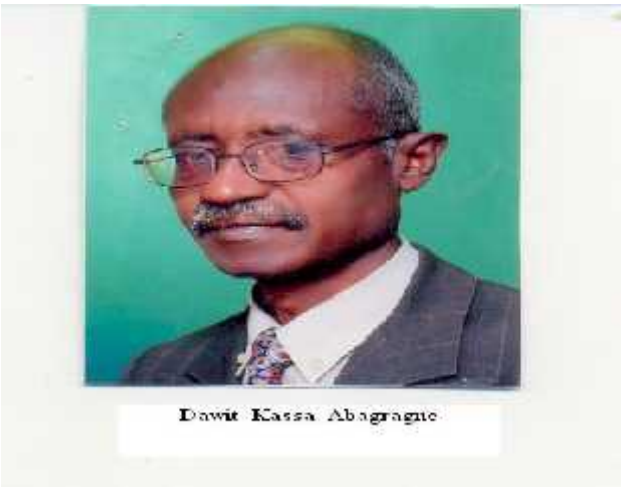
ASHP believes that pharmacists, as experts on medication use, are uniquely qualified to serve as medication safety leaders. Medication safety leaders articulate the vision and direction for improving the safety of the medication-use system to prevent patient harm. The medication safety leader's role includes responsibility for leadership through direction and prioritization, medication safety expertise, influencing practice change, research, and education. Through analysis of the organization's medication safety data and literature review, the medication safety leader will lead development and implementation of proactive error-prevention strategies and build a culture of safety across the organization

Approved by the ASHP Board of Directors on April 13, 2012, and by the ASHP House of Delegates on June 10, 2012. Developed through the ASHP Section of Inpatient Care Practitioners Section

Obituary

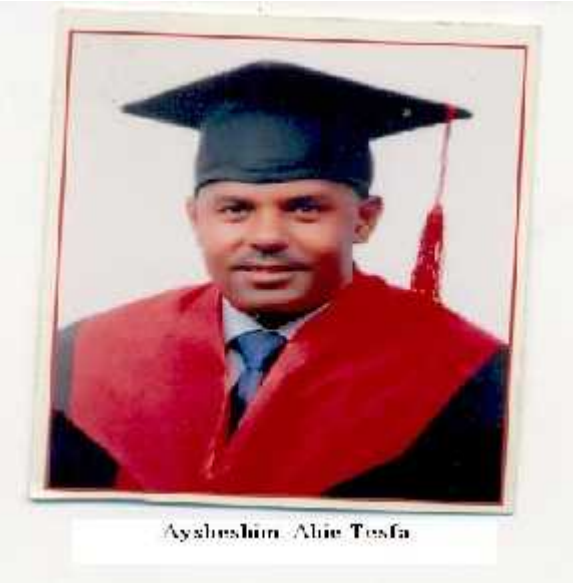
EPA deeply regrets the loss of its members this year and wishes strength to their families and friends.

May their soul rest in peace in Heaven



Dawit Kassa Abagragie

Dr. Wubeamlak Yenet Ayen



Ayshesihm Ahie Tesfa

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4. Continuing Education

Hospital Acquired Infection

Compiled by Bethelehem Gulelat

A nosocomial infection also called "hospital acquired infection" can be defined as: an infection acquired in hospital by a patient who was admitted for a reason other than that infection. It is an infection occurring in a patient, in a hospital or other health care facility in whom the infection was not present or incubating at the time of admission. This includes infections acquired in the hospital but appearing after discharge, and also occupational infections among staff of the facility.

Many factors promote infection among hospitalized patients are decreased immunity among patients; the increasing variety of medical procedures and invasive techniques creating potential routes of infection; the transmission of drug-resistant bacteria among crowded hospital populations, and poor infection control practices may facilitate transmission.

Frequency of infection

Nosocomial infections occur worldwide and affect both developed and resource-poor countries. Infections acquired in health care settings are among the major causes of death and increased morbidity among hospitalized patients. They are a significant burden both for the patient and for public health. A prevalence survey conducted under the auspices of WHO in 55 hospitals of 14 countries representing 4 WHO Regions (Europe, Eastern Mediterranean, South-East Asia and Western Pacific) showed an average of 8.7% of hospital patients had nosocomial infections. At any time, over 1.4 million people worldwide suffer from infectious complications acquired in hospital. The highest frequencies of nosocomial infections were reported from hospitals in the Eastern Mediterranean and South-East Asia Regions (11.8 and 10.0% respectively), with a prevalence of 7.7 and 9.0% respectively in the European and Western Pacific Regions. The most frequent nosocomial infections are infections of surgical wounds, urinary tract infections and lower respiratory tract

infections. Studies by the WHO and other scientists, have also shown that the highest prevalence of nosocomial infections occurs in intensive care units and in acute surgical and orthopaedic wards. Infection rates are higher among patients with increased susceptibility because of old age, underlying disease, or chemotherapy.

Impact of nosocomial infections

Hospital-acquired infections add to functional disability and emotional stress of the patient and, in some cases, lead to disabling conditions that reduce the quality of life. Nosocomial infections are also one of the leading causes of death.

Hospital-acquired infections add to the imbalance between resource allocation for primary and secondary health care by diverting scarce funds to the management of potentially preventable conditions. The advancing age of patients admitted to health care settings, the greater prevalence of chronic diseases among admitted patients, and the increased use of diagnostic and therapeutic procedures which affect the host defences will provide continuing pressure on nosocomial infections in the future. Organisms causing nosocomial infections can be transmitted to the community through discharged patients, staff, and visitors. If organisms are multi resistant, they may cause significant disease in the community.

The global market for healthcare-acquired infection treatments were nearly $16 billion in year 2010. And it is forecasted to reach $25.6 billion by 2016. Markets for infection control devices and products were $8.2 billion in the year 2010.

Prevention of nosocomial infections is the responsibility of all individuals and services providing health care. Everyone must work cooperatively to reduce the risk of infection for patients and staff.

Role of the hospital pharmacist

The hospital pharmacist is responsible for:

- ✓ obtaining, storing and distributing pharmaceutical preparations using practices which limit potential transmission of infectious agents to patients
- ✓ dispensing anti-infectious drugs and maintaining relevant records (potency, incompatibility, conditions of storage and deterioration)

- ✓ obtaining and storing vaccines or sera, and making them available as appropriate
- ✓ maintaining records of antibiotics distributed to the medical departments
- ✓ providing the Antimicrobial Use Committee and Infection Control Committee with summary reports and trends of antimicrobial use
- ✓ having available the following information on disinfectants, antiseptics and other anti-infectious agents:
- ✓ active properties in relation to concentration, temperature, length of action, antibiotic spectrum
- ✓ toxic properties including sensitization or irritation of the skin and mucosa
- ✓ substances that are incompatible with antibiotics or reduce their potency
- ✓ physical conditions which unfavorably affect potency during storage: temperature, light, humidity
- ✓ harmful effects on materials.

The hospital pharmacist may also participate in the hospital sterilization and disinfection practices through:

- ✓ participation in development of guidelines for antiseptics, disinfectants, and products used for washing and disinfecting the hands
- ✓ participation in guideline development for use of equipment and patient materials
- ✓ participation in quality control of techniques used to sterilize equipment in the hospital including selection of sterilization equipment (type of appliances) and monitoring.

Common Laboratory Tests and Their Interpretation for Pharmacists.

Contributed by Bethelehem Gulelat Reference: Jima university training manual of clinical pharmacy

PART One

Results of laboratory test may aid in:

- Discovering occult disease
- Preventing irreparable damage (e.g., phenylketonuria)
- Early diagnosis after onset of signs or symptoms
- Differential diagnosis of various possible diseases
- Determining the stage of the disease
- Estimating the activity of the disease
- Detecting the recurrence of the disease
- Monitoring the effect of therapy
- Genetic counseling in familial conditions
- Medico-legal problems, such as paternity suits

Note the following when interpreting laboratory data

- Normal values may vary from laboratory to laboratory, depending on techniques and reagents used. And thus references for that specific institution should be used. Information obtained from the literature should only serve as a general guide.
- Normal values may also vary depending on the patient's age, gender, weight, height, and other factors.
- False positive or false negative results can result due to laboratory error.
- Potential causes of laboratory error include technical error, improper calculation, inadequate specimen, incorrect sample timing, improper sample preservation, food substances affecting specimen, or medication interference with laboratory tests.

- If laboratory error is suspected, the test should be repeated.
- Always treat the patient, not the laboratory value!

The purpose is to enable pharmacists to have a good understanding of the common laboratory tests and their interpretation. Brief description of the tests is given for each test along with conditions associated with an increase and decrease in the test value. Please note that the reference ranges given as normal values in the list here are provided only for informational purpose and may not be exactly the same with what other institution uses. Slight differences might exist due to differences in reagents and instruments used in different institutions. Therefore it is advised to refer to institution's normal ranges and use them accordingly when trying to interpret abnormal laboratory values.

It very important to note that the role of pharmacist during collection and interpretation of patient specific laboratory values is to identify medication related problems and monitor therapy NOT for making a DIAGNOSIS !!!

Often, laboratory tests are ordered in groups usually based on systems. Common examples include liver function tests (LFTs), renal function tests (RFTs), basic metabolic panel, thyroid panel, lipid panel, etc. Below there are interpretations of common laboratory tests.

➢ Complete blood count (CBC)

Also called Full Blood Count (FBC)

The CBC is an extremely common laboratory test that provides values for hemoglobin (Hgb), hematocrit (Hct), white blood cells (WBCs), red blood cells (RBCs), and red cell indices—mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC). In addition, some laboratories may also include platelet count and WBC differential.

Hemoglobin (Hgb)

Normal range

Male 14-18 g/dL	SI 8.7-11.2 mmol/L
Female 12-16 g/dL	SI 7.4-9.9 mmol/L

Description

Hgb is found in RBCs and helps carry oxygen to the tissues in the body. Hemoglobin level is a direct indicator of the oxygen-carrying capacity of the blood. Different factors such as high altitudes, extreme exercise (such as in the case of endurance athletics), and pulmonary conditions may result variations in hemoglobin values.

Clinical Significance

- ✓ *Increased Hemoglobin*

Hemoglobin values may be increased in diseases such as polycythemia vera and chronic obstructive lung disease. Hgb may also be increased in chronic smokers and individuals who engage in regular vigorous exercise or live at high altitudes.

- ✓ *Decreased Hemoglobin*

Hemoglobin is decreased in anemia of all types, particularly iron deficiency anemia. Hgb is also reduced with blood loss, hemolysis, pregnancy, fluid replacement, or increased fluid intake.

Red Blood Cell Count or Erythrocyte Count

Normal Range

Male 4.2-5.9 × 10^6 cells/mm3	SI 4.2-5.9 × 10^{12} cells/L
Female 3.5-5.5 × 10^6 cells/mm3	SI 3.5-5.5 × 10^{12} cells/L

Description

Red blood cells (RBCs) are produced in the bone marrow. They are released into the systemic circulation and serve to transport oxygen from the lungs to the body tissues. After circulating for a life span of approximately 120 days, the RBCs are cleared by the reticuloendothelial system. The actual amount of RBCs per unit of blood is the RBC count.

Clinical Significance

- ✓ *Increased RBCs*

Increased red blood cell counts (*erythrocytosis)* are associated with polycythemia vera, high altitudes, and strenuous exercise.

- ✓ *Decreased RBCs*

Red blood cell counts are decreased in various types of anemias, lymphomas, and leukemia. After puberty, females have lower RBCs and Hgb due to menstrual bleeding.

White Blood Cell or Leukocyte Count

Normal Range

3,200-11,300 cells/mm3 SI 3.2-11.3 × 10^9 cells/L

Description

The WBC count represents the total number of WBCs in a given volume of blood. Mature white blood cells exist in five forms: neutrophils, lymphocytes, monocytes, eosinophils, and basophils. A WBC count with differential provides a breakdown of the percentage of each type of WBC.

Clinical Significance

- ✓ *Increased WBCs*

An increase in WBC count is referred to as *leukocytosis*. Leukocytosis may be caused by infection, leukemia, trauma, thyroid storm, and use of cathecolamines and short term corticosteroids.

Emotion, stress, and seizures may also increase WBC count. When WBC count is greaterthan 50,000 cells/mm3, false elevations in Hgb and MCH can occur.

- ✓ *Decreased WBCs*

A decrease in WBC count is referred to as *leukopenia*. Decreased WBCs may be seen in viral infection, aplastic anemia, and in bone marrow depression caused by the use of chemotherapy or anticonvulsants.

Lymphocytes

Normal Range

20%-40% SI 0.20-0.40

Description

Lymphocytes are the second most common type of circulating WBCs. They are important in the immune response to foreign antigens.

Clinical Significance

- ✓ Increased Lymphocytes

An elevated lymphocyte count is called *lymphocytosis*. Lymphocytes may be elevated in hepatitis, mononucleosis, chickenpox, herpes simplex, herpes zoster, and other viral infections. Some bacterial infections (eg, syphilis, brucellosis), leukemia, and multiple myeloma are also associated with lymphocytosis.

- ✓ Decreased Lymphocytes

A decreased lymphocyte count is referred to as *lymphopenia*. Lymphopenia may result from acute infections, burns, trauma, lupus, HIV, and lymphoma.

Platelets

Normal Range

150,000-450,000/µL SI 150-450 × 10^9/L

Description

Platelets are a critical element in blood clot formation. The risk of bleeding is low unless platelets fall below 20,000 to 50,000/µL.

Clinical Significance

- ✓ *Increased Platelets*

Increased platelets (*thrombocytosis, thrombocythemia*) may be caused by infection, malignancies, splenectomy, chronic inflammatory disorders (eg, rheumatoid arthritis), polycythemia vera, hemorrhage, iron deficiency anemia, or myeloid metaplasia.

- ✓ *Decreased Platelets*

Decreased platelet counts (*thrombocytopenia*) may occur in autoimmune disorders such as idiopathic thrombocytopenic purpura (ITP) and also with aplastic anemia, radiation, chemotherapy, space-occupying lesion in the bone marrow, bacterial or viral infections, and use of heparin or valproic acid.

➢ Urin-analysis (UA)

Description

Urinalysis is a useful laboratory test that enables the clinician to identify patients with renal disorders, as well as some non-renal disorders. Components of the UA are gross appearance, pH, specific gravity (SG), protein, glucose, ketones, blood, bilirubin, leukocyte esterase, and nitrites.

Appearance and Color

On visual examination, the normal urine color should range from clear to dark yellow. Some cloudiness is normal and may be caused by phosphates or urates. The presence of WBCs, RBCs, or bacteria may cause abnormal urine cloudiness.

Abnormal urine colors include the following:

- *Red-orange* may be caused by presence of myoglobin (from muscle breakdown from seizures, cocaine, or injuries), hemoglobin, medications (rifampin, phenazopyridine, phenolphthalein, phenothiazines), or foods (beets, carrots).
- *Blue-green* may result from administration of amitriptyline or methylene blue, or pseudomonal infection.
- *Brown-black* may be associated with presence of myoglobin or porphyrins from porphyria or sickle cell crisis, phenol poisoning, or rhubarb ingestion.

Specific Gravity (SG)

Normal Range

Normal values for SG are from 1.005 to 1.025.

Description

Specific gravity is an indication of the ability of the kidney to concentrate urine. Unusually low specific gravity would suggest that the kidneys are not able to concentrate urine appropriately.

Clinical Significance

Low Specific Gravity

Low specific gravity (*hyposthenuria*) may occur in chronic renal failure or diabetes insipidus.

High Specific Gravity

High specific gravity (*hypersthenuria*) may be associated with dehydration, excretion of radiologic contrast media, congestive heart failure (CHF), toxemia of pregnancy, or syndrome of inappropriate anti-diuretic hormone (SIADH). In addition, increased excretion of glucose or protein greater than 2 g/day may also increase urine specific gravity.

pH

Normal Range

Normal values for pH are from 4.5 to 8.

Description

Normal urine specimens are acidic. The average pH value is approximately 6.

Clinical Significance

Alkaline urine may be found in certain urinary tract infections (UTIs caused by urea-splitting organisms *Proteus, Pseudomonas*), renal tubular acidosis, and with use of acetazolamide or thiazide diuretics.

Acidic urine may be caused by metabolic acidosis, pyrexia, or diabetic ketosis.

Urine Protein

Normal Range

Normal values for protein are from 0 (< 30 mg/dL) to 1 + (30-100 mg/dL).

Description

Trace protein in the urine is a common clinical finding and often has no clinical significance.

Clinical Significance

Repeated positive tests or *proteinuria* of greater than 150 mg/dL may be a marker of renal disease.

Causes of protein in the urine include diabetic nephropathy, interstitial nephritis, hypertension, fever, exercise, pyelonephritis, multiple myeloma, lupus, and severe CHF.

Glucose and Ketones

Normal Range

Both glucose and ketones should be negative.

Description

Glucose begins to spill into urine (*glucosuria*) when serum blood glucose is greater than 180 mg/dL.

Clinical Significance

Glucose in the urine suggests diabetes mellitus or, in a known diabetic, suggests the need for improved glucose control. Glucose in the urine may also be associated with Cushing disease, pancreatitis, and use of thiazide diuretics, steroids, or oral contraceptives.

Excess amounts of ketones form when carbohydrate metabolism is altered. Diabetic ketoacidosis (DKA), starvation, high-protein/low-carbohydrate diets, and alcoholism may produce ketones in the urine.

Blood in the Urine

Normal Range

The normal value should be negative to trace.

Description

Blood in the urine (*hematuria*) may indicate urinary tract damage.

Clinical Significance

Common causes of hematuria are infection, nephrolithiasis, malignancies, and benign prostatic hypertrophy (BPH).

False-positive results for blood in the urine may occur when povidone iodine is used as a cleansing agent before urine specimen collection. False-negative results may occur in patients taking high doses of vitamin C or ascorbic acid.

Bilirubin

Normal Range

The normal value should be from zero to trace.

Description

Bilirubin in the urine usually produces a dark yellow or brown color. It appears in the urine before other signs of liver dysfunction appear.

Clinical Significance

Bilirubin in the urine may be associated with liver disease (eg, hepatitis), septicemia, or obstructive biliary tract disease.

Phenazopyridine or phenothiazines may cause a false-positive result for bilirubin in the urine.

➢ Electrolytes and Blood Chemistry

Electrolytes and blood chemistries are usually the first set of laboratory tests ordered upon initial patient presentation. Depending on the institution, these tests may be ordered using different acronyms. A basic metabolic panel (BMP) includes sodium, potassium, chloride, carbon dioxide (CO2), glucose, blood urea nitrogen (BUN), and creatinine.

Sodium

Normal Range

135-147 mEq/L SI 135-147 mmol/L

Description

Sodium (Na+) is the most prevalent cation in the extracellular fluid. Sodium is important in regulating serum osmolality, fluid balance, and acid-base balance.

In addition, sodium also assists in maintaining the electric potential necessary for transmission of nerve impulses.

Clinical Significance

- ✓ *Increased Sodium (Hypernatremia)*

Increased sodium (*hypernatremia*) may result from increased sodium intake or increased fluid loss. thirst is the primary mechanism to prevent hypernatremia,

and, therefore, hypernatremia usually occurs in individuals who are unable to obtain adequate fluid intake. Fluid loss from gastroenteritis, diabetes insipidus, Cushing disease, hyperaldosteronism, and administration of hypertonic saline solution are causes of hypernatremia.

- ✓ *Decreased Sodium (Hyponatremia)*

Decreased sodium (*hyponatremia*) may be caused by a decrease in total body sodium but is more commonly attributed to excess accumulation of body water (*dilutional hyponatremia*). Common causes of dilutional hyponatremia include CHF, cirrhosis, severe burns, chronic renal failure, and nephrotic syndrome. Sodium depletion may also be seen in SIADH, cystic fibrosis, mineralocorticoid deficiency, or fluid replacement with solutions that do not contain sodium. SIADH may be associated with disease states such as cancer or the use of medications, including chlorpropamide, thiazide diuretics, and carbamazepine.

Potassium

Normal Range

3.5-5.2 meq/L SI 3.5-5.2 mmol/L

Description

Potassium (K+) is the main intracellular cation. Serum concentrations of potassium are not always an accurate indicator of potassium levels because potassium is an intracellular ion. Potassium plays a key role in many bodily functions, including regulation of nerve excitability, acid-base balance, and muscle function. Cardiac function and neuromuscular function can be significantly affected by either an increase or decrease in potassium levels.

Clinical Significance

- ✓ *Increased Potassium (Hypernatremia)*

Causes of increased potassium (*hyperkalemia*) include metabolic or respiratory acidosis, renal failure, Addison disease, dehydration, and massive cell damage from burns, injuries, and surgery. Medications such as angiotensin enzyme converting (ACE) inhibitors, angiotensin receptor blockers (ARBs), potassium supplements, potassium-sparing diuretics, and oral contraceptives containing drospirenone are also contributing factors to hyperkalemia. It is important to remember that a high

potassium value may be reported if the specimen was hemolyzed when the laboratory test was performed.

- ✓ *Decreased Potassium (Hypokalemia)*

Causes of decreased potassium (*hypokalemia*) include severe diarrhea and/or vomiting, respiratory alkalosis, hyperaldosteronism, Cushing disease, alcoholism, and use of amphotericin B or thiazide, loop, or osmotic diuretics.

If a patient is hypokalemic and potassium supplements have not helped to correct the low potassium, check to see if the magnesium is also low.

Decreased potassium is difficult to correct while magnesium remains low. (Generally magnesium has to be corrected before attempting to correct potassium)

Chloride

Normal Range

95-106 mEq/L SI 95-106 mmol/L

Description

Chloride is the principal extracellular anion. Chloride primarily serves a passive role in the maintenance of fluid balance and acid-base balance. Serum chloride values are useful in identifying fluid or acid-base balance disorders.

Clinical Significance

- ✓ *Increased Chloride (Hyperchloremia)*

Increased chloride (*hyperchloremia*) may be seen in metabolic acidosis, respiratory alkalosis, dehydration, diabetes insipidus, eclampsia, and renal disorders.

- ✓ *Decreased Chloride (Hypochloremia)*

Decreased chloride (*hypochloremia*) may be associated with prolonged vomiting, gastric suctioning, metabolic alkalosis, CHF, SIADH, Addison disease, or use of acid suppressants (H2 blockers and proton pump inhibitors [PPIs]).

Glucose

Normal Range

Fasting 70-110 mg/dL SI 3.9-6.1 mmol/L

Description

Glucose is an important energy source for most cellular functions. Blood glucose

regulation is achieved through a complex set of mechanisms that involves insulin, glucagon, cortisol, epinephrine, and other hormones.

Clinical Significance

- ✓ *Increased Glucose (Hyperglycemia)*

The most common cause of increased glucose (*hyperglycemia*) is diabetes mellitus. A fasting blood glucose greater than 126 mg/dL on two occasions or a random blood glucose greater than 200 mg/dL (along with symptoms of diabetes) on two occasions is consistent with a diagnosis of diabetes mellitus. Patients are diagnosed with impaired fasting glucose (IFG) if blood glucose levels are 100 to 125 mg/dL when fasting. Impaired glucose tolerance (IGT) is defined as a random glucose level greater than or equal to 140 mg/dL but less than 200 mg/dL. Both IFG and IGT are suggestive of prediabetes. Other causes of hyperglycemia include Cushing disease, sepsis, pancreatitis, shock, trauma, myocardial infarction, and use of corticosteroids or niacin.

- ✓ *Decreased Blood Glucose (Hypoglycemia)*

Decreased blood glucose (*hypoglycemia*) may result from missing a meal, oral hypoglycemic agents, insulin overdose, or Addison disease.

Blood Urea Nitrogen

Normal Range

6-20 mg/dL SI 2.1-7.1 mmol/L

Description

Urea nitrogen is an end product of protein catabolism. It is produced in the liver, transported in the blood, and cleared by the kidneys. BUN concentration serves as a marker of renal function.

Clinical Significance

- ✓ *Increased BUN*

Increased BUN (*azotemia*) may be associated with acute or chronic renal failure, CHF, gastrointestinal bleeding (gut flora metabolizes blood to ammonia and urea

nitrogen), high-protein diet, shock, dehydration, anti-anabolic and nephrotoxic medications.

- ✓ *Decreased BUN*

Decreased BUN is seen in liver failure because of inability of the liver to synthesize urea, and in disease states such as SIADH and acromegaly.

Creatinine

Normal Range

0.6-1.3 mg/dL SI 50-115 µmol/L

Description

Muscle creatine and phosphocreatine break down to form creatinine. Creatinine is released into the blood and excreted by glomerular filtration in the kidneys. As long as muscle mass remains fairly constant, creatinine formation remains constant. An increase in serum creatinine in the face of unchanged creatinine formation suggests a diminished ability of the kidneys to filter creatinine. Thus, serum creatinine is used as a tool to identify patients with renal dysfunction.

Clinical Significance

- ✓ *Increased Creatinine*

Increased creatinine is associated with renal dysfunction, dehydration, urinary tract obstruction, vigorous exercise, hyperthyroidism, myasthenia gravis, increased meat intake, and use of nephrotoxic drugs such as cisplatin and amphotericin B.

- ✓ *Decreased Creatinine*

Serum creatinine may be reduced in patients with cachexia, inactive elderly or comatose patients, and spinal cord injury patients.

BUN/Creatinine Ratio

Calculating the BUN/creatinine ratio may suggest an etiology for renal dysfunction. A BUN/creatinine ratio greater than 20 suggests a pre renal cause such as GI

bleeding. A BUN/creatinine ratio between 10 and 20 indicates intrinsic renal disease.

Creatinine Clearance

This calculation provides an estimate of the glomerular filtration rate (GFR) and is a better indication of renal function than using serum creatinine alone. In addition to assessing kidney function in patients with renal failure, the creatinine clearance (CrCl) can be used to monitor patients on nephrotoxic medications and to assess need for renal dosing adjustments.

Uric Acid

Normal Range

Male 3.4-8.5 mg/dL	SI 202-506 µmol/L
Female 2.3-6.6 mg/dL	SI 137-393 µmol/L

Description

Uric acid is the main metabolic end product of the purine bases of DNA.

Clinical Significance

- ✓ *Increased Uric Acid (Hyperuricemia)*

Increased uric acid (*hyperuricemia*) may be caused by excessive production of purines or inability of the kidney to excrete urate. Common causes of hyperuricemia are renal dysfunction, metabolic acidosis, tumor lysis syndrome, purine-rich diet, and use of furosemide, thiazide diuretics, and niacin. Hyperuricemia may be associated with the development of gouty arthritis, nephrolithiasis, and gouty tophi.

- ✓ *Decreased Uric Acid (Hypouricemia)*

Decreased uric acid levels (*hypouricemia*) are usually of little clinical significance but may occur with a low-protein diet, deficiency of xanthine oxidase, or use of allopurinol, probenecid, or high doses of aspirin or vitamin C.

Total Serum Protein

Normal Range

6.0-8.5 g/dL	SI 60-85 g/L

Description

The total serum protein is the sum of albumin, globulins, and other circulating proteins in the serum. Albumin and globulins are indicators of nutritional status.

Clinical Significance

- ✓ *Increased Protein* (*Hyperproteinemia*)

Increased protein (*hyperproteinemia*) may be associated with collagen vascular diseases (lupus, rheumatoid arthritis, scleroderma), sarcoidosis, multiple myeloma, and dehydration.

- ✓ *Decreased Protein* (H*ypoproteinemia*)

Decreased serum protein (*hypoproteinemia*) may result from a decreased ability to synthesize protein (liver disease) or an increased protein wasting as seen in renal disease, nephrotic syndrome, and third-degree burns.

Part Two will be continued on the next volume

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