Coordinated meeting between Physician and medical Lab on CamLIS

Why we need to talk about the quality and Patient safety

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Objective

At the end of this activity, you will be able to:

- Understood, what's important elements of an information management system.
- The advantages and disadvantages of a computerized information management system.
- Disease identification and outbreak investigation
- Specialized testing and Support of disease surveillance and epidemiology investigations
- Should promote appropriate, timely diagnostic testing, including specimen collection, and pathogen identification and accurate, timely reporting of results to guide patient treatment."
- The underutilization and incorrect use of medical tests and diagnostic

Role in Quality Management System

The test result is the final product of the laboratory.

- Network supports response to all kinds of public health emergencies, but especially detection and response
- Labs test according to consensus protocols
- Timely and accurate testing and reporting
- Linked with local, and others agencies
- Supported by MoH and lab s panthers

The role of laboratory information systems in healthcare quality improvement

To evaluate the status of hospital sites with CamLIS are critical to high quality healthcare service provision.

Data show that the need for these systems is growing to meet accompanying technological

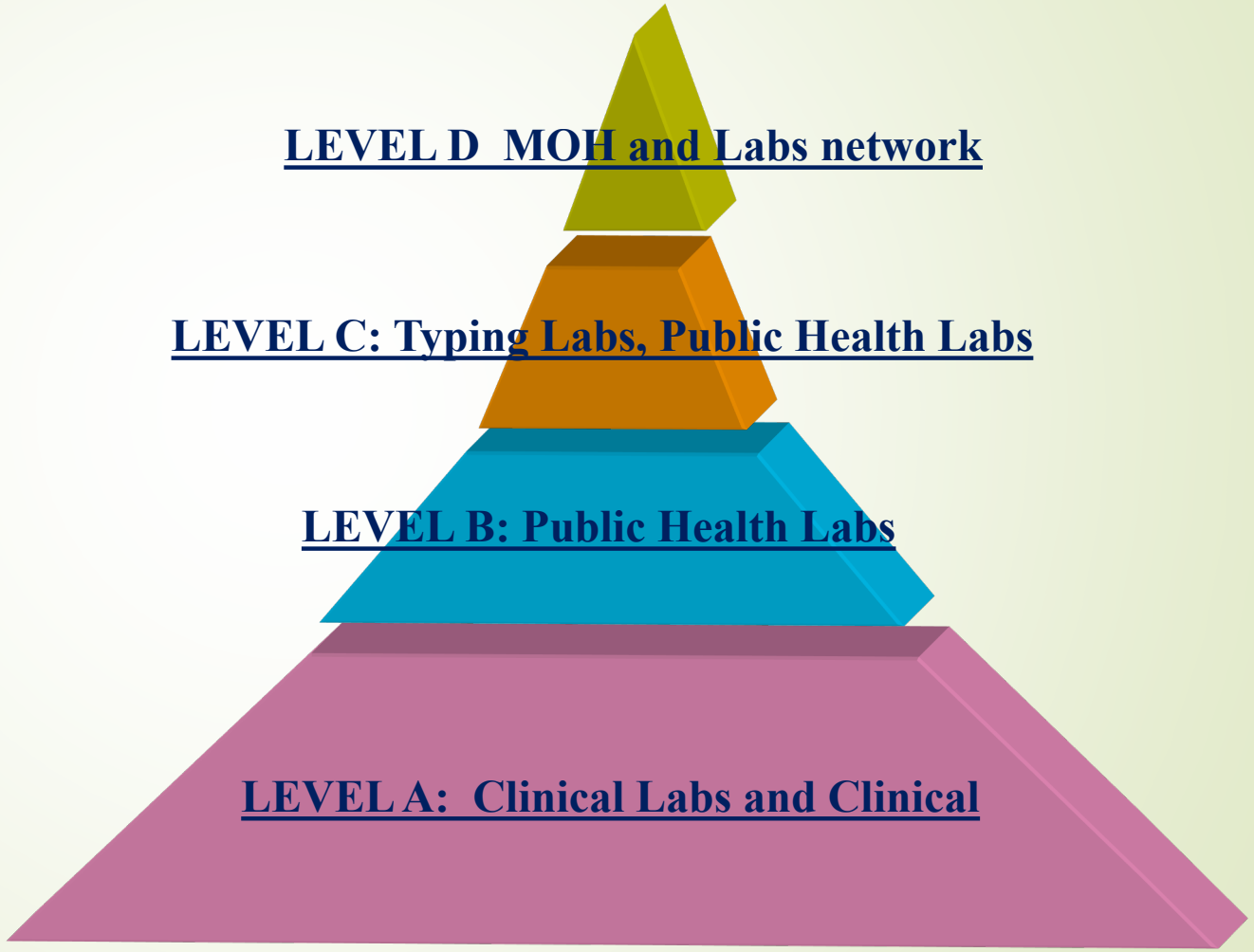
Including patient result verification, has greatly improved laboratory test throughput while decreasing **turn-around-times**, enabling critical results to reach physicians rapidly for improved clinical outcomes.

METHODOLOGY and APPROACH:

CamLIS and Healthcare Management Systems Analytics Database, which includes over 73 facilities in the future plan, healthcare to provides extensive data on the software, and information technology infrastructure within healthcare organizations.

Laboratory Levels

Keep in mind that if you are clinical lab or not you are officially part of this network.



We need all hospitals are actively involved in laboratory systems planning to improve health service quality. Specifically, are currently being installed in 2012 with present and for future installation 47 labs.

As a result, increasing investment in laboratory information systems is providing state-of-the-art clinical laboratory support, which enhances clinical care processes and improves quality.

These state-of-the-art Laboratory Information Systems, when linked with other clinical information systems such as Computerized Physician Order Entry and Electronic Medical Record, will support further healthcare quality improvement.

The Safe Practice Recommendations address the following:

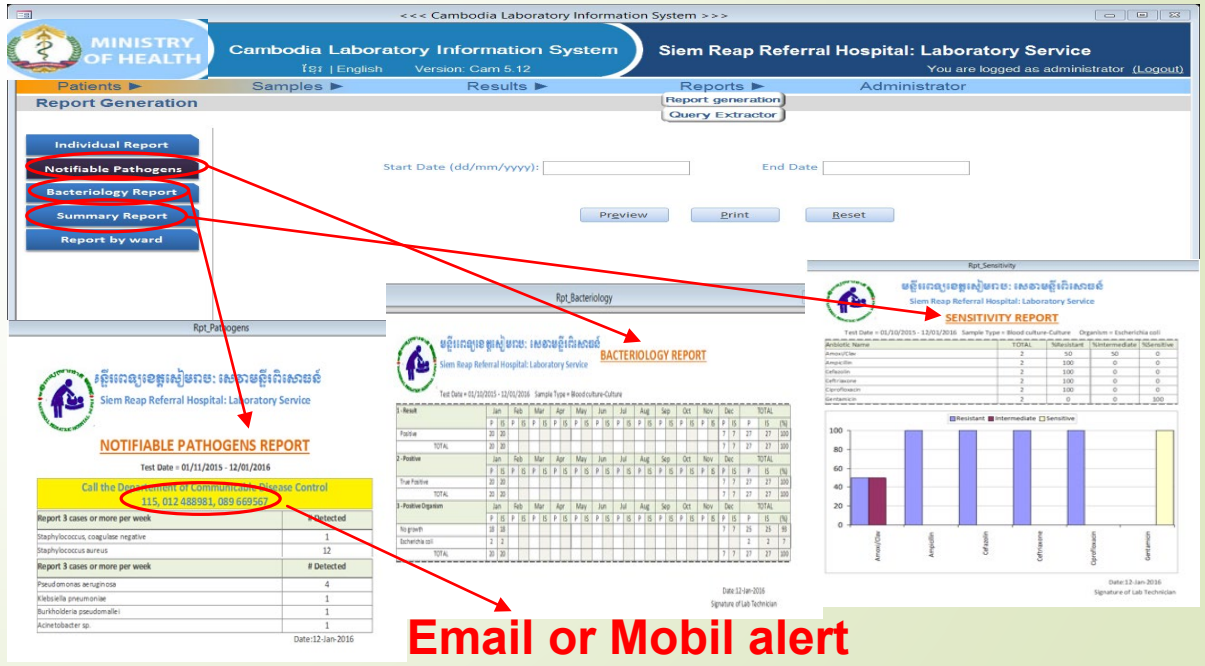
- Who should receive the results
- Who should receive the results when the ordering provider is not available
- What results require timely and reliable communication
- When the results should be actively reported to the ordering provider with explicit time frames
- How to notify the responsible provider
- How to design, support, and maintain the systems involved

Where are we Today

The laboratory director is responsible for establishing policies and procedures to:

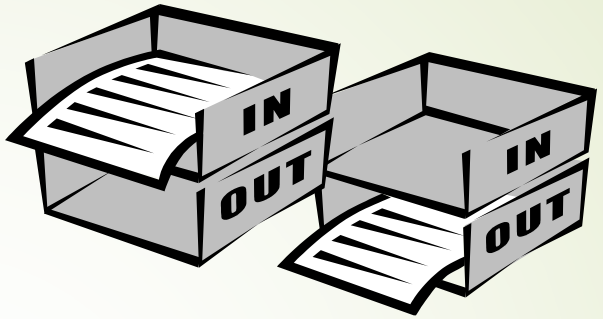
- safeguard a patient's privacy
- assure laboratory data confidentiality

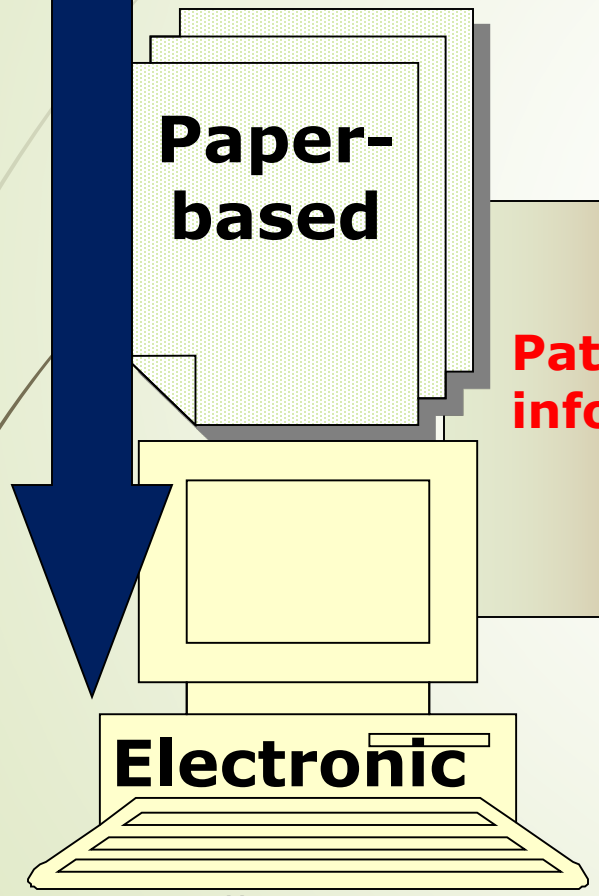
timely
accurate
legible
easily understood



Information Management

- Establish processes for managing data





Patient information

Quality Lab Report

- accessible
- accurate
- timely
- secure
- confidential
- private

Errors in clinical laboratories or errors in laboratory medicine?

The test has been performed, errors; intra-analytical; laboratory medicine; mistakes; post-analytical procedures; pre-analytical; total testing .

1. Errors exclusively within the laboratory
• *Pre-analytical*
–Acceptance of improper specimens
–Mismatch during the analysis
• *Intra-analytical*
–Failure of the diagnostic system
–Analytical interference
–Procedure not followed
–Undetected failure in quality control
• *Post-analytical*
–Erroneous validation of analytical data
–Failure in reporting
–Excessive TAT
2. Laboratory errors caused by organizational problems outside the laboratory
–Wrong identification of a patient at the bedside
–Sample mismatch during blood withdrawal performed by non-laboratory personnel
–Wrong procedure for specimen collection
–Errors in specimen transport to the laboratory
3. Errors at the laboratory-clinical interface
–Appropriateness of test request
–Appropriateness of test interpretation
–Appropriateness of test utilization

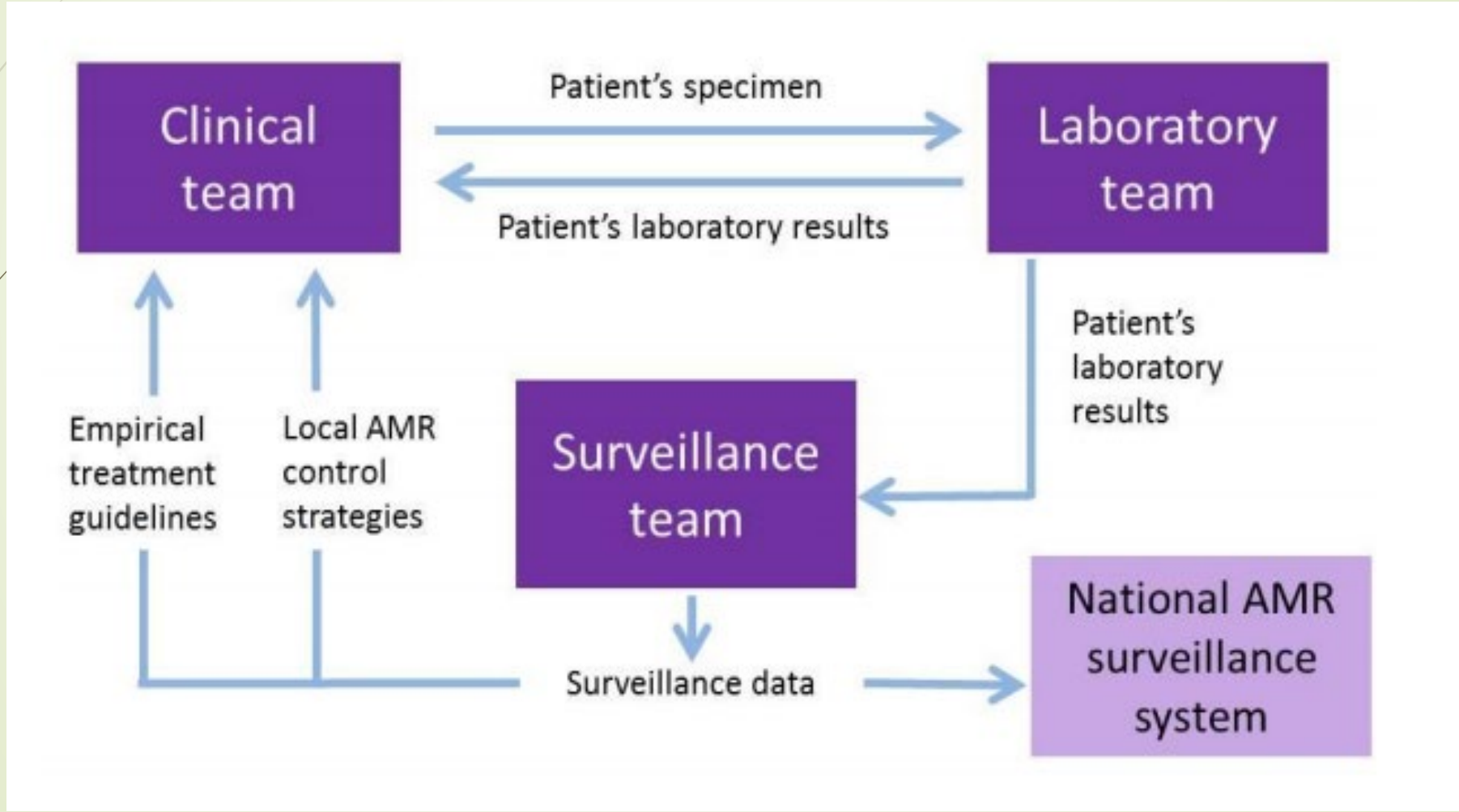
TAT, turnaround time.

How the clinical microbiologist should report the laboratory Results

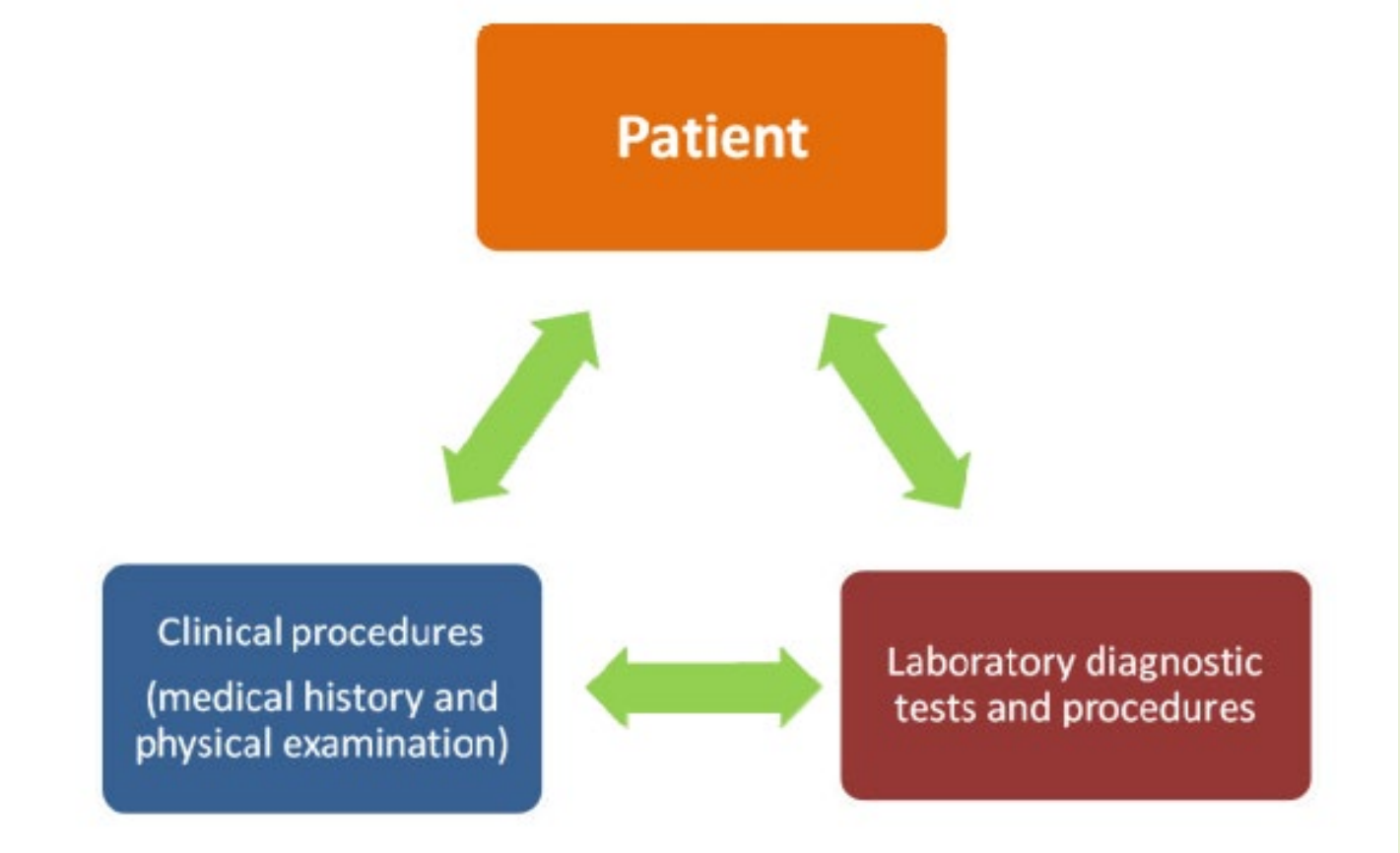
- To determine significance of results requires knowledge of **the Patient's Clinical Status**
- The report should encourage communication between clinician and Medical labs

- What laboratory tests help answer the objective(s)?
- What specimens are required for the laboratory test(s)?
- What's the sampling strategy?

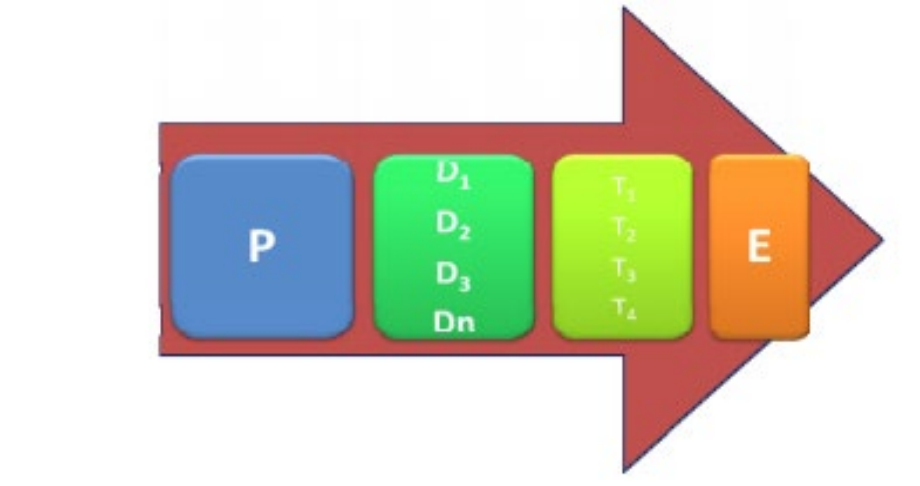
Ex: Relationship between individual care and surveillance data



Ex: Steps of the diagnostic pathway



Triangle of interdependence between physicians who perform clinical diagnosis
(medical history, physical examination)



P = appearance of problem (sign, symptom, or some laboratory findings);

D = definition of problem, working diagnosis and differential diagnosis; followed by

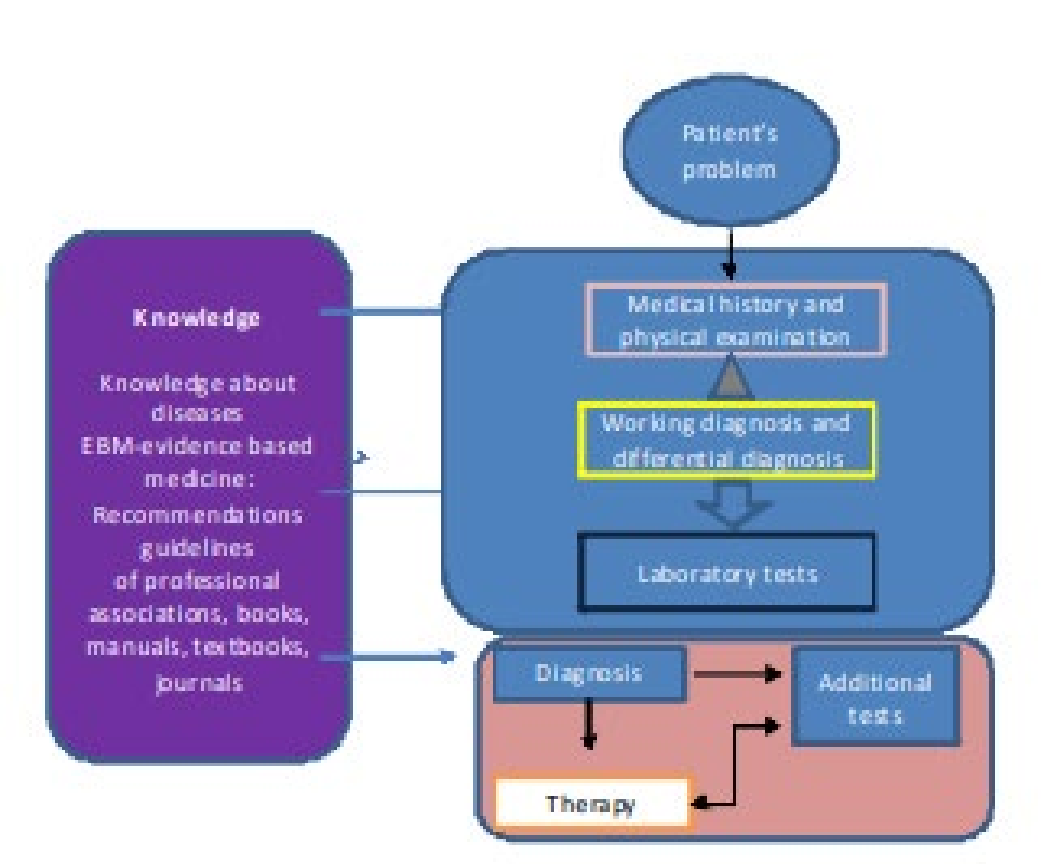
T = treatment or therapy; and

E = evaluation of therapy or treatment.

Clinical diagnosis and practice:

- Systematic errors as a result of selection bias, information bias and confounding
- quantitative aspects of diagnosis and treatment
- the effect size and aspects regarding its precision
- clinical importance of results
- external validity or generalizability
- Application of results in practice and
- Evaluation of performance

The role of clinician



The clinician is responsible for conducting the clinical process, primarily for the implementation of diagnostic procedures and diagnosing the patient's problem

To decide what data/information should be collected, what laboratory and diagnostic tests should be looked for, how to interpret the information from the tests and examinations request

Safe Practice Recommendations for Communicating Critical Test Results

The ordering provider should receive and follow up on the results of all ordered tests

- The ordering provider has the responsibility to communicate outstanding diagnostic tests and assign responsibility for follow up to a covering provider

Elements of a successful call system

- Simple to understand
- Easily available to all stakeholders
- The procedures for changes to the call schedule are explicitly clear to all users
- Supports reporting clinicians in identifying and reaching responsible provider
- Supports automatic forwarding of calls to the covering provider/service if ordering provider not available

What is the value of Clinical Laboratory Services in Health Care

Laboratory information enables physicians and other healthcare professionals to make appropriate evidence-based diagnostic or therapeutic decisions for their patients.

Clinical laboratory services are the most cost effective with the objective information used in clinical decision-making

Have a direct impact on many aspects of patient care including, but not limited to, length of stay, patient safety, resource utilization, and customer satisfaction.

Key Messages

ensure all data—the final results of the laboratory—is well managed

- consider all the ways laboratory data will be used when planning a system
- assure the accessibility, accuracy, timeliness, and security of data
- ensure confidentiality and privacy of patient information
- Timely is very thing between diseases onset and specimens Inc Results
- These new diagnostics are technologically advanced but do not automatically provide improvements in clinical care and population health
- Security in Data canters and Lab Networks should be trusted to restrict use to only authorised users.
- Supports both **clinical management** and **public health functions** (e.g., lab-based surveillance).
- Reduce the over diagnosis, and overtreatment in others…
- Clinicians must provide a strong counterbalance: educating patients, respecting baseline risk, thinking and expecting misleading feedback

We can't solve the problem without understanding the human needs and interests of the patients involved in the conflict.

Thank you

Experiences to Share in this Meeting

Introduce concepts, principals and laboratory service
also Clinical – Laboratory Correlation and communication Diagnostic process

Group activities

- Problems to solve
- Cases to diagnose
- Results to interpret
- Factors contributing to laboratory in an academic medical and to assess the effect of an educational feedback on inappropriate test and ordering behaviour.
- Monitoring and evaluation of the diagnostic
- Discussion
- Laboratory tours !!!
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Laboratory Values Interpretation Resource

2. Complete Blood Count (CBC)

Complete Blood Count (CBC) Provides results regarding the concentration of red blood cells, white blood cells, and platelets in a blood sample.[1]		Causes	Presentation	Clinical Implications
White Blood Cells Routine test to identify the presence of infection, inflammation, allergens. **REFERENCE VALUES**[13] **5.0-10.0** 10^9/L	**Trending Upward** *(leukocytosis)*[13] > 11.0 10^9/L	Infection Leukemia Neoplasm Trauma Surgery Sickle-cell disease Stress/pain Medication-induced Smoking Obesity Congenital Chronic inflammation Connective tissue disease	Fever Malaise Lethargy Dizziness Bleeding Bruising Weight loss (unintentional) Lymphadenopathy Painful inflamed joints	Symptoms-based approach when determining appropriateness for activity, especially in the presence of fever. Consider timing of therapy session due to early-morning low level and late-afternoon high peak.[14]
	Trending Downward *(leukopenia)*[13] < 4.0 10^9/L	Viral infections Chemotherapy Aplastic anemia Autoimmune disease Hepatitis	Anemia Weakness Fatigue Fever Headache Shortness of breath	Symptoms-based approach when determining appropriateness for activity, especially in the presence of fever.[14]
	Trending Downward *(neutropenia)*[13] < 1.5 10^9/L 0.5-1.0 10^9/L = moderate neutropenia < 0.5 10^9/L= severe neutropenia	Stem cell disorder Bacterial infection Viral infection Radiation	Low-grade fever Skin abscesses Sore mouth Symptoms of pneumonia	Neutropenic precautions (dependent on facility guidelines).[14] Symptoms-based approach when determining appropriateness for activity, especially in the presence of fever.[14]

Complete Blood Count (CBC)		Causes	Presentation	Clinical Implications
Platelets **REFERENCE VALUES** **140-400 k/uL**[13]	**Trending Upward** *(thrombocytosis)* > 450 k/uL	Splenectomy Inflammation Neoplasm/cancer Stress Iron deficiency Infection Hemorrhage Hemolysis High altitudes Strenuous exercise Trauma	Weakness Headache Dizziness Chest pain Tingling in hands/feet	Symptoms-based approach when determining appropriateness for activity; monitor symptoms; collaborate with interprofessional team.[13-15] Elevated levels can lead to venous thromboembolism.
	Trending Downward *(thrombocytopenia)* < 150 k/uL	Viral infection Nutrition deficiency Leukemia Radiation Chemotherapy Malignant cancer Liver disease Aplastic anemia Premenstrual and postpartum	Petechiae Ecchymosis Fatigue Jaundice Splenomegaly Risk for bleeding	In presence of severe thrombocytopenia (< 20 k/uL): Symptoms-based approach when determining appropriateness for activity; collaborate with interprofessional team (regarding possible need for/timing of transfusion prior to mobilization)[14] Fall risk awareness (risk of spontaneous hemorrhage).[16,17]
Hemoglobin Assess anemia, blood loss, bone marrow suppression **REFERENCE VALUES** **Male:** 14-17.4 g/dL[13] **Female:** 12-16 g/dL[13] ***Note:** Values are slightly decreased in elderly.*[13]	**Trending Upwards** *(polycythemia)*	Congenital heart disease Severe dehydration (or hemoconcentration) Chronic obstructive pulmonary disease (COPD) Congestive heart failure (CHF) Severe burns High altitude	Orthostasis Presyncope Dizziness Arrhythmias CHF onset/exacerbation Seizure Symptoms of transient ischemic attack (TIA) Symptoms of MI Angina	Low critical values (< 5-7 g/dL) can lead to heart failure or death.[13] High critical values (> 20 g/dL) can lead to clogging of capillaries as a result of hemoconcentration.[13] Symptoms-based approach when determining appropriateness for activity, monitor symptoms, collaborate with interprofessional team.[14]

Complete Blood Count (CBC)		Causes	Presentation	Clinical Implications
Hemoglobin (cont.) Assess anemia, blood loss, bone marrow suppression **REFERENCE VALUES** **Male:** 14-17.4 g/dL[13] **Female:** 12-16 g/dL[13] ***Note:*** *Values are slightly decreased in elderly.*[13]	**Trending Downward** *(anemia)*	Hemorrhage Nutritional deficiency Neoplasia Lymphoma Systemic lupus erythematosus Sarcoidosis Renal disease Splenomegaly Sickle cell anemia Stress to bone marrow RBC destruction	Decreased endurance Decreased activity tolerance Pallor Tachycardia	Monitor vitals including SpO_2 to predict tissue perfusion. May present with tachycardia and/or orthostatic hypotension. Medical team might monitor patients with pre-existing cerebrovascular, cardiac, or renal conditions for ineffective tissue perfusion related to decreased hemoglobin.[18] If <8 g/dL: Symptoms-based approach when determining appropriateness for activity; collaborate with interprofessional team (regarding possible need for/timing of transfusion prior to mobilization).[13-15,19] Consultation with the interprofessional team as while as monitoring of signs and symptoms is imperative since hemoglobin levels and blood transfusions is individualized.[18] • hospitalized patients who are hemodynamically stable and asymptomatic may transfuse at 7 g/dL • post surgical cardiac or orthopedic patients and those with underlying cardiovascular disease may transfuse at 8 g/dL. • patients with hematological disorders, oncological disorders and severe thrombocytopenia ,or chronic transfusion-dependent anemia: no transfusion threshold recommendation is available.

Complete Blood Count (CBC)		Causes	Presentation	Clinical Implications
Hematocrit Assess blood loss and fluid balance. **REFERENCE VALUES** **Male:** 42-52%[13] **Female:** 37-47%[13] ***Note:*** *Values are slightly decreased in the elderly.* [13]	**Trending Upward** *(polycythemia)*	Burns Eclampsia Severe dehydration Erythrocytosis Tend to be elevated with those living in higher altitude Hypoxia due to chronic pulmonary conditions (COPD, CHF)	Fever Headache Dizziness Weakness Fatigue Easy bruising or bleeding	Low critical value (<15-20%) cardiac failure or death.[13-15] High critical value (>60%) spontaneous blood clotting.[13-15] Symptoms-based approach when determining appropriateness for activity; monitor symptoms; collaborate with interprofessional team[13-15]
	Trending Downward *(anemia)*	Leukemia Bone marrow failure Multiple myeloma Dietary deficiency Pregnancy Hyperthyroidism Cirrhosis Rheumatoid arthritis Hemorrhage High altitude	Pale skin Headache Dizziness Cold hands/feet Chest pain Arrhythmia Shortness of breath	Patient might have impaired endurance; progress slowly with activity. Monitor vitals including SpO_2 to predict tissue perfusion. Might present with tachycardia and/or orthostatic hypotension. Medical team might monitor patients with pre-existing cerebrovascular, cardiac, or renal conditions for ineffective tissue perfusion related to decreased hematocrit.[18] If < 25%: Symptoms-based approach when determining appropriateness for activity; collaborate with interprofessional team (regarding possible need for/timing of transfusion prior to mobilization)[13-15,18]

3. Electrolyte Panel

Electrolyte Reference Values		Causes	Presentation	Clinical Implications
The Basic Metabolic Panel (BMP) is a group of specific tests for electrolyte level, blood sugar, kidney status and acid-base balance. Significant changes in electrolytes, acid-base balance, renal function and blood sugar may indicate kidney failure, respiratory distress, and impaired cognitive status. Changes in sodium, potassium and calcium alter the excitability of neurons, cardiac, and skeletal muscles that can produce arrhythmias, weakness, and spasms/tremors.[1]				
Sodium (Na) Primary determinant of extracellular fluid volume. **REFERENCE VALUES** **134-142 mEq/L[13]**	**Hypernatremia** *(sodium level > 145 mEq/L)* **Trending Upward**	Increased sodium intake Severe vomiting CHF Renal insufficiency Cushing's syndrome Diabetes[20]	Irritability Agitation Seizure Coma[21] Hypotension Tachycardia Decreased urinary output[22]	Impaired cognitive status. Seizure precautions for patients with past medical history.[21]
	Hyponatremia *(sodium level < 130mEq/L)* **Trending Downward**	Diuretic use Gastrointestinal impairment Burns/wounds Hypotonic IV use Cirrhosis[20]	Headache Lethargic Decreased reflexes Nausea and vomiting (N/V) Diarrhea Seizure Coma Orthostatic hypotension Pitting edema[21]	Impaired cognitive status. Monitor vitals secondary to risk for orthostatic hypotension.[23]
Potassium (K) Important for function of excitable cells such as nerves, muscles, and heart. **REFERENCE VALUES** **3.7-5.1 mEq/L[13]**	**Hyperkalemia** *(serum potassium levels > 5.5 mEq/L)* **Trending Upward**	Renal failure Metabolic acidosis Diabetic ketoacidosis (DKA) Addison's disease Excess potassium supplements Blood transfusion[20]	Muscle weakness/paralysis Paresthesia Bradycardia Heart block Ventricular fibrillation Cardiac arrest[21]	Patient at risk for cardiac issues > 5 mEq/L: Use symptoms-based approach when determining appropriateness for activity [1,20,21] Might exhibit muscle weakness during intervention.
	Hypokalemia *(serum potassium levels < 3.5 mEq/L)* **Trending Downward**	Diarrhea/vomiting Gastrointestinal impairment Diuretics Cushing's syndrome Malnutrition Restrictive diet ETOH abuse[20]	Extremity weakness Decreased reflexes Paresthesia Leg cramps EKG changes Cardiac arrest Hypotension Constipation[21]	Symptoms-based approach when determining appropriateness for activity.[1,20,21] Severe hypokalemia < 2.5 mEq/L: collaborate with interprofessional team.

Electrolyte Reference Values		Causes	Presentation	Clinical Implications
Calcium (Ca) Important for bone formation, cell division and growth, blood coagulation, muscle contraction, and release of neurotransmitters. **REFERENCE VALUES** **8.6-10.3 mg/dL**[13]	**Hypercalcemia** *(high levels of calcium in blood)* **Trending Upward**	Excessive calcium supplements/antacids Bone destruction – tumor Immobilization Fracture Excessive vitamin D Cancer Renal failure[20]	Ventricular dysrhythmias Heart block Asystole Coma Lethargy Muscle weakness Decreased reflexes Constipation Nausea/vomiting[21]	Symptoms-based approach when determining appropriateness for activity.[1,20,21]
	Hypocalcemia *(low levels of calcium in blood)* **Trending Downward**	ETOH abuse Poor dietary intake Limited GI absorption Pancreatitis Laxative use[21]	Anxiety Confusion Agitation Seizure EKG changes Fatigue Numbness/tingling Increased reflexes Muscle cramps[21]	Might have impaired cognitive abilities. Symptoms-based approach when determining appropriateness for activity.[1,20,21]
Chloride (Cl) Important for fluid balance and acid base status. **REFERENCE VALUES** **98-108 mEq/L**[13]	**Hyperchloremia** *(high levels of chloride in blood)* **Trending Upward**	High-salt, low-water diet Hypertonic IV Metabolic Acidosis Renal failure[21]	Lethargy Decreased level of consciousness Weakness Edema Tachypnea Hypertension (HTN) Tachycardia[21]	Determine if appropriate for treatment if exhibiting decreased level of consciousness.[21]
	Hypochloremia *(low levels of chloride in blood)* **Trending Downward**	Low salt diet Water intoxication Diuresis Excessive vomiting and/or diarrhea[21]	Agitation Irritability Hypertonicity Increased reflexes Cramping Twitching[21]	Monitor level of consciousness and motor function.[1,20,21]

4. Kidney Function

Kidney Function Reference Values		Causes	Presentation	Clinical Implications
Blood Urea Nitrogen (BUN) Evaluates kidney function. **REFERENCE VALUES** **6-25 mg/dL**[13]	**Trending Upward**	High-protein diet Renal failure Decreasing volume CHF GI Bleed Fever Increased protein Catabolism[21]	HTN Fluid retention Fatigue Poor appetite N/V Itchy/dry skin Decreased cognition Dyspnea Bone pain[21]	Decreased tolerance to activity.[21] Symptoms-based approach when determining appropriateness for activity.[1,20,21]
	Trending Downward	Hepatic disease Malnutrition[21]	Uncommon; usually not a concern[21]	Symptoms-based approach when determining appropriateness for activity.[1,20,21]
Serum Creatinine Evaluates kidney function. **REFERENCE VALUES** **Male:** 0.7-1.3 mg/dL[13] **Female:** 0.4-1.1 mg/dL[13]	**Trending Upward**	Renal disease Muscular dystrophy Rhabdomyolysis Dehydration[21]	Reduced urine output Dark-colored urine Edema Back pain Fatigue Low fever Loss of appetite Headache Confusion Dyspnea[21]	Decreased tolerance to activity.[19] Symptoms-based approach when determining appropriateness for activity.[1,20,21]
	Trending Downward	Age Pregnancy Low muscle mass Liver disease Low-protein diet[21]	Fatigue (this is uncommon; can be precursor to autoimmune disease)[21]	Symptoms-based approach when determining appropriateness for activity.[1,20,21]

5. Endocrine

Glucose Reference Values		Causes	Presentation	Clinical Implications
Glucose[24] Measures blood glucose at the time sample obtained. **REFERENCE VALUES** 70-100 mg/dL **FASTING PLASMA GLUCOSE (FPG)** 90-130 mg/dL **Criteria for the Diagnosis of Diabetes**[24] FPG > 126 mg/dL ***OR*** 2-hour Plasma Glucose > 200 mg/dL	Hyperglycemic Trending Upward *(> 200 mg/dL)*	Diabetes mellitus[21] Sepsis Brain Tumors Certain medications IV glucose After a meal Pancreatitis	Diabetic ketoacidosis Severe fatigue[21]	Decreased tolerance to activity.[21] Symptoms-based approach to appropriateness of activity.[1,20,21]
	Hypoglycemic Trending Downward *(< 70 mg/dL)*	Excess insulin[21] Brain injury Pituitary deficiency Malignancy Addison's disease	Lethargy Irritability Shaking Extremity Weakness Loss of consciousness[21]	May not tolerate therapy until glucose level increased.[21] A glucose target between 140-180 mg/dL is recommended for most patients in noncritical care units while hospitalized.[24]

Hgb A1C Reference Values	Causes	Presentation	Clinical Implications
Hgb A1C[24] Shows the average level of blood glucose control over the previous 3 months. **REFERENCE VALUES** **Normal: < 5.7%** **Pre-diabetes mellitus: 5.7 - 6.4%** **With diabetes mellitus: > 6.5%** *(poor glucose control)*	Diabetes mellitus	Eye disease Heart disease Kidney disease Nerve damage Stroke Gum disease Non-traumatic amputations[24]	Monitor vitals if poorly controlled diabetes. Educate importance of exercise for blood sugar control. Consider for wound care management.[24]

Thyroid Function Reference Values[1]		Presentation	Clinical Implications
Thyroxine (T4) **REFERENCE VALUES** **Total 4.5-11.5 µg/dL** **Triiodothyronine (T3)** **REFERENCE VALUES** **80-200 ng/dL** **Thyroid – Stimulating Hormone (TSH)** **REFERENCE VALUES** **0.3-3.0 U/mL** ***Note:*** *Increased TSH and decreased T4 = thyroid disease; decreased TSH = pituitary disease*	**Hyperthyroidism** **Increased T3 and/or T4**	Tremors Nervousness/lability Weakness/muscular atrophy Increased reflexes Fatigue Tachycardia – increased cardiac output Arrhythmias (atrial fibrillation) Hypotension Chronic periarthritis Proximal weakness Also affects: integumentary, gastrointestinal and genitourinary systems	Decreased exercise tolerance – both strength and capacity. Monitor heart rate and blood pressure. Patient at risk for dysrhythmias during exercise. Patient in a hypermetabolic state will deplete nutrients quickly with exercise.[1]
	Hypothyroidism **Increased TSH** **Decreased T3 and or T4**	Slow Speech/Hoarseness Slow Mental Function Ataxia Proximal muscle weakness Carpel tunnel syndrome Prolonged reflexes Paresthesia Muscular/joint edema Back pain Bradycardia CHF Poor peripheral circulation Hyperlipidemia HTN Also affects: integumentary, gastrointestinal and genitourinary systems	Hypothyroidism – frequently accompanied by myalgia and CK elevation. More prone to skin tears. Activity intolerance; should improve with treatment of hypothyroidism. Rhabdomyolysis, although rare, can appear in the presence of heavy exercise, alcohol, or medications. Monitor heart rate – bradycardia.[1]

Anion Gap[13]

The difference between free cations and free anions. The major free cations are Sodium (Na+) and Potassium (K+). The major anions are Chloride (Cl−) and Bicarbonate (HCO3−).

The anion gap (AG) it is calculated from the equation AG= [(Na+) + (K+)] − [(Cl−) + (HCO − 3)]- note- K+ may or may not be included- refer to your specific lab to know if K+ is included in Anion Gap

REFERENCE VALUE

8 to 16 mEq without K+
12 to 20 mEq with K+

Clinical Considerations – Elevated Anion Gap

- ETOH Ketoacidosis
- Uncontrolled diabetes-Increased ketoacids
- Methanol intoxication- Increased formic acid
- Tissue hypoxia-Increased lactic acid
- Ketogenic diet
- Fasting
- Poisoning- salicylate, ethynol, methanol

Clinical Decisions

Use a systems-based approach based on the cause of the elevated AG level, not the value itself.

7. Liver Function/Hepatic Panel

Liver Function/Hepatic Panel Reference Ranges Assesses the liver's ability to clear bilirubin, total protein, and albumin.		Causes	Presentation	Clinical Implications
Serum Albumin Half-life of 21 days. **3.5-5.2 g/dL[13]** **Serum Prealbumin** Half-life 2 days; detects current nutritional status within a patient's body.[13] **19-39 mg/dL[13]** 0-5 mg/dL = severe protein depletion 5-10 mg/dL = moderate protein depletion 10-15 mg/dL (mild protein depletion)[13]	**Trending Upward**	Severe infections Congenital disorders Severe dehydration Hepatitis Chronic inflammation Tuberculosis Overdose of cortisone medications CHF Renal Disease Cancer[21]	Clinical features are dependent on the cause (i.e. renal, cardiac, TB, etc.)[21]	Assess integumentary daily Collaborate with the interprofessional team regarding nutrition[31]
	Trending Downward	Infection Nutritional compromise Inflammation Liver disease Crohn's disease Burns Malnutrition Thyroid disease[21]	Peripheral edema Non-healing wound Hypotension[21]	Assess integumentary daily. Collaborate with the interprofessional team regarding nutrition. Low levels occur with prolonged hospital stay.[13] Serum Albumin: < 3.0 g/dL nutritionally compromised; < 2.8 g/dL generalized symmetrical peripheral edema, poor wound healing, potential drug toxicity Serum Pre-Albumin: < 10 g/dL significant nutritional risk, poor wound healing, generalized edema

Liver Function/Hepatic Panel Reference Ranges Assesses the liver's ability to clear bilirubin, total protein, and albumin.		Causes	Presentation	Clinical Implications
Serum Bilirubin Total bilirubin **0.3-1.0 mg/dL[13]** **Critical value: > 12 mg/dL[13]**	Trending Upward	Cirrhosis Hepatitis Hemolytic anemia Jaundice Transfusion reaction Bile duct occlusion Chemotherapy	Patients with severe disease might have fatigue, anorexia, nausea, fever, and, occasionally, vomiting. Might have loose, fatty stools.	Symptoms-based approach when determining appropriateness for activity.[1, 18, 19] Adapt education if decreased cognition. Patients with advanced disease are at risk for osteoporosis and bleeding due to deficiencies of fat soluble vitamins.
Ammonia (NH_3) **15-60 µg/dL[13]** Evaluates liver function and metabolism. The liver converts ammonia from blood to urea. If the liver is damaged, then increased ammonia levels are noted.	Trending Upward	Cirrhosis Severe hepatitis Reye's syndrome Severe heart disease Kidney failure Severe bleeding of stomach or intestines (GI system)	Hepatic encephalopathy Confusion Lethargy Dementia Daytime sleepiness Tremors Breakdown of fine motor skills Numbness and tingling (peripheral nerve impair) Speech impairment	Might need to alter communication and education, and designate patient as an increased fall risk, if encephalopathy present.[1]

8. Lipid Panel [36]

High-Density Lipoprotein (HDL) "Good" cholesterol: It helps to remove excess cholesterol deposits from the arterial lining. Higher levels can reduce the incidence of coronary heart disease.	**Males ≥ 40 mg/dl** **Females ≥ 50 mg/dl**			
Low-Density Lipoprotein (LDL) "Bad" cholesterol: It deposits in the arterial lining and compromises blood flow.	**Desired Level** **< 100 mg/dl**	Borderline high: 130-159 mg/dl	High: 160-189 mg/dl	Very high: ≥ 190 mg/dl
Triglycerides	**Normal** **< 150 mg/dl**	Borderline high: 150-199 mg/dl	High: 200-499 mg/dl	Very high: ≥ 500 mg/dl
Total Cholesterol	**Desired Level** **< 200 mg/dl**	Borderline high: 200-239 mg/dl	High: ≥ 240 mg/dl	

Clinical Implications: Cardiovascular disease is the No. 1 cause of death in the United States, with an estimated 1.5 million heart attacks and 5 million strokes occurring annually – many in individuals who have no prior symptoms. Prevention of ischemic cardiovascular events is of fundamental importance. Risk factors – including age, smoking status, hypertension, diabetes, cholesterol, and HDL cholesterol – are used to identify individuals likely to have an ischemic event.[37]