Rational use of Biochemistry testing

annual refresher course for family physicians
November 26 2018
Dr. Julie St-Cyr
Declaration

• "I (we) declare that I have no conflicts of interest in the authorship of this contribution."
Learning objectives

• Organizations promoting rational use of biochemistry tests

• Identify the appropriate biochemistry tests recommended by the CTFPHC (now the CTFOTPHE) and the USPSTF for the periodic health exam (screening)

• Learn about the best tests for specific diagnoses
In 2012 the ABIM Foundation launched Choosing Wisely® with a goal of advancing a national dialogue on avoiding wasteful or unnecessary medical tests, treatments and procedures.
Key Principles

• We need to order tests and prescribe medications based on best evidence. Unnecessary medications can cause unwanted side effects, and unnecessary testing can lead to further testing or possible harm.

• We have an obligation to our patients, profession and society to be responsible stewards of medical resources. If we are all committed to evidence-based prescribing and test ordering, we can reduce the great overuse of health care resources in the US, and make medical care more efficient and affordable.
INESSS’s mission is to promote clinical excellence and the efficient use of resources in the health and social services sector. At the heart of the mission, INESSS assesses, in particular, the clinical advantages and the costs of the technologies, medications and interventions used in health care and personal social services. It issues recommendations concerning their adoption, use and coverage by the public plan, and develops guides to clinical practice in order to ensure their optimal use.
Les résultats des 14 analyses sont présentés dans les sections suivantes, soit d’abord les analyses en biochimie suivies des analyses en hématologie.

Liste d’analyses incluses biochimie:
• 1. Amylase et lipase sériques pour le diagnostic de la pancréatite aiguë
• 2. Aspartate aminotransférase (AST) pour la détection d’une atteinte hépatique
• 3. Bilirubine directe pour la détection d’une cholestase
• 4. Créatine kinase MB (CK-MB) pour le diagnostic de l’infarctus aigu du myocarde
Usage judicieux de 14 analyses biomédicales: Avril 2014

Résultats:
• 5. Électrophorèse des protéines sériques
• 6. Lactate déshydrogénase (LDH) dans le diagnostic de l’infarctus aigu du myocarde
• 7. Thyroxine Libre (T4L) pour le diagnostic d’une maladie thyroïdienne
• 8. Urée pour l’évaluation de la fonction rénale
• 9. Vitamine D 25-OH
Why order tests

- Screening
- Diagnosis
- To assess response to a specific treatment
- To determine prognosis
Periodic screening

Why develop periodic screening procedures?
- asymptomatic adults harbor organic disease
- screening can detect a disease at an early stage
- early detection can alter the course of the disease.
Preventive Care Checklist Forms
Preventive Care Checklist

• Biochemistry tests
  males and females age 21-64:
    Hemoccult multiphase q1-2 years (age ≥50)

    Fasting Blood Glucose of A1C if at risk

    Fasting Lipid Profile (≥40 yr or sooner if at risk males) or
    Fasting Lipid Profile (≥50 yr or postmenopausal or sooner if at
    risk females)
Preventive Care Checklist

- Biochemistry tests:
  - males and females age >65:
    - Hemoccult multiphase q1-2 years (age 65-74)
    - Fasting Blood Glucose or A1C if at risk
    - Fasting Lipid Profile q1-5 years (up to 75)
CTF recommendations

• Do’s= A & B recommendations

• Don'ts= D & E recommendations
<table>
<thead>
<tr>
<th>Disease</th>
<th>Test</th>
<th>Populations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes Mellitus</td>
<td>Blood glucose fasting</td>
<td>General population</td>
</tr>
<tr>
<td>Ovarian cancer</td>
<td>CA125</td>
<td>Pre and post menopausal</td>
</tr>
<tr>
<td>Pancreatic cancer</td>
<td>CA 19-9</td>
<td>General population</td>
</tr>
<tr>
<td>Prostate cancer</td>
<td>PSA</td>
<td>Males &gt; 50</td>
</tr>
<tr>
<td>UTI</td>
<td>Urine dipstick/culture</td>
<td>Elderly ambulatory males, elderly</td>
</tr>
</tbody>
</table>
Type 2 Diabetes Mellitus: Screening
Release Date: October 2015

Population: Adults aged 40 to 70 years who are overweight or obese

Recommendation: The USPSTF recommends screening for abnormal blood glucose as part of cardiovascular risk assessment in adults aged 40 to 70 years who are overweight or obese. Clinicians should offer or refer patients with abnormal blood glucose to intensive behavioral counseling interventions to promote a healthful diet and physical activity.

Grade: B
<table>
<thead>
<tr>
<th>Population</th>
<th>Recommendation</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men, Screening with PSA</td>
<td>The U.S. Preventive Services Task Force (USPSTF) recommends against prostate-specific antigen (PSA)-based screening for prostate cancer.</td>
<td>D</td>
</tr>
<tr>
<td>Population</td>
<td>Recommendation</td>
<td>Grade</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Adults aged 50 to 75 years</td>
<td>The USPSTF recommends screening for colorectal cancer starting at age 50 years and continuing until age 75 years. The risks and benefits of different screening methods vary.</td>
<td>A</td>
</tr>
<tr>
<td>Population</td>
<td>Recommendation</td>
<td>Grade</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Nonpregnant, asymptomatic adults</td>
<td>The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for thyroid dysfunction in nonpregnant, asymptomatic adults.</td>
<td></td>
</tr>
</tbody>
</table>
Not screening tests!

Tumor markers such as PSA, CEA, CA 125, CA 19-9:

1. are not useful as a screening assay for cancer detection in the normal population
2. results can not be interpreted as absolute evidence of the presence or absence of cancer
3. serum markers are not specific for malignancy and values may vary by method
4. useful for evaluating patients’ response to therapy
5. predicting recurrence
there is a low incidence of ovarian cancer in the general population (age-adjusted incidence of 17 per 100,000 women).

In women at average risk, the positive predictive value of an abnormal screening test is, at best, approximately 2% (i.e., 98% of women with positive test results will not have ovarian cancer).
Using tests for diagnosis

• Common diagnostic tests in *unselected* ambulatory patients such as: liver enzymes, amylase, tumor markers, protein electrophoresis are not indicated for screening and should be used for specific diagnosis.

• A consequence of automation and social changes.
Sequential multiple analyzer or SMA
Common diagnostic tests

• Biochemical profiles are not routinely indicated for screening asymptomatic adults.

• Probability that a healthy person will have normal results for 1 test = 95%
  6 tests = 74%
  20 tests = 36%
What is the question?
Does my patient have pancreatitis?

- Order lipase if not available pancreatic amylase is the best choice.

- These tests are to be used in asymptomatic individuals.
Amylase

- Mysterious increase in pancreatic amylase
**BIOCHIMIE / BIOCHEMISTRY**

<table>
<thead>
<tr>
<th>ANALYSE(S)</th>
<th>RESULTAT(S)</th>
<th>ALARMES UNITES</th>
<th>VAL.DE REF.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST(S)</td>
<td>RESULT(S)</td>
<td>FLAG(S) UNITES</td>
<td>REF.RANGE</td>
</tr>
</tbody>
</table>

**BIOCHIMIE GÉNÉRALE / GENERAL BIOCHEMISTRY**

SPECIMEN GLD COLLECTED 14/04/28 13:37 BY CSI1 RECEIVED 14/04/28 13:55 BY ROB

CRÉATININE 67 µmol/L 44-123
AMYLASE PANCRÉATIQUE 1046 H U/L 4-60

Increased pancreatic amylase in an asymptomatic patient suggests the presence of macr bound to an antibody. An amylase clearance is recommended to eliminate this possibil clearance of this patient is 0.09% (reference range: > 2.0%), which consistent with a

**CHIMIE URINAIRE (MICTION) / URINE RANDOM**

SPECIMEN 130 COLLECTED 14/04/29 15:00 BY SL RECEIVED 14/04/29 15:01 BY SL

URINE CREAT. 9.21 mmol/L NONE
AMYLASE 143 U/L NONE

**IMMUNOLOGIE / IMMUNOLOGY**

<table>
<thead>
<tr>
<th>ANALYSE(S)</th>
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</tbody>
</table>

**DEPISTAGE DE MICROALBUMINE / MICROALBUMIN SCREEN**

SPECIMEN 130 COLLECTED 14/04/29 15:00 BY SL RECEIVED 14/04/29 15:01 BY SL

URINE CREAT. 9.21 mmol/L NONE
Does my patient have liver disease?

Useful for diagnosing hepatocellular inflammation or obstruction as in patients with jaundice, with history of alcohol abuse or on certain therapeutic drugs.

• Enzymes of hepatocellular necrosis: AST and ALT
• Enzymes of cholestasis: Alk Phos and GGT
Does my patient have liver disease?

• These are not LFTs
• Live enzymes answer the question is there liver disease.
• True liver function tests include: albumin, PT and bilirubin
Liver enzymes

- Hyperbilirubinemia
  - Hepatocellular disorder
    - Increased AST and ALT
  - Biliary obstruction
    - Increased Alk Phos
- Infection
- Drugs
- Intra or extra hepatic obstruction
**Table 1. Causes of Chronically Elevated Aminotransferase Levels.**

<table>
<thead>
<tr>
<th>Hepatic causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol abuse</td>
</tr>
<tr>
<td>Medication</td>
</tr>
<tr>
<td>Chronic hepatitis B and C</td>
</tr>
<tr>
<td>Steatosis and nonalcoholic steatohepatitis</td>
</tr>
<tr>
<td>Autoimmune hepatitis</td>
</tr>
<tr>
<td>Hemochromatosis</td>
</tr>
<tr>
<td>Wilson’s disease (in patients ≤40 years old)</td>
</tr>
<tr>
<td>Alpha1-antitrypsin deficiency</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nonhepatic causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Celiac sprue</td>
</tr>
<tr>
<td>Inherited disorders of muscle metabolism</td>
</tr>
<tr>
<td>Acquired muscle diseases</td>
</tr>
<tr>
<td>Strenuous exercise</td>
</tr>
</tbody>
</table>
TABLE 3. Medications, Herbs, and Drugs or Substances of Abuse Reported to Cause Elevations in Liver-Enzyme Levels.

<table>
<thead>
<tr>
<th>Medications</th>
<th>Herbs and homeopathic treatments</th>
<th>Drugs and substances of abuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibiotics</td>
<td>Chaparral</td>
<td>Anabolic steroids</td>
</tr>
<tr>
<td>Synthetic penicillins</td>
<td>Chinese herbs</td>
<td>Cocaine</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>Si bu huan</td>
<td>5-Methoxy-3,4-methylenedioxymethamphetamine</td>
</tr>
<tr>
<td>Nitrofurantoin</td>
<td>Ephedra (mahuang)</td>
<td>(MDMA, “ecstasy”)</td>
</tr>
<tr>
<td>Ketoconazole and fluconazole</td>
<td>Gentian</td>
<td>Phencyclidine (“angel dust”)</td>
</tr>
<tr>
<td>Isoniazid</td>
<td>Germander</td>
<td>Glues and solvents</td>
</tr>
<tr>
<td>Antiepileptic drugs</td>
<td>Alchemilla (lady’s mantle)</td>
<td>Glues containing toluene</td>
</tr>
<tr>
<td>Phenytoin</td>
<td>Senna</td>
<td>Trichloroethylene, chloroform</td>
</tr>
<tr>
<td>Carbamazepine</td>
<td>Shark cartilage</td>
<td></td>
</tr>
<tr>
<td>Inhibitors of hydroxymethylglutaryl-coenzyme A reductase</td>
<td>Scutellaria (skullcap)</td>
<td></td>
</tr>
<tr>
<td>Simvastatin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pravastatin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lovastatin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atorvastatin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonsteroidal antiinflammatory drugs</td>
<td>Sulfonylureas for hyperglycemia</td>
<td></td>
</tr>
<tr>
<td>Sulfonylureas for hyperglycemia</td>
<td>Glipizide</td>
<td></td>
</tr>
<tr>
<td>Glipizide</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 2. Laboratory Tests That May Identify the Cause of Elevated Aminotransferase Levels in a Patient with No Symptoms

<table>
<thead>
<tr>
<th>Test</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial tests</strong></td>
<td></td>
</tr>
<tr>
<td>Test for hepatitis C antibody in serum</td>
<td>Presence of hepatitis C antibody indicates chronic hepatitis C</td>
</tr>
<tr>
<td>Test for hepatitis B surface antigen, surface antibody, and core antibody in serum</td>
<td>Presence of hepatitis B surface antigen and core antibody indicates chronic hepatitis B</td>
</tr>
<tr>
<td>Measurement of serum iron and total iron-binding capacity</td>
<td>Iron overload suggests hemochromatosis</td>
</tr>
<tr>
<td>Measurement of serum ceruloplasmin</td>
<td>Decreased ceruloplasmin levels suggest Wilson's disease (if patient is ≤40 years old)</td>
</tr>
<tr>
<td>Serum protein electrophoresis</td>
<td>Increase in polyclonal immunoglobulins suggests autoimmune hepatitis</td>
</tr>
<tr>
<td>Serum protein electrophoresis</td>
<td>Marked decrease in α-globulin bands suggests α1-antitrypsin deficiency</td>
</tr>
<tr>
<td><strong>Additional tests</strong></td>
<td></td>
</tr>
<tr>
<td>Reverse-transcriptase polymerase chain reaction for hepatitis C virus RNA</td>
<td>Presence of viral RNA indicates chronic hepatitis C</td>
</tr>
<tr>
<td>Alpha1-antitrypsin phenotyping</td>
<td>Presence of the ZZ phenotype indicates α1-antitrypsin deficiency</td>
</tr>
<tr>
<td>Tests for antiendomysial and antigliadin antibodies in serum</td>
<td>Presence of antibodies indicates celiac sprue</td>
</tr>
<tr>
<td>Measurement of creatine kinase and aldolase</td>
<td>Elevated enzyme levels indicate disorders of striated muscle</td>
</tr>
</tbody>
</table>

*If the results of the initial set of tests are normal, these additional tests may pinpoint the cause.*
OPD CLINIC
No Req./Order#: 
Méd. Req./Req. Dr.
DYLEWSKI JOE
Copie à/Copy to:
DYLEWSKI JOE
SMH- Room G-100

Montreal, PQ,

BIOCHIMIE / BIOCHEMISTRY

<table>
<thead>
<tr>
<th>TEST(S)</th>
<th>RESULTAT(S)</th>
<th>ALARMES</th>
<th>UNITES</th>
<th>VAL.DE REF.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HÉMOULYSE / HEMOLYSIS</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICTERE / ICTERUS</td>
<td>3</td>
<td>H</td>
<td></td>
<td>0-2</td>
</tr>
<tr>
<td>LIPÉMIE / LIPEMIA</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
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INDICES SÉRIQUES / SERUM INDICES
SPECIMEN GLD COLLECTED 05/01/27 12:20 BY RSS RECEIVED 05/01/27 12:33 BY ROB

<table>
<thead>
<tr>
<th>TEST(S)</th>
<th>RESULTAT(S)</th>
<th>FLAG(S)</th>
<th>UNITES</th>
<th>REF. RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HÉMOULYSE / HEMOLYSIS</td>
<td>0</td>
<td></td>
<td></td>
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<tr>
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<td>3</td>
<td>H</td>
<td></td>
<td>0-2</td>
</tr>
<tr>
<td>LIPÉMIE / LIPEMIA</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
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BIOCHIMIE GÉNÉRALE / GENERAL BIOCHEMISTRY
SPECIMEN GLD COLLECTED 05/01/27 12:20 BY RSS RECEIVED 05/01/27 12:33 BY ROB

<table>
<thead>
<tr>
<th>TEST(S)</th>
<th>RESULTAT(S)</th>
<th>UNITES</th>
<th>REF. RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BILIRUBINE TOTALE</td>
<td>51.4</td>
<td>umol/L</td>
<td>3.6-25.2</td>
</tr>
<tr>
<td>DIRECT BILIRUBINE</td>
<td>28.9</td>
<td>umol/L</td>
<td>0.0-4.0</td>
</tr>
<tr>
<td>ALKALINE PHOSPHATASE</td>
<td>176</td>
<td>IU/L</td>
<td>13-113</td>
</tr>
<tr>
<td>ALT</td>
<td>1303</td>
<td>IU/L</td>
<td>5-60</td>
</tr>
<tr>
<td>AST</td>
<td>357</td>
<td>IU/L</td>
<td>10-42</td>
</tr>
</tbody>
</table>

Légende/legend: L: Bas/Low  H: Haut/High  P: Critique/Panic  AB: Anormal/Abnormal
### Microbiologie / Virologie

<table>
<thead>
<tr>
<th>Analyse(s)</th>
<th>Resultat(s)</th>
<th>Alarmes</th>
<th>Unites</th>
<th>Val. de Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test(s)</td>
<td>Resultat(s)</td>
<td>Flag(s)</td>
<td>Unites</td>
<td>Ref. Range</td>
</tr>
</tbody>
</table>

#### Sérologie / Serology

Specimen E11 collected 05/01/23 11:54 by DP received 05/01/23 12:38 by KA

Hep. B Surface Antigen: Negative

#### Sérologie Virologie / Serology (Virology)

Specimen E11 collected 05/01/23 11:54 by DP received 05/01/23 12:38 by KA

Hepatitis A IgM: 17.49 COI

Valeurs de référence/Normal Ranges:

- <1.1 COI: Absence d'anticorps IgM pour l'hépatite A
- Absence of Hepatitis A IgM Antibody

***************************************************************************************

**Légende/legend:**

L: Bas/Low  H: Haut/High  P: Critique/Panic  AB: Anormal/Abnormal
What is my patient’s renal function?

Do I wish to evaluate renal filtration or the glomerulus as a selective sieve?

- **eGFR**: The test estimates the volume of blood that is filtered by the kidneys over a given period of time. There is consensus that an eGFR represents the best routinely available measurement of kidney function.
• Calculation of an eGFR is currently based on the MDRD equation.

More recently, a modified equation has been endorsed by KDIGO, by the Canadian Society of Nephrology (CSN), and the Ontario Renal Network (ORN). The CKD-EPI equation is considered to be more accurate than the MDRD equation for calculating eGFR, particularly for patients with an eGFR in the 60-120 mL/min/1.73 m2 range, for females, and for younger patient populations.
Renal function

- The CKD-EPI equation uses a more sophisticated calculation for the eGFR, but includes the same factors as MDRD equation; those are age, gender, serum creatinine, and ethnicity. No additional patient information needs to be provided by clinicians.

  **Note:** For patients who do not have muscle mass typical of their demographic group, a 24-hour urine creatinine clearance may be used to improve diagnostic accuracy.
Renal function

Why not creatinine alone?

• In assessment of renal function, plasma creatinine remains normal down to a GFR of about 30 mL/min.

• Creatinine is therefore not a sensitive marker of renal function.
Who should be tested for CKD?

• Patients with diabetes mellitus
• Patients with hypertension
• Patients with heart failure
• Patients with atherosclerotic coronary, cerebrovascular or peripheral vascular disease
• Patients with unexplained anemia
• Patients with a family history of ESRD
• First nations peoples
Renal function

What about urea?

• The principal clinical utility of serum urea, which lies in its measurement in conjunction with that of serum creatinine and subsequent calculation of the urea nitrogen-to-creatinine ratio. This can be used as a crude discriminator between prerenal and postrenal azotemia.
• As part of the work up of patients with stage 3 CKD to evaluate the need for nutritional status assessment.
• To determine timely initiation of dialysis
Mrs White

- 81 year old female with a serum creatinine of 90 μmol/L (normal).
- **EQUATION:VALUE:**
  - \[ 52 \text{ (mL/min/1.73 m}^2) \text{ CKD-EPI CREATININE (2009)} \]

  \[ \text{eGFR: 30-59 ml/min/1.73m}^2 = \text{a moderate decrease in renal function.} \]
Mr. Weider

- 26 year old african american body builder with a creatinine of 90 μmol/L (normal).

- **EQUATION:VALUE:**
  117(mL/min/1.73 m²) CKD-EPI CREATININE (2009)
Montreal, PQ,

à suivre - continued

BIOCHIMIE / BIOCHEMISTRY

<table>
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<tr>
<th>ANALYSE(S)</th>
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<tr>
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<td>FLAG(S)</td>
<td>UNITS</td>
<td>REF.RANGE M.T.</td>
</tr>
</tbody>
</table>

Débit de filt. glomérulaire / Glomerular Filt. Rate
TFGe / eGFR 29 ml/min/1.73sm

Stade de la maladie rénale chronique selon le NKF
Stage of Chronic Kidney Disease according to NKF

- Dommage rénal avec FG normale ou élevée >= 90
  Kidney damage with normal or increased GFR

- Dommage rénal avec FG un peu diminuée 60-89
  Kidney damage with mild decrease in GFR

- Baisse de FG modérée 30-59
  Moderate decrease in GFR

- Baisse de FG importante 15-29
  Severe decrease in GFR

- Défaillance rénale / Kidney failure <15

5

suite à la prochaine page - continued on next page
Renal function

- Glomerular permeability: in diseases such as diabetes there may develop an increased glomerular permeability with progressively increasing excretion of higher molecular weight proteins as permeability increases (e.g., albumin, IgG).

  Normally we excrete up to 30mg/24hr of albumin but we can use the ACR (albumin/creatinine) to screen for diabetic nephropathy instead of a 24 hr urine collection.
Testing for CKD

- A random urine sample can identify kidney injury. Urine albumin or protein excretion should be quantified with an albumin to creatinine ratio (ACR) or a protein to creatinine ratio (PCR).
- 24 hour urine collections are not routinely required to assess creatinine clearance or protein excretion as they are cumbersome and often inaccurate.
SPECIMEN GLD COLLECTED 09/12/08 07:51 BY N-MML RECEIVED 09/12/08 10:28 BY ROB

<table>
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<th>ANALYSE(S)</th>
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<td>UNITS</td>
<td>REF.RANGE M.T.</td>
</tr>
</tbody>
</table>

PROTIÈNE RÉACTIVE-C  
LESS THAN 1.00 mg/L  
0.00-8.00 Remis

DEPISTAGE DE MICROALBUMINE / MICROALBUMIN SCREEN

SPECIMEN 130 COLLECTED 09/12/08 07:51 BY N-MML RECEIVED 09/12/08 10:51 BY ROB

<table>
<thead>
<tr>
<th>ALBUMIN RANDOM</th>
<th>14.40</th>
<th>mg/L</th>
<th>0.00-20.00</th>
<th>Remis</th>
</tr>
</thead>
<tbody>
<tr>
<td>URINE CREAT.</td>
<td>16.66</td>
<td>mmol/L</td>
<td>NONE</td>
<td>Remis</td>
</tr>
<tr>
<td>ALB/CREAT RATIO</td>
<td>0.9</td>
<td></td>
<td>0.0-2.0</td>
<td>Remis</td>
</tr>
</tbody>
</table>

If ratio is high, Please confirm with 2 out of 3 measurements over 3 months.
Specific diseases
Screening for type 2 diabetes:

- using a fasting plasma glucose (FPG) and/or glycated hemoglobin (A1C) should be performed every 3 years in individuals ≥40 years of age or in individuals at high risk using a risk calculator.
Diagnosis of DM:

- A fasting plasma glucose level of ≥7.0 mmol/L or
- a 2-hour plasma glucose value in a 75 g oral glucose tolerance test of ≥11.1 mmol/L or
- a glycated hemoglobin (A1C) value of ≥6.5% (no fasting needed)
Therapy in most individuals with type 1 or type 2 diabetes should be targeted to achieve:

- an A1C ≤7.0% in order to reduce the risk of microvascular and, if implemented early in the course of disease, macrovascular complications.

In order to achieve an A1C ≤7.0%, people with diabetes should aim for:

- FPG or preprandial PG target of 4.0–7.0 mmol/L and a 2-hour PPG target of 5.0–10.0 mmol/L
à suivre - continued

BIOCHIMIE / BIOCHEMISTRY

<table>
<thead>
<tr>
<th>TEST(S)</th>
<th>RESULTAT(S)</th>
<th>ALARMES</th>
<th>UNITES</th>
<th>VAL.DE REF.</th>
<th>T.M.</th>
<th>REF.RANGE</th>
<th>M.T.</th>
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<td>ALT</td>
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<td>IU/L</td>
<td>5-60</td>
<td>Remis</td>
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<td>10-42</td>
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<td>g/L</td>
<td>32-46</td>
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<td>umol/L</td>
<td>150-285</td>
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<td>L</td>
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<td>JGL</td>
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<td>CA IONIZED PH CORR. 7.4</td>
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<td>mmol/L</td>
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<td>JGL</td>
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</table>

SPECIMEN L1C COLLECTED 09/12/08 07:51 BY N-MMI RECEIVED 09/12/08 10:30 BY ROB

HEMOGLOBIN A1C 0.061 I/AUT

EFFECTIVE(VE): 09/09/2009

OBJECTIF DE TRAITEMENT: <=0.07
TARGET FOR GLYCEMIC CONTROL: <=0.07

SPECIMEN GLD COLLECTED 09/12/08 07:51 BY N-MMI RECEIVED 09/12/08 10:28 BY ROB

APOLIPOPROTEIN B 1.48 H g/L 0.00-0.90 Remis

GAZ SANGUINS / BLOOD GAS

SPECIMEN BGS COLLECTED 09/12/08 07:51 BY N-MMI RECEIVED 09/12/08 10:19 BY JGL

pH 7.29 L 7.35-7.45 JGL
Screening for **CKD:**

In adults, screening for CKD in diabetes:

- Random urine ACR and a serum creatinine converted into an eGFR.

- Screening should commence at diagnosis of diabetes in individuals with type 2 diabetes and 5 years after diagnosis in adults with type 1 diabetes and repeated yearly thereafter.
A diagnosis of CKD should be made in patients with a random urine ACR ≥2.0 mg/mmol and/or an eGFR<60 mL/min on at least 2 of 3 samples over a 3-month period.
2016 Canadian Cardiovascular Society Guidelines for the Management of Dyslipidemia for the Prevention of Cardiovascular Disease in the Adult
HOW TO SCREEN

For all:
• History and physical examination
• Standard lipid panel (TC, LDL-C, HDL-C, TG)
• Non-HDL-C (will be calculated from profile)
• Glucose
• eGFR

Optional:
• ApoB
• Urine albumin:creatinine ratio
  (if eGFR <60 mL/min/1.73m², hypertension or diabetes)

NON-FASTING LIPID TESTING IS ACCEPTABLE
Non-HDL-C = Total Cholesterol – HDL-C
Atherogenic Apo B-containing Lipoproteins

Chylomicron Remnants

VLDL
Very low-density lipoprotein

IDL
Intermediate density lipoprotein

Lp(a)
Lipoprotein(a)

LDL-C
Calculated from standard Lipid Profile
ApoB
Measured separately

LDL
Low-density lipoprotein

HDL
High-density lipoprotein
Friedewald equation

• **Friedewald (1972) Formula:**

\[
LDL = TC - HDL - \frac{TG}{2.17} \quad \text{(mmol/L)}.
\]

If \( TG \geq 4.5 \text{ mmol/L} \) formula is precluded.
References

• Clinical Practice Guidelines:  
  2013 Canadian Diabetes Association  
  www.diabetes.ca

• Canadian Task Force on the Periodic Health Exam
References

• PDF] 2016 Update of the *Canadian Cardiovascular Society Guidelines* for ...
References

- McPherson & Pincus: Henry's Clinical Diagnosis and Management by Laboratory Methods, 21st ed.; SI Units
- http://www.mayomedicallaboratories.com/test-catalog
References

- Clinical practice guidelines
- Web-based calculators:
  - http://www.renal.org/eGFRcalc/GFR.pl
- Downloadable calculators and PDA formats:
  - http://www.pcel.info/gfr/
  - http://www.medcalc.com/