GLS.211 – ECH/DTH Meditech HCIS Reference Intervals for VITROS Sites

Applicability This document applies to all ECH/DTH VITROS Meditech HCIS sites and personnel of APL Laboratory Services.

Purpose This document states the reference intervals for ECH/DTH Meditech HCIS Laboratory analytes for sites with a VITROS chemistry analyzer.

Test	Reference Intervals
ACETAMINOPHEN, P/S	Report Comment: If appropriate Consult Alberta Poison Centre @ 1-800-332-1414
ALBUMIN, P/S	MALE, FEMALE, UNKNOWN g/L 0 – 364 d 30 - 50 1 yr – 150 yr 35 – 50 The following comment auto-appends to every ALB result: "Albumin measured using bromocresol green (BCG) method. Note method-specific reference interval."
ALKALINE PHOSPHATASE (ALP), P/S	MALE, FEMALE, UNKNOWN U/L 0 - 14 d 70 - 320 15 d - 364 d 130 - 500 1 yr - 12 yr 130 - 430 18 - 150 yr 40 - 120 MALE, UNKNOWN U/L 13 yr - 14 yr 130 -500 15 yr - 17 yr 60 – 250 FEMALE U/L 13 yr - 14 yr 60 - 225 15 yr - 17 yr 50 - 140
ALT (ALANINE AMINOTRANSFERASE), P/S	MALE, FEMALE, UNKNOWN U/L 0 - <18 yr <40 M/U ≥ 18 yr <70 F ≥ 18 yr <50
ANION GAP	MALE, FEMALE, UNKNOWN mmol/L 0 – 150 yr 4-14
AST (ASPARTATE AMINOTRANSFERASE), P/S	MALE, FEMALE, UNKNOWN U/L 0 – <30 d <115 ≥30 d – 364 d <80 ≥1 yr – 6 yr <60 ≥ 7 yr – 17 yr <45 M/U ≥18 yr <55 F≥18 yr <45

<table>
<tr><th>Test</th><th>Reference Intervals</th></tr>
<tr><td>BETA HUMAN CHORIONIC GONADOTROPIN (BHCG), U</td><td>Negative</td></tr>
<tr><td>BETA HUMAN CHORIONIC GONADOTROPIN (BHCG), P/S</td><td>MALE, FEMALE, UNKNOWN IU/L
0 – 150 yr < 5</td></tr>
<tr><td>BETA-HYDROXYBUTYRATE, B</td><td>MALE, FEMALE, UNKNOWN mmol/L
0 – 150 yr 0.0 – 0.3</td></tr>
<tr><td>BILIRUBIN, P/S – Conjugated (Bc) (Neonatal testing only)</td><td>See Provincial Chemistry Document: Guidelines for Biliary Artresia Testing for Meditech Sites</td></tr>
<tr><td>BILIRUBIN, P/S - DIRECT</td><td>MALE, FEMALE, UNKNOWN µmol/L
0 – 150 yr <7</td></tr>
<tr><td>BILIRUBIN, P/S – TOTAL</td><td>MALE, FEMALE, UNKNOWN µmol/L
29 days – 150 yr <20</td></tr>
<tr><td>BILIRUBIN, S – NEONATAL (for fDTH HCIS sites)</td><td>MALE AND FEMALE µmol/L
0 – 6 d no reference range
7 d – 14 d <250
15 d - 29 d <20

<table>
<tr><th>Age</th><th>If NBIL result is:</th><th>Then Append Comment</th></tr>
<tr><td>≤24 hours</td><td>≥250</td><td>Bilirubin levels of ≥250 µmol/L in the first 24 hours of life require pediatric consultation and further investigation. Please interpret according to the Canadian Pediatric Society Guidelines for Phototherapy.</td></tr>
<tr><td>>24 - ≤48 hours</td><td>≥250</td><td>Bilirubin levels of ≥250 µmol/L in the first 48 hours of life require follow-up monitoring. Please interpret according to the Canadian Pediatric Society Guidelines for Phototherapy.</td></tr>
<tr><td rowspan="2">>48 hours – 6 days</td><td>< 250</td><td>Values <250, not associated with rising bilirubin values, may be considered normal for this age group. Please interpret according to the Canadian Pediatric Society Guidelines for Phototherapy.</td></tr>
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<tr><td>≥350 - ≤400</td><td>Bilirubin levels >350 µmol/L, the use of phototherapy would be prudent after appropriate assessment even when no blood group incompatibility exist. Pediatric consultation is recommended. Please interpret according to the Canadian Pediatric Society Guidelines for Phototherapy.</td></tr>
<tr><td>>400</td><td>Bilirubin levels > 400 µmol/L require prompt pediatric or neonatal consultation for potential need of exchange transfusion. Please interpret according to the Canadian Pediatric Society Guidelines for Phototherapy.</td></tr>
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<tr><td>Blood Gases, Arterial, Venous, Capillary</td><td>Refer to tables on the last page of this document</td></tr>
<tr><td>BNP (B-TYPE NATRIURETIC PEPTIDE), P</td><td>MALE, FEMALE, UNKNOWN ng/L
0 - 150 yr

Diagnostic Criteria:
<100 CHF Unlikely
100 – 500 CHF Possible
>500 CHF Likely</td></tr>
<tr><td>CALCIUM, P/S</td><td>MALE, FEMALE, UNKNOWN mmol/L
0 – 10 d 1.80 - 2.90
11 d – 365 d 2.20-2.80
>1 yr 2.10-2.60</td></tr>
<tr><td>CARBON DIOXIDE, P/S</td><td>MALE, FEMALE, UNKNOWN mmol/L
0 – 150 yr 20 – 32</td></tr>
<tr><td>CBC (COMPLETE BLOOD COUNT), B</td><td>See GLS.216 ECH Meditech HCIS CBC and Differential Reference Intervals</td></tr>
<tr><td>CELL COUNT, CSF</td><td>Normal CSF
Color: Colorless
Clarity: Clear
RBC: 0 x 10^6/L
WBC: 0 – 5 x 10^6/L</td></tr>
</table>

Test	Reference Intervals
CHLORIDE, P/S	MALE, FEMALE, UNKNOWN mmol/L 0 – 150 yr 98 - 112
CHOLESTEROL, TOTAL, P/S	MALE, FEMALE, UNKNOWN: mmol/L <=1 yr 2.36 – 5.32 >1 – 17 yr 2.70 – 5.89 The following comment will be attached to the result: Acceptable limit relative to dyslipidemia and atherosclerosis risk is < 4.40 mmol/L 18 – 150 yr No reference range The following comment will be attached to the result: Desirable < 5.17 mmol/L High >= 6.21 mmol/L
CK (CREATINE KINASE), P/S	MALE, FEMALE, UNKNOWN U/L 0 d – 1 yr 40 - 230 2 – 9 yr 40 – 220 MALE/UNKNOWN 10 – 17 yr 40 – 200 18 - 150 yr <250 FEMALE 10 – 17 yr 30 - 160 18 – 150 yr <200
CREATININE, P/S	MALE, FEMALE, UNKNOWN umol/L 0 d – 1 yr 10 - 40 2 – 5 yr 20 – 45 6 – 12 yr 20 – 75 13 – 14 yr 30 – 95 MALE/UNKNOWN 15 – 150 yr 50 - 120 FEMALE 15 – 150 yr 40 – 100
CRP (C-REACTIVE PROTEIN), P/S	MALE, FEMALE, UNKNOWN mg/L 0 – 150 yr 0 – 10
D-DIMER QUANTITATIVE (Triage Meter)	0.5 mg/L A D-Dimer level BELOW the 0.5 mg/L cutoff may be used with the standardized clinical assessment and/or imaging studies to help exclude venous thromboembolism (VTE). Values above the cutoff are not diagnostically useful in VTE assessment.
DIFFERENTIAL, B	See "ECH Meditech HCIS CBC and Differential Reference Intervals”
DIGOXIN, P/S	MALE, FEMALE, UNKNOWN nmol/L 0 – 150 yr

Test	Reference Intervals
	Suggested Ranges: Heart failure: 0.6 – 1.2 Atrial Fibrillation: Not Defined Caution: Results > 1.5 nmol/L are associated with a higher risk of toxicity in heart failure patients.
eGFR (CKD-EPI)	The following Interpretive Comment will be appended to all eGFR results on adults (≥18 years) with eGFR results <60 mL/min/1.73 m^2. "eGFR <60 mL/min/1.73 m^2 or urine Albumin/creatinine ratio ≥3.00 mg/mmol for more than 3 months suggests chronic kidney disease. For information on diagnosis, management and referral see www.diagnoseckd.ca." The following Interpretive Comment will be appended to all eGFR results on adults (≥18 years) “Reduced muscle mass will lead to overestimation, and increased muscle mass underestimation of eGFR.” eGFR results will not be reported on patients <18 years of age, dialysis patients and patients with an unknown gender.
ESR (ERYTHROCYTE SEDIMENTATION RATE), B	0 – 17 yr 0 - 10 mm/h FEMALE 18 – 150 yr 0 - 20 mm/h MALE/UNKNOWN 18 – 150 yr 0 - 15 mm/h
ETHANOL, P/S	MALE, FEMALE, UNKNOWN mmol/L 0 - 150 yr <3.0 Report Comment: The method currently used for ETOH testing is not specific for ETOH and may cross react with other alcohols. Please interpret results accordingly.
FREE T4, P/S	MALE, FEMALE, UNKNOWN pmol/L 0 d – 13 d 11.0 – 65.0 14 d – 150 yr 10.0 – 28.0
GGT (GAMMA-GLUTAMYL TRANSFERASE), P/S	MALE, FEMALE, UNKNOWN U/L 0 – <15 d 20 – 200 15 d – 1 yr <100 1 yr – <18 yr <27 MALE/UNKNOWN U/L 18 – 150 yr <80 FEMALE U/L 18 – 150 yr <50
GLUCOSE, CSF	MALE, FEMALE, UNKNOWN mmol/L 0 - 150 yr 2.2 – 4.4

Test	Reference Intervals
GLUCOSE – FASTING, P/S	MALE, FEMALE, UNKNOWN mmol/L < 30 d 2.5 – 5.5 30 d – 150 yr 3.3 – 6.0
GLUCOSE – RANDOM, P/S	MALE, FEMALE, UNKNOWN mmol/L < 30 d 2.5 – 11.0 30 d – 150 yr 3.3 – 11.0 Appended comment when random glucose >11.0 mmol/L: A random glucose concentration of greater than or equal to 11.1 mmol/L plus symptoms of disease meets one of the diagnostic criteria for Diabetes Mellitus. Canadian Diabetes Guidelines (2008)
GLUCOSE – GESTATIONAL DIABETIC SCREEN, P/S	Gestational Diabetic Screen Interpretive Guidelines (Canadian Diabetes Guidelines 2013): Normal: < 7.8 Follow-up with GTT-2h Pregnant: 7.8-11.0 mmol/L Gestational Diabetes: >= 11.1 mmol/L
GLUCOSE – TOLERANCE TEST – GESTATIONAL, P/S	Gestational Glucose Tolerance Test Interpretive Guidelines (Canadian Diabetes Guidelines (2013)): Gestational Diabetes Mellitus - glucose results meet ONE of the criteria below: Fasting: >= 5.3 mmol/L 1h Glucose: >= 10.6 mmol/L 2h Glucose: >= 9.0 mmol/L
GLUCOSE – TOLERANCE TEST – 2 h, P/S	Glucose Tolerance Test Interpretive Guidelines (Non-pregnant; Canadian Diabetes Guidelines (2013)): Normal Glucose Tolerance: Fasting Glucose: 3.3 - 6.0 mmol/L AND 2h Glucose < 7.8 mmol/L Impaired Fasting Glucose and Impaired Glucose Tolerance: Fasting Glucose: 6.1 - 6.9 mmol/L AND 2h Glucose 7.8 - 11.0 mmol/L Diabetes Mellitus: Fasting Glucose: > 6.9 mmol/L OR 2h Glucose > 11.0 mmol/L
LACTATE, P	MALE, FEMALE, UNKNOWN mmol/L 0 – 150 yr 0.5 - 2.2
LACTOSE – TOLERANCE TEST – 2 h, P/S	Lactose Tolerance Interpretive Criteria: NORMAL Response: >= 1.1 mmol/L Rise in glucose of 1.1 mmol/L or greater from baseline does not support lactase deficiency or malabsorption. Please interpret results within clinical context. ABNORMAL Response: <= 1.0 mmol/L Rise in glucose of 1.0 mmol/L or less from baseline

Test	Reference Intervals
	suggests lactase deficiency or malabsorption. Please interpret results within clinical context.
LD (LACTATE DEHYDROGENASE), P/S	MALE, FEMALE, UNKNOWN U/L 0 – 150 yr 120 – 246
LIPASE, P/S	MALE, FEMALE, UNKNOWN U/L 0 – 150 yr 23 – 300
LIPID – PROFILE, P/S	Pediatric Lipid Profile (0 – 17 yr) Total Cholesterol No reference range HDL-C No reference range LDL-C No reference range Triglycerides No reference range Non-HDL-C No reference range The following comment will be attached to the Non-HDL-C result: Lipid Profile acceptable limits relative to dyslipidemia and atherosclerosis risk: Total Cholesterol Acceptable <4.40 mmol/L HDL-C Acceptable >1.16 mmol/L LDL-C Acceptable <2.84 mmol/L Triglycerides Acceptable <0.85 mmol/L (0-9 years) OR <1.02 mmol/L (10-17 years) Non-HDL-C Acceptable <3.10 Adult Lipid Profile (18 – 150 yr) Total Cholesterol No reference range HDL-C No reference range LDL-C 0.0 – 3.4 mmol/L Triglycerides 0.0 – 1.7 mmol/L Non-HDL-C 0.0 – 4.2 mmol/L The following comment will be attached to the Non-HDL-C result: For patients 30 years of age or older, the Framingham Risk Score (FRS), modified for family history, is recommended for risk assessment (2016 CCS Guideline, Can J Cardiol 2016): FRS Calculation Resources can be found at: https://myhealth.alberta.ca/Alberta/Pages/Heart-Disease-Risk-Calculator.aspx Low Risk (FRS < 10%) Treatment advised if LDL-C >= 5.0 mmol/L Treatment target: > 50% reduction LDL-C Intermediate Risk (FRS 10 - 19%) Treatment advised if LDL-C >= 3.5 mmol/L OR Non-HDL-C >= 4.3 mmol/L OR ApoB >= 1.2 g/L; Consider treatment for men>=50 and women>=60 yrs with one additional CV risk factor

Test	Reference Intervals
	Treatment targets: LDL-C < 2.0 mmol/L OR decrease by > 50% OR Non-HDL-C < 2.6 mmol/L OR ApoB < 0.8 g/L High Risk (FRS >= 20% or presence of high risk features) Treatment advised in all patients Treatment targets: LDL-C < 2.0 mmol/L OR decrease by > 50% OR Non-HDL-C < 2.6 mmol/L OR ApoB < 0.8 g/L
LITHIUM, S	MALE, FEMALE, UNKNOWN mmol/L 0 - 150 yr Suggested Therapeutic Range: Acute Mania Therapy 1.0 - 1.5 Bipolar Maintenance Therapy 0.6 - 1.2
MAGNESIUM, P/S	MALE, FEMALE, UNKNOWN mmol/L 0 – 150 yr 0.70 – 1.00
MALARIAL PARASITE SCREEN, B	Negative
MONONUCLEOSIS TEST, S	Negative
OCCULT BLOOD, F	Negative
pH, Arterial - Cord Blood	pH 7.20 - 7.40
pH, Venous - Cord Blood	pH 7.25 - 7.45
PHOSPHATE, P/S	MALE, FEMALE, UNKNOWN mmol/L 0 - 14 d 1.40 - 2.70 15 d - 30 d 1.60 - 2.70 31 d - 4 yr 1.20 - 2.20 5 yr - 12 yr 1.10 - 1.90 13 yr - 17 yr 0.90 - 1.70 18 yr - 150 yr 0.70 - 1.50
POTASSIUM, P/S	MALE, FEMALE, UNKNOWN mmol/L 0 - 28 d 3.5 – 6.0 29 d to 364 d 3.5 – 5.5 1 yr -150 yr 3.5 - 5.0
PROTEIN – TOTAL, CSF	MALE, FEMALE, UNKNOWN g/L 0 - 150 yr 0.12 – 0.60 *Manufacturer suggested reference interval verified in house
PROTEIN – TOTAL, P/S	MALE, FEMALE, UNKNOWN g/L 0 - 364 d 40 – 70 1 yr – 150 yr 62 - 82
PT (PROTHROMBIN TIME), INR, P	0.8 - 1.2 Therapeutic Range: 2.0 - 3.0 **NOTE:** For some indications a higher target therapeutic range is required. Reference: February 2012, 141(2_suppl) Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Practice Guidelines.
PTT (PARTIAL THROMBOPLASTIN TIME), P	Reference Range and Therapeutic Range varies with instrument. Please refer to patient report for current value.
RETICULOCYTE COUNT, B	Absolute Birth – 6m no reference interval

Test	Reference Intervals
	>6m – 150 yr 20 – 90 x 10^9/L
RHEUMATOID FACTOR QUALITATIVE, S	Negative
SALICYLATE, P/S	MALE, FEMALE, UNKNOWN mmol/L No reference intervals
SEMINAL FLUID ANALYSIS, POST VASECTOMY, Semf	No sperm present
SODIUM, P/S	MALE, FEMALE, UNKNOWN mmol/L 0 – 150 yr 135 - 145
THROMBIN TIME, P	Reference interval varies with instrument/testing location. Please refer to the patient report or look in NetCare or the EMR.
THYROXINE (T4), FREE, P/S	MALE, FEMALE, UNKNOWN pmol/L 0 d - 13 d 10.0 - 54.0 14 d - 150 yr 9.0 - 23.0
TRIGLYCERIDE, P/S	MALE, FEMALE, UNKNOWN: mmol/L 0 – 17 yr < 1.50 The following comment will be attached to the result: Acceptable limit relative to dyslipidemia and atherosclerosis risk <0.85 mmol/L (0-9 years) OR <1.02 mmol/L (10-17 years). 18 – 150 yr 0.00 – 1.70
TROPONIN I (TnI), P/S	Reference range varies with instrument. Please refer to patient report for current value(s).
TSH (THYROID STIMULATING HORMONE), P/S	MALE, FEMALE, UNKNOWN mU/L 0 – 13 d 1.00 - 25.00 14 – 76 d 1.00 - 10.00 77d – <1 yr 0.40 - 7.00 1 – <5 yr 0.40 - 6.00 5 – <14 yr 0.30 - 5.00 14 – 150 yr 0.20 - 4.00
URATE, P/S	MALE, FEMALE, UNKNOWN µmol/L 0 – 9 yr 100 – 300 MALE/UNKNOWN 10 – 17 yr 135 – 510 18 – 150 yr 180 – 500 FEMALE 10 – 17 yr 180 – 450 18 – 150 yr 150 – 400
UREA, P/S	MALE, FEMALE, UNKNOWN mmol/L < 2 yr 1.0 – 7.5 2 – 17 yr 2.0 – 7.0 MALE/UNKNOWN 18 – 55 yr 3.0 – 8.0 >55 yrs 3.0 – 9.0

Test	Reference Intervals
	FEMALE 18 – 55 yr 2.0 – 7.0 >55 yr 3.0 – 8.0
URINALYSIS, U	MALE, FEMALE, UNKNOWN 0 – 150 yr Blood: Negative Clarity: Clear Color: Yellow Glucose: Negative Ketone: Negative Leukocytes: Negative Nitrite: Negative pH: 5 – 8 Protein: Negative SG: 1.005 – 1.030
URINALYSIS MICROSCOPIC, U	MALE, FEMALE, UNKNOWN 0 – 150 yr WBC: 0 – 5/hpf RBC: 0 – 2/hpf Squamous/Transitional epithelial cells: 0 – 5/hpf Renal Tubular epithelial cells: negative Bacteria & other organisms: Negative Casts, hyaline: 0 – 2/lpf All other cast types: Negative Oval Fat Bodies, Trichomonas and Yeast: Negative

Blood Gases Reference Intervals

TEST NAME	ADULT/PEDIATRIC	
	ARTERIAL	VENOUS
Blood Gases i-STAT	**Reference Interval**	**Reference Interval**
pH	7.35 - 7.45	7.32 - 7.42
pCO_2 (mmHg)	35 - 45	40 - 50
pO_2 (mmHg)	70 - 90	30 - 50
HCO_3 (mmol/L)	20 - 26	22 - 28
Base Excess (mmol/L)	- 2 to +2	- 2 to +2
TCO_2 (mmol/L)	21 - 28	23 - 30
O_2 Saturation (%)	92 - 98	60-80

*Manufacturer suggested reference interval verified in house

TEST NAME	ADULT/PEDIATRIC		
	ARTERIAL	VENOUS	CAPILLARY
Blood Gases IL GEM® Premier 4000	**Reference Interval**	**Reference Interval**	**Reference Interval**
pH	7.35 - 7.45	7.32 - 7.42	7.34 - 7.44
pCO_2 (mmHg)	35 - 45	40 - 50	37 - 47
pO_2 (mmHg)	70 - 90	30 - 50	40-60
HCO_3 (mmol/L)	20 - 26	22 - 28	21 - 27
Base Excess (mmol/L)	- 2 to +2	- 2 to +2	- 2 to +2
TCO_2 (mmol/L)	21 - 28	23 - 30	22 - 29
O_2 Saturation (%)	92 - 98	60 - 80	90 - 95
Hb (g/L)	120-180		120 - 180
O_2Hb (%)	92 - 98		90 - 95
COHb (%)	0 - 3	0 - 3	0 - 3
MHb (%)	0 – 1.5		0 - 1.5
Ionized Calcium (mmol/L)	1.10 – 1.48 (0-14days) 1.09-1.25 (14days)		
Lactate (mmol/L)	0.5-2.2	0.5-2.2	

TEST NAME	CORD/UMBILICAL	
	ARTERIAL	VENOUS
Blood Gases IL GEM® Premier 4000 and i-STAT	**Reference Interval**	**Reference Interval**
pH	7.20-7.40	7.25-7.45
	"Physiologically, the arterial cord blood pH is always expected to be lower than the venous cord blood pH. When the arterial pH >venous pH, this likely indicates a sampling error or specimen mislabeling."	
	A pH < 7 for an arterial cord blood sample may indicate a severe hypoxic event intrapartum or prepartum.	

*Manufacturer suggested reference interval verified in house