Appendix A - Major Changes for Laboratory Medicine with Connect Care Fully Launched Sites

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A. Clinical Microbiology

Ordering COVID-19 and other respiratory virus testing in Connect Care:

Use the "Respiratory Infection (inc. COVID-19) NAT" smart group.

- Select the patient presentation/encounter (Admitted or ED patient likely to be admitted; ED likely to be discharged; outpatient)
- Select the symptoms present (influenza-like illness (ILI); other COVID-19 symptoms; asymptomatic)
- "Rapid COVID-19 PCR" is automatically selected for all patients. All other orders must be selected if testing is indicated. Samples will be routed for rapid on-site testing based on the selections made.
- If the patient has ILI:
    - If influenza or RSV is circulating, select "Rapid Influenza and RSV NAT"
- The respiratory pathogen panel can also be selected if they meet the criteria listed.
- For outbreak screening, select "Asymptomatic" and then "Outbreak"
- A specific smart group with defaults set for ETT's/BAL's can be added to your preference list upon request if you order this testing on ETT's and BAL's more frequently than other specimen sources.

Blood Cultures

- For patients weighing >30kg, use the "Blood culture Panel x 2" in order sets regardless of patient age
- Refer to the APL collection guidelines for pediatric blood cultures to optimize the sensitivity and help identify true line infections vs. contaminants. Blood cultures should always be collected from two (2) sites in patients >30kg and is suggested for all patients except neonates.
- For patients weighing ≤30kg, use the "Blood Culture Panel-Pediatric (weight based)" order set. Bottles will be ordered and collected as follows:

Body Weight (kg)	Site 1	Site 2	Number of bottles to be collected
Less than or equal to 5 kg	Pediatric Bottle Minimum 1 mL		1
5.1 - 12.7 kg	Pediatric Bottle 4 mL	Pediatric Bottle 2-4 mL	1-2
12.8 kg - 30 kg	Aerobic + Anaerobic 10 mL + 10 mL	Aerobic 10 mL	2-3
Greater than 30 kg	Aerobic + Anaerobic 10 mL + 10 mL	Aerobic + Anaerobic 10 mL + 10 mL	4

***Cutibacterium (Propionibacterium)* culture for prosthetic devices**

- When ordering a tissue or fluid culture associated with a prosthetic device. There is a built in question for tissue and fluid culture orders "Prosthetic implant in situ" or "Is this tissue associated with an implanted medical device?" Select "Yes" if this is the case and the lab will hold plates for *Cutibacterium.*
- All cultures also have a "suspect organism" field you can fill out from a list of common organisms or free text.

Ordering NAT/PCR vs Serology

Viral loads (e.g. HIV viral load, EBV viral load) and other PCR tests are all termed 'NAT' (nucleic acid test) in Connect Care. Ensure that the name of the order correctly corresponds to the test you require (i.e. a serology (antibody) test versus a NAT (PCR) test). Incorrect ordering of tests can lead to testing delays, test cancellations, incorrect tubes being collected, and repeat blood draws. If you have questions about which NAT/PCR or serology infectious disease tests, consult the test directory or call the ProvLab microbiologist on-call at 403-333-4942.

Further changes to Microbiology orders in Connect Care vs. Meditech are summarized in the table below:

Notable Microbiology orders in Connect Care vs. Legacy (Meditech)-Not all inclusive:		
Connect Care Order Name	**Legacy (Meditech) Order Name**	**Notes**
ROUTINE BACTERIOLOGY		
Acute Pharyngitis Screen	Culture, Throat	For throat swabs for Group A Streptococcus
Bacterial Enteric Panel	Culture, Stool	Testing performed will be culture or PCR for common bacterial pathogens (site-dependent). For lab sites performing PCR, culture will also be performed on all PCR-positive specimens.
Bronchial Culture, Routine	Culture/Gram, Respiratory	For bronchoscopically-obtained brushes, washes and lavages. For EBUS aspirates, order Fluid Culture.
Ear Canal Culture	Culture/Gram, Ear	For swabs of the external ear canal, order 'Ear Canal Culture'. For all other ear specimen types, order 'Wound Culture', 'Tissue Culture'or 'Fluid Culture', as appropriate
Eye Culture, Superficial Eye Culture, Invasive	Culture/Gram, Eye	For swabs of the eye, order 'Eye Culture, Superficial' For all other eye specimen types, order 'Eye Culture, Invasive'
Sputum Culture, Routine	Culture/Gram, Respiratory	For aspirated (e.g. endotracheal, tracheotomy) and expectorated sputa
Wound Culture	Culture/Gram, Superficial Culture/Gram, Wound Deep	For swabs of superficial or deep wounds only. For fluid collections, submission of aspirated fluid material is preferred if feasible; order Fluid Culture. If clinically appropriate it is always preferable to collect a tissue/bone sample submit tissue (order Tissue culture or Bone culture)
Mycobacterium Culture	TB Culture/AFB Smear	For tuberculous and non-tuberculous mycobacteria smear and culture, including blood. Culture for other bacteria must be ordered separately according to specimen type/source.
Blood Culture Panel-Pediatric (weight based) Blood Culture Panel Adultx2 Blood Culture Panel Adult x3 (Endocarditis)	Culture, Blood	See "Blood Cultures" section above this table
Implanted Medical Device Culture	Culture/Gram, Foreign Body	Use for culture of explanted pacemakers, prosthetic joints, deep brain stimulators, IUDs etc. **Do not use for catheter tips** – use "Catheter Tip Culture" instead.
Genital Culture, Bacterial	Culture/Gram, Genital	

Notable Microbiology orders in Connect Care vs. Legacy (Meditech)-Not all inclusive:		
Connect Care Order Name	**Legacy (Meditech) Order Name**	**Notes**
PARASITIC INVESTIGATIONS		
Stool Parasite Screen Ova And Parasites, Tissue And/Or Fluid	Ova and Parasite Examination Source: Stool, Urine	The screen will routinely test for Giardia and Cryptosporidium by molecular/antigen detection. If microscopic examination of stool specimens for O&P is required, order Stool Parasite Screen and indicate relevant clinical history. O&P tissue/fluid (including urine) is done by microscopy.
INFECTION PREVENTION AND CONTROL		
ARO Screening MRSA And CPO - **MRSA Nasal and Inguinal Swab (1 order, 2 swabs)** - MRSA wound swab - CPO Screen Screening will be triggered as per IPC current protocols.	ARO Hospital Admission Screen Adult: - **MRSA Nasal swab** - **MRSA Rectal**/ostomy Swab - MRSA Wound swab - VRE rectal/ostomy swab (routine screening discontinued in 2021) ARO Hospital Admission Screen Peds: - **MRSA Nasal swab** - **MRSA Groin swab** (umbilicus if <2 mo) - MRSA wound	This admission screening order panel is only accessible in Connect Care via the ARO Admission Screening Best Practice Advisory (BPA) which is part of RN and not MD workflow. This panel is not on MD Admission order sets. Tests are still accessible independent of order panel if needed [Methicillin-Resistant Staphylococcus aureus (MRSA) Screen]. **Based on new Infection Prevention and Control guidelines, MRSA screening will be performed on nasal + inguinal swabs, as opposed to the previous nasal + rectal swabs. The nasal/inguinal swab results will be reported as one order instead of two separate orders**
Carbapenemase Producing Organisms Screen	Carbapenemase Producing Organisms	Should only be ordered by Infection Prevention and Control or by consultation with the Microbiologist on-call.
ESBL Screen	Not previously orderable.	To be ordered exclusively by Infection Prevention and Control

B. Clinical Biochemistry

I. Standardization in Test Reporting

Note: Site specific information is given in some instances but be aware that standardization and alignment in reporting is standard in Connect Care. Be aware that new reference intervals, flagging limits, comments, etc. may be present. Contact your local laboratory if you have site specific questions.

Note: Minor routing changes of tests not done on site may be seen. These are not expected to significantly impact turnaround time. Please contact the lab with any questions or concerns.

Reporting Ranges

- The upper limit of the reporting range for some tests will change and therefore results may now report with a greater than (>) instead of a numeric result. Please contact Laboratory for more information if required.

Random Urine Changes

- Orders for random urine albumin, calcium, or total protein will be reported as the analyte concentrations and the analyte/urine creatinine ratios as well as associated reference intervals. Reference interval changes may apply.

Timed Urine Changes

- Orders for timed urine albumin will be reported as the analyte concentrations and the analyte/urine creatinine ratios as well as associated reference intervals. Reference interval changes may apply.

24-hour Urine Changes

- Urine electrolytes will include an anion gap.
- If Urine protein >6.00 ratio will report as ">"
- 24-hour urines will be reported with urine creatinine and provincially standardized daily reference intervals

Alanine Aminotransferase

- Reference interval has been standardized by instrument type. This may not be a change at each site.

Site	Age	Reference Interval U/L
Rural South Zone and North Zone (Ortho Vitros)	0d - < 17y	<40
	>/= 18y F	<50
	>/= 18y M/U/X	<70

Anion Gap

- Anion Gap will be automatically calculated for all electrolyte panels.
- Standardized reference intervals will be implemented by instrument type (only Launch 7 sites included below):

Testing Site	Instrument	Reference Interval (mmol/L)
Rural Sites using iSTAT	Abbott iSTAT	13 – 21
Chinook Regional Hospital Medicine Hat Regional Hospital	Roche Cobas	4 – 16
Chinook Regional Hospital Medicine Hat Regional Hospital	ABL90 FlexPlus	4 – 16
Rural Sites using Ortho Vitros	Ortho Vitros	8 – 15

Bilirubin

- Total bilirubin is a single order, regardless of age. Neonatal bilirubin does not need to be specifically ordered; Epic will default to the appropriate test by patient age.
- Standardization in available tests to order and in the reference intervals (see Section III. b):
    - Bilirubin, Total
    - Bilirubin, Total and Conjugated
- Specific testing will follow when above tests are ordered based on patient age and instrument availability.
- Both tests (Bilirubin, Total; Bilirubin, Total and Conjugated) will reflex to the Biliary Atresia protocol in the appropriate age group (7 days to 5 months)
    - Note: If age 0-6 days or age >5 months, conjugated bilirubin will be performed only if "Bilirubin, Total and Conjugated" is ordered

Blood Gases

- At Chinook Regional Hospital and Medicine Hat Regional Hospital, blood gas panels have been standardized by analyte between the central laboratory and Point of Care Testing. Please note that pO2, sO2, and oxyhemoglobin will not be reported by the central laboratory if the specimen is collected in a Vacutainer. Please contact laboratory for any questions.
- Reference intervals and critical values for blood gases were standardized for the province in preparation for Connect Care Implementation. Please see the Blood Gas section under Point of Care Testing for information and refer to Blood Gas Standardization of Reference Intervals & Critical Values.

C-Reactive Protein

- Standardized reference intervals by instrument (only Launch 7 sites included below) will be implemented:

Testing Site	Instrument	Reference Interval (mg/L)
Chinook Regional Hospital Medicine Hat Regional Hospital	Roche Cobas	<8.0

Cardiovascular Disease Risk Assessment (CVDRA)

- The Cardiovascular Disease (CVD) Risk Assessment (CVDRA) is available to order through Connect Care
- This test includes a standard lipid panel; in addition, when the answers to all required history questions are provided and the patient is not automatically classified as high risk based on the lipid panel results and/or answers to history questions, a 10-year Framingham risk score is calculated and reported with an appropriate interpretive comment based on the most recent Canadian Cardiovascular Society Dyslipidemia guidelines.
- If answers to the required history questions are not provided, only a lipid panel will be reported.
- See January 24, 2022 Lab Bulletin: Introduction of Cardiovascular Disease Risk Assessment Lab Order in Connect Care

Cortisol

- There has been standardization of interpretive comments for Cortisol which are based on the specific assay in use. Please contact the laboratory if further information is required for interpretation.

Creatinine Clearance

- Standardized reporting units: ml/min/1.73m^2
- New reference interval: 78.00 – 138.00 ml/min/1.73m^2

Electrolyte Panel

- Only one electrolyte panel is available. It consists of Sodium, Potassium, Chloride, CO2, and Anion Gap

Electrolyte Panel, Urine

- There is a random and 24 hour panel available
- Panel consists of Urine Sodium, Urine Potassium, Urine Chloride and Urine Anion Gap
    - Anion Gap, Urine = (UNA + UK) – UCL mmol/L

Fluids

- At Medicine Hat Regional Hospital, each fluid test must now be ordered individually (additional reflex testing has been discontinued).
- For ascites, the serum ascites albumin gradient will no longer be automatically provided at Medicine Hat Regional Hospital when an ascites fluid is received in laboratory

Gentamicin

- New test code available is "Gentamicin Level, 8 Hour Interval."

Glucose meter check

- This test is now available across the province and is intended to check the accuracy of patient's glucose meter against the lab glucose result, and will have three required order questions:
    - Fasting time
    - Patient glucose meter type
    - Patient glucose meter result

Hemoglobin A1c

- New reference interval: 4.3 – 5.9%
- Most patients with diabetes require HbA1c monitoring with one test per 3 months; utilization rules for HbA1c are built into Connect Care:

Order frequency for …	Age	Is limited to …
Male	All	Once every 60 days
Female, Unknown/X	< 10 yr or > 55 yr	
	10 yr to 55 yr	Once every 21 days

- When clinically appropriate, a clinical exception can be requested to bypass the utilization rule.

HIV Serology by Rapid Assay (Rapid HIV)

- This test is orderable in Epic as "HIV Serology by Rapid Assay."
- Process instruction on order screen:
    - Rapid HIV is intended for URGENT DIAGNOSIS of HIV for the indications listed in "reasons for testing". Order HIV 1 and 2 Serology (Antigen and Antibody) for routine diagnosis. For Blood and Body Fluid Exposures order "BBFE Panel".
- All rapid HIV results (non-reactive, indeterminate, reactive, Invalid) will reflex to a HIV serology test (confirmation test performed at ProvLab)
- There are now only four clinical indications for testing. They are listed as order questions:
    - Female in labor and delivery with no prenatal care or recent HIV testing
    - Acutely ill patient with HIV in the differential diagnosis
    - Person with HIV high risk behaviors, unlikely to return for results
    - Other (must specify)

Ionized Calcium

- "Calcium, ionized" and "Calcium, Ionized, pH adjusted" will be reported with standardized critical values: <0.80 mmol/L and >1.50 mmol/L
- Standardization of reference intervals by instrument has occurred for "Calcium, ionized" and "Calcium Ionized, pH adjusted" (Launch 7 sites included below):

Testing Site	Instrument	Parameter	Age – change to 15 day info for ABL	Reference Interval (mmol/L)	Critical Values (mmol/L)
Chinook Regional Hospital Medicine Hat Regional Hospital	ABL90 FlexPLus	Calcium, Ionized	<15 days	1.10 – 1.48	<0.80, >1.50
			15 days – 150 years	1.09 – 1.25	
		Calcium, Ionized, pH adjusted	<15 days	1.10 – 1.48	
			15 days – 150 years	1.09 – 1.25	
Slave Lake Healthcare Centre Edson Healthcare Centre Westlock Healthcare Centre William J. Cadzow – Lac La Biche Healthcare Centre Whitecourt Healthcare Centre St. Therese – St. Paul Healthcare Centre Hinton Healthcare Centre	Abbott iSTAT	Calcium, Ionized	All	1.15-1.35	<0.80, >1.50
		Calcium, Ionized, pH normalized	All	1.15-1.35	<0.80, >1.50

Iron and Total Iron Binding Capacity (TIBC)

- When Unsaturated Iron Binding Capacity (UIBC) is <3 umol/L, the TIBC and the Iron Saturation Index cannot be calculated. In these cases, a new component will be reported: Iron Saturation Estimate.
    - Iron Saturation Estimate = >(iron / iron +2)

Ketone Screen, blood

- New test code is "Beta-Hydroxybutyrate (BOH)"

Lactate Dehydrogenase (LD), CSF

- New orderable

Lactose Tolerance, 2 hours

- A cutoff of 1.1 mmol/L will be used to determine whether the test is normal or abnormal
    - If a difference of 1.1 mmol/L glucose or greater from baseline to either the 30 min, 60 min, or 120 min time point is observed, the test result is NORMAL
    - If a difference of less than 1.1 mmol/L from baseline to ALL of the 30 min, 60 min, and 120 min time points is observed, then the result is ABNORMAL
- Standardization and recording of time to consume drink and drink dose:
    - If more than 5 minutes taken to drink the dose, the following comment will append to the report: *"Drink consumed over X minutes, not the recommended 5 minutes. Interpret results with caution.*"

NT-proBNP

Standardized reporting units will be in ng/L. Interpretative comments will reflect these standardized units.

Occult Blood, Stool

- A new standardized test comment will append to all fecal occult blood test results: "*Fecal Occult Blood Testing may be of limited clinical value due to potential interferences, especially if processed immediately after collection. The test result may be subject to interference from Vitamin C supplements (false negative), and dietary and/or medication interference (false positive).*"

Osmolal Gap

- There are three new orderable tests:
    - Osmolal Gap
    - Osmolal Gap, Unaccounted
    - Osmolality, Calculated
    - Fecal Osmolal Gap
- Standardization for reporting of "Osmolal Gap, Unaccounted" by applying factor of 1.25 on the ethanol result.
    - If ethanol <2, then zero will be used for ethanol to calculate "Osmolal Gap, Unaccounted."
- "Osmolal Gap, Unaccounted" must be ordered to be reported, as it will no longer be automatically added to the order if Osmolal Gap is ordered, and Ethanol is >=2
- At Chinook Regional Hospital, an additional sample for volatile testing (alcohol panel) will no longer be collected along with the Osmolal gap. If testing for volatile alcohols is required, a second collection is required.

Troponin

- This test code will order the troponin (conventional or high sensitivity) that is available at the local site to ensure quick turnaround time.
- A delta will be calculated for high sensitivity troponin method when there are consecutive measurements available, with the absolute difference in ng/L being reported on the patient chart.
- ONLY Outpatients/Community patients with critical troponin I (TnI) results (>0.10 ug/L), troponin T (TnT) results (>0.100 ug/L) or high sensitivity Troponin T (TnT) results (>52 ng/L) will have their results phoned to the ordering physician.
    - Be aware of the unit change for troponin T (TnT), as it has been standardized for troponin T (TnT) to ug/L. Sites with TnT are: Bassano Health Centre, Bow Island Health Centre, Brooks Health Centre, Oyen Big Country Hospital.
- Hemolysis is known to severely decrease results for the Troponin T, High Sensitivity test method that is used at Chinook Regional Hospital and Medicine Hat Regional Hospital. Hemolyzed samples drawn on inpatients or emergency patients will be sent for recollection to eliminate interference. Subsequent hemolyzed samples collected within 6 hours of the initial sample will be reported to assist in clinical interpretation. Hemolyzed samples received on outpatients will not be reported due to interference and must be reordered by the physician.

Urate (Rasburicase)

- New orderable test, "Urate, (Rasburicase)", will be available for plasma urate testing when patient is on Rasburicase. It includes collection instructions and a separate label to indicate a separate tube is required for the special collection.

Vitamin B12

- Reference interval for Vitamin B12 in patients aged 0 – 9 y is standardized as follows. This is not a change for sites that refer to sites that went live in previous launches.

Age	Reference Interval (pmol/L)
0 – 9 y	>/= 250
>/= 10y	No change (>/= 160)

II. Gender U and X

- Changes have been made to improve reporting of Gender U and X results when patients are resulted within a laboratory live on Connect Care. There are still challenges in legacy systems in adopting gender U and X which may be exacerbated if a patient has testing performed at multiple sites in the province since the legacy system may overwrite gender identity when they register a patient.
    - Tests that have different male and female reference intervals will have specific reference intervals designated for U and X and will include a reporting comment with the test result
- Examples from Clinical Biochemistry are provided below, Hematology parameters are later in this document.
    - Creatinine
      ≥ 15 years: 40-120 umol/L
      Patient identifies as gender X, or gender is unknown. The reference interval provided encompasses male and female ranges. Result should be interpreted in the context of the clinical history.
    - LH
      For patients ≥10 years the following comment will append:
      Reference Interval:
      Follicular < 15.0 IU/L
      Luteal < 15.0 IU/L
      Midcycle 30.0 – 100.0 IU/L
      Post Menopausal: 18.0 – 65.0 IU/L
      Male < 12.0 IU/L
      Patient identifies as gender X, or gender is unknown. Interpret result based on an appropriate reference interval listed above.

III. Clinical Biochemistry Reference Interval and Critical Value Standardization

a) Urinalysis

Current urinalysis reporting in Alberta uses multiple different instruments and reporting schemes, particularly for macroscopic (dipstick) reporting. With Connect Care, urinalysis will be standardized to align reporting across the province. See tables below for new reporting information.

Major changes:

- Most Launch 7 sites already report in SI units, so there may not be a change in reporting categories with Connect Care at your site. The provincially standardized build for instruments is shown below for reference.

	Connect Care Provincially Standardized Reporting	
Analyzer	**Clinitek**	**Reference Interval**
Performing Lab	All Launch 7 Sites	
Ascorbic Acid	Not applicable Not applicable	Not Applicable
Glucose	Negative 5.5 mmol/L 14 mmol/L 28 mmol/L >= 55 mmol/L	Negative
Ketones	Negative Trace 1.5 mmol/L 3.9 mmol/L >=7.8 mmol/L	Negative
Protein	Negative Trace 0.3 g/L 1.0 g/L >=3.0 g/L	Negative
Leukocyte Esterase	Negative 15 Leu/µL 70 Leu/µL 125 Leu/µL 500 Leu/µL	Negative
Blood	Negative Trace-Lysed Trace-Intact 25 Ery/µL 80 Ery/µL 200 Ery/µL	Negative
Nitrite	Negative Positive	Negative

Not Applicable: Indicates this value is not a reporting option by the analyzer/dipstick.

*Clinitek reporting has been updated since Launch 1 to condense the previous categories of 'Trace-Intact' and 'Trace-Lysed' into one category called 'Trace.'

- Urinalysis reporting has been standardized to use the same reference intervals and units for both

macroscopic and microscopic reporting (See tables below)

Macroscopic Urinalysis Tests

Analyte	Reference Interval	Units
Blood, Urine	Negative	Ery/µL
Clarity, Urine	Clear	-
Color, Urine	Colourless, Yellow, Amber	-
Glucose Urine	Negative	mmol/L
Ketones, Urine	Negative	mmol/L
Leukocyte Esterase, Urine	Negative	Leu/µL
Nitrites, Urine	Negative	-
pH, Urine	5.0-8.0	-
Protein, Urine	Negative	g/L
Specific Gravity	1.005-1.030	-

Microscopic Urinalysis Tests

Component	Reference Interval	Units
RBC	0-2	RBC/HPF
WBC	0-5	WBC/HPF
Bacteria	0-20	Bacteria/HPF
Epithelial Cells	0-5	Epithelial Cells/HPF
Non-squamous epithelial cells	0-5	Non-squamous epithelial cells
Hyaline Casts	0-2	Hyaline casts/LPF
Other cast types	Absent	Casts/LPF
Crystals	Absent	Crystal/HPF
Yeast	Absent	N/A

b) General Chemistry Tests

There has been provincial standardization of reference intervals, critical values and/or units. See table below for new reporting information. These may not be new at each site; however, the addition of Gender X is new for South Zone.

M = Male; F = Female; U = Unknown Sex; X = Gender X

Analyte	Age	Gender (M, F, U, X)	Reference Interval	Units	Critical Value
Ammonia	0 d – < 3 mo	M, F, U, X	30 –100	µmol/L	>110
	3 mo – 16 yr		20– 50		>110
	> 16 yr		20 – 50		>200
Alkaline Phosphatase	0 - 14d	M, F, U, X	70 – 320	U/L	None
	15 – 364 d	M, F, U, X	130 – 500		
	1 – 12 y	M, F, U, X	130 – 430		
	>/= 18 y	M, F, U, X	40 – 120		
	13 – 14 y	F	60 – 225		
	15 - 17 y	F	50 – 140		
	13 – 14 y	M	130 – 500		
	15 – 17 y	M	60 – 250		
	13 – 14 y	U, X	60 – 500		
	15 – 17 y	U, X	50 - 250		
Beta hCG, Quantitative	All	M, F, U, X	< 5	IU/L	None
Bilirubin, Conjugated	All	M, F, U, X	<7	µmol/L	None
Bilirubin, Total	0 d – < 7 d	M, F, U, X	None	µmol/L	>300
	7 d – < 15 d	M, F, U, X	<250		>300
	15 d – < 30 d		<20		>300
	30 d – 150 yr		<20		None
Cholesterol	0 d – < 2 yr	M, F, U, X	2.36 – 5.32	mmol/L	None
	2 yr – < 18 yr		2.70 – 5.89		>300
	18 yr – 150 yr		None		None
Creatine Kinase	All	F	30 – 200	U/L	None
		M, U, X	30 - 350		
Creatinine	<1 d	M, F, U, X	None	µmol/L	None
	1 d – < 2 yr		10 – 40		
	2 yr – < 6 yr		20 – 45		
	6 yr – < 13 yr	M, F, U, X	20 – 75	µmol/L	None
	13 yr – < 15 yr	M	30 – 95		
	15 yr – 150 yr	F	50 – 120		
	15 yr – 150 yr	U, X	40 – 100		
	15 yr – 150 yr		40 – 120		
Estradiol	0 mo – < 1 mo	M, F, U, X	< 350	pmol/L	None
	1 mo – < 10 yr	M, F, U, X	< 30		
	>= 10 yr	F	Follicular: 110 - 330 Midcycle: 220 - 1960 Luteal: 220 - 850 Post-menopausal: <= 500		
	>= 10 yr	M	< 160		
	>= 10 yr	U, X	Appended comment includes male and female reference intervals		
Ethanol	0 d – 150 yr	M, F, U, X	< 2	mmol/L	>65

Folate	All	M, F, U, X	>= 10	nmol/L	None
Iron	0 d – 150 yr	M, F, U, X	8 - 35	umol/L	Less than 12 yr: >54
Iron Saturation Index	0 d – 17 yr	M, F, U, X	0.10 – 0.50	None	None
	18 yr – 150 yr	M	0.12 – 0.60		
	18 yr – 150 yr	F	0.10 – 0.55		
	18 yr – 150 yr	U, X	0.10 – 0.60		
NTpro BNP	0 d – < 1 yr	M, F, U, X	54 – 556	ng/L	None
	1 yr – < 2 yr		39 – 578		
	2 yr – < 6 yr		20 – 565		
	6 yr – < 12 yr		10 – 340		
	12 yr – < 18 yr		6 – 216		
	18 yr – 150 yr		0 – 300		
Osmolality, Urine	0 d – 150 yr	M, F, U, X	50 – 1400	mmol/kg	None
Testosterone	0 – 5 mo	F	< 2.0	nmol/L	None
	0 – 5 mo	M, U, X	< 19.0		
	6 mo – 10 yr	M, F, U, X	< 0.20		
	11 yr – 17 yr	F	< 1.8		
	11 yr – 14 yr	M	< 20.0		
	15 yr – 17 yr	M	4.0 – 27.0		
	18 yr – 150 yr	F	< 2.0		
	18 yr – 150 yr	M	8.0 – 35.0		
Total Iron Binding Capacity	0 d – 17 yr	M, F, U, X	50 – 80	umol/L	None
	18 yr – 150 yr	M, F, U, X	40 - 75		
Urate	0 d – < 5 yr	M, F, U, X	100 – 300	umol/L	None
	5 yr – < 10 yr	M, F, U, X	140 – 330		
	10 yr – < 18 yr	M	160 – 500		
	10 yr – < 70 yr	F	150 – 400		
	10 yr – 150 yr	U, X	150 – 500		
	18 yr – 150 yr	M	200 –500		
	70 yr – 150 yr	F	150 – 500		
Urine Calcium, 24 hr	All	M, F, U, X	2.0 – 7.5	mmol/d	None
Urine Calcium/ Creatinine Ratio	0 yr – <1 yr	M, F, U, X	< 2.25	mmol/mmol	None
	1 yr – <2 yr		< 1.70		
	2 yr – <3 yr		< 1.40		
	3 yr – <5 yr		< 1.20		
	>= 5 yr		< 0.60		
Urine Chloride, 24 hr	All	M, F, U, X	110 – 250	mmol/d	None
Urine Creatinine, 24 hr	0 yr – < 3 yr	M, F, U, X	None	mmol/d	None
	3 yr – < 9 yr		1.0 – 6.0		
	9 yr – < 13 yr		5.0 – 12.5		
	13 yr – < 18 yr		7.0 – 16.5		
	>= 18 yr	M	9.0 – 18.0		
		F	7.0 – 16.0		
		U, X	7.0 – 18.0		
Urine Phosphate, 24 hr	All	M, F, U, X	15.0 – 50.0	mmol/d	None
Urine Potassium, 24 hr	All	M, F, U, X	25.0 – 125.0	mmol/d	None
Urine Sodium, 24 hr	All	M, F, U, X	45 – 250	mmol/d	None
Urine Urate, 24 hr	All	M, F, U, X	1.5 – 4.5	mmol/d	None
Urine Urea, 24 hr	All	M, F, U, X	430 – 710	mmol/d	None

c) Therapeutic Drug Monitoring and Toxicology Tests

Ethanol

- New comment will append to all Ethanol results: "*This result must not be used or disclosed for potentially medicolegal or other non-medicalpurposes.*"

For all Therapeutic Drug Monitoring (TDM)

- Order/collection questions: TDM dosing information (regimen/route/time of last and next dose/regimen duration).
- This request mirrors information collected on paper requisitions.
- Dosing information, if provided, will appear on the final report

Reference intervals There has been provincial standardization of reference intervals, critical values and/or units. See below table for standardized reporting information.

Analyte	Target Level	Units	Critical Value	Comment
Acetaminophen	Not applicable	umol/L	>250	*Consult Poison and Drug Information Service (PADIS) at 1-800-332-1414 if appropriate.*
Carbamazepine	17-50	umol/L	>65	
Digoxin	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 (target level appended to result as a comment)	nmol/L	>2.6	
Gentamicin (Pre-Dose)	<2	mg/L	>1.9	*Note: If patient is receiving extended interval dosing the target trough is less than 0.5 mg/L. Dosing is 4 to 10 mg/kg and interval is 24h or more.*
Gentamicin (Post-Dose)	5-10	mg/L	>14.9 mg/L	
Gentamicin, 8h Interval	See Hartford Nomogram	mg/L	>10.9	*CAUTION: Specimen should be collected 7-9 hours after the START of infusion for proper interpretation. Refer to Hartford Nomogram (applies only to 7 mg/kg dose; if other dose used, obtain pharmacokinetic consult). Refer to Aminoglycoside Dosing/Monitoring Guidelines, AHS Bugs and Drugs Online*
Gentamicin, Other	N/A	mg/L	>14.9	
Lithium	Acute mania therapy 1.00 -1.50 Bipolar maintenance 0.60 -1.20 Depression 0.30 - 0.60 (target level appended to result as a comment)	mmol/L	>2.00	
Methotrexate	<100	umol/L	None	*Level interpretation dependent on*

				institution protocols, type of therapy (intermediate versus high dose) and individual patient factors.
Phenobarbital	45 - 170	µmol/L	> 190	
Phenytoin, total	≤ 3 months: 25 – 55 >3mo: 40-80	umol/L	≤ 3 mo: >80 > 3 mo: >120	*CAUTION: For IV drug administration, specimen must be collected 2 hours or more after end of dose for proper interpretation.*
Salicylate	N/A	mmol/L	>2.20	
Tobramycin, Other	N/A	mg/L	>14.9	
Theophylline	28 - 83	µmol/L	>110	
Valproate	350 - 700	umol/L	>1040	
Vancomycin, Pre-Dose	10.0-20.0	mg/L	> 25.0	*Vancomycin Levels greater than 15 mg/L increase risk of nephrotoxicity. Note: Vancomycin levels may be undetectable or falsely low in patients with elevated Immunoglobulins. Contact Laboratory Senior Staff to arrange for alternate testing if required. Routine monitoring of vancomycin levels is not generally recommended. Please refer to Vancomycin Dosing/Monitoring Guidelines, AHS Bugs and Drugs Online Document.*
Vancomycin, Other	N/A	mg/L	>60.0	*Note: Vancomycin levels may be undetectable or falsely low in patients with elevated Immunoglobulins. Contact Laboratory Senior Staff to arrange for alternate testing if required. Routine monitoring of vancomycin levels is not generally recommended. Please refer to Vancomycin Dosing/Monitoring Guidelines, AHS Bugs and Drugs Online Document.*

d) Blood Gas Tests

Reference intervals and critical values were standardized for the province in preparation for Connect Care Implementation through Clinical Knowledge and Content Management (CKCM). The Working Group assigned to this was created in consultation with the Critical Care Strategic Clinical Network, the Provincial Respiratory Professional Practice Council, and Laboratory Point of Care Testing Network, with additional experts consulted as required.

See the **Point of Care Testing** section below, and refer to Blood Gas Standardization of Reference Intervals & Critical Values.

C. Point of Care Testing (POCT)

I. Result inclusion of POCT devices

There are changes to result reporting for POCT devices that may require workflow and clinical practice changes: see **Point of Care Testing (POCT) Information Sheet.**

- This can be found in the *Connect Care Knowledge Library* located on Insite on the main Connect Care page: Insite.ahs.ca/ConnectCare > Connect Care Support (Resources tab) > Knowledge Library.

A controlled connectivity rollover of POCT devices to the POCT AegisPOC data management middleware, and then into Epic will occur in conjunction with Connect Care Launches. Results from POCT devices will either: 1) flow directly from the device through the new POCT middleware into the electronic medical record (i.e. connected), or 2) be manually entered into AegisPOC so results can flow into Epic and then onto Netcare (i.e. unconnected).

Connected device workflows:

- POCT Device Connect Care Workflows
  - Roche Accu-Chek Inform II Glucose Meter
  - Abbott i-STAT1 and i-STAT Alinity
  - Radiometer ABL90 Flex Plus
  - Siemens Clinitek Status Plus
  - Sysmex pocH-100i

Unconnected (Manual Test Result Entry) device workflows:

- POCT Workflows for Manual Test Methods
  - AegisPOC Launch Button Set Up for Manual Test Result
  - AegisPOC Manual Test Result Entry - AmnioTest
  - AegisPOC Manual Test Result Entry - AmniSure
  - AegisPOC Manual Test Result Entry - Drager Jaundice Meter
  - AegisPOC Manual Test Result Entry - Glucose Meter
  - AegisPOC Manual Test Result Entry - Hemocue 201
  - AegisPOC Manual Test Result Entry - Manual Urine Dipstick
  - AegisPOC Manual Test Result Entry - Siemens Clinitek Status
  - AegisPOC Manual Test Result Entry - Urine Pregnancy
  - AegisPOC Manual Test Result Entry - Roche h232
- Additional AegisPOC Manual Test Result Entry Resource:
  - AHS My Learning Link course: “POCT-AegisPOC Manual Test Result Entry”

II. All healthcare professionals/providers must adhere to the following when performing POCT:

- Be a trained and certified clinical user of POCT
  - Completed POCT certification requirements to access or use all devices (manual or automated).
  - APL POCT will provide access to the POCT middleware system, AegisPOC, for result transmission or manual test result entry.
  - To determine if you are a certified user of a manual APL POCT supported program, review Provincial POCT - Manual Test Result Entry - Troubleshooting.
- Use your AHS employee ID barcode number to access POCT devices or to access the AegisPOC Manual Test Result Entry application.
- Use correct Epic patient identifier for POCT:
  - Use the correct encounter Epic-generated patient ID encounter (Contact Serial Number **[CSN]**).
  - Only the correct CSN will allow results to flow uninterrupted to the patient's Epic health record and to Netcare.
  - Additional Connect Care CSN Resources:
    - **Point of Care Testing (POCT) Work Package.** This can be found in the *Connect Care Knowledge Library* located on Insite on the main Connect Care page: Insite.ahs.ca/ConnectCare > Connect Care Support (Resources tab) > Knowledge Library
    - **AHS My Learning Link course**: "POCT-Connect Care POCT Requirements."

III. POCT Reference Interval and Critical Value Standardization

Anion Gap

- Standardization of reference intervals by POCT device (Launch 7 sites included below):

Testing Site	Instrument	Reference Interval (mmol/L)
Athabasca Healthcare Center Bonnyville Healthcare Center Edson Healthcare Center Hinton Healthcare Center Onoway Community Health Services Swan Hills Healthcare Center Pincher Creek Health Center Crowsnest Pass Health Center Milk River Health Center Cardston Health Center Taber Health Center	i-STAT	13-21
Northern Lights Regional Hospital (Ft. McMurray) Chinook Regional Hospital Medicine Hat Regional Hospital	ABL Radiometer 90 Flex Plus	4-16

Ionized Calcium

- Standardization of critical values: <0.80 mmol/L and >1.50 mmol/L
  Standardization of reference intervals by POCT device for "Calcium, ionized" and "Calcium Ionized, pH normalized" (Launch 7 sites included below):

Testing Site	Instrument	Reference Interval (mmol/L)
Athabasca Healthcare Center Bonnyville Healthcare Center Edson Healthcare Center Hinton Healthcare Center Swan Hills Healthcare Center Pincher Creek Health Center Crowsnest Pass Health Center Milk River Health Center Cardston Health Center Taber Health Center	i-STAT	1.15 – 1.35
Northern Lights Regional Hospital (Ft. McMurray) Medicine Hat Regional Hospital Chinook Regional Hospital	ABL Radiometer 90 Flex Plus	1.10 – 1.48 (<15 d) 1.09 – 1.25 (≥15 d)

Macroscopic urinalysis

- Standardization of reference intervals:

Analyte	Reference Interval	Units
Blood, Urine	Negative	Ery/µL
Clarity, Urine	Clear	
Color, Urine	Colourless, Yellow, Amber	
Glucose Urine	Negative	mmol/L
Ketones, Urine	Negative	mmol/L
Leukocyte Esterase, Urine	Negative	Leu/µL
Nitrites, Urine	Negative	-
pH, Urine	5.0-8.0	-
Protein, Urine	Negative	g/L
Specific Gravity	1.005-1.030	-

- Macroscopic Urinalysis Reporting

With each Connect Care Launch, all POCT urinalysis patient test results must be reported into the EPIC patient electronic medical record. This requirement applies to both **Manual** (dipstick, Clinitek Status) and **Automated** (Clinitek Status®+) testing. All reporting units for urinalysis testing in EPIC have been standardized provincially to SI units, which provides a numerical result rather than using other reporting schemes (e.g., 1+/2+/3+, small/medium/large).

Urinalysis result reporting for Connect Care

Test component	Siemens Clinitek Status Device result reporting	Manual Dipstick Urinalysis Test strip vial reporting	Connect Care (EPIC) Result Reporting
Color		Colorless	Colorless
	Yellow	Yellow	Yellow
	Amber	Amber	Amber
	Orange	Orange	Orange
	Red	Red	Red
	Brown	Brown	Brown
		Black	Black
	Other	Other	Other
Clarity	Clear	Clear	Clear
	Slightly Cloudy	Slightly Cloudy	Slightly Cloudy
	Cloudy	Cloudy	Cloudy
	Turbid	Turbid	Turbid
	Other (do not use)		
SG (Specific Gravity)	≤1.005	1.000	<1.005
		1.005	1.005
	1.010	1.010	1.010
	1.015	1.015	1.015
	1.020	1.020	1.020
	1.025	1.025	1.025
		1.030	1.030
	≥1.030		≥1.030
	Unable to interpret due to interfering substance	Unable to interpret due to interfering substance	Unable to interpret due to interfering substance
pH	5.0	5.0	5.0
	5.5		5.5
	6.0	6.0	6.0
	6.5	6.5	6.5
	7.0	7.0	7.0
	7.5	7.5	7.5
	8.0	8.0	8.0
	8.5	8.5	8.5
	≥9.0		≥9.0
LEU (Leukocytes) Leu/µL	Negative	Negative	Negative
	Ca 15	Trace (15)	15
	Ca 70	Small (+) (70)	70
	Ca 125	Moderate (++) (125)	125
	Ca 500	Large (+++) (500)	500
NIT (Nitrite)	Negative	Negative	Negative
	Positive	Positive	Positive
PRO (Protein)	Negative	Negative	Negative
	Trace	Trace	Trace
	0.3	0.3	0.3
	1.0	1.0	1.0
	≥3.0	3.0	≥3.0
		≥20	≥3.0

Test component	Siemens Clinitek Status	Manual Dipstick Urinalysis	Connect Care (EPIC) Result Reporting
	Device result reporting	Test strip vial reporting	
GLU (Glucose) mmol/L	Negative 5.5 14 28 ≥55	Negative 5.5 14 28 55 ≥111	Negative 5.5 14 28 ≥55 ≥55
KET (Ketone) mmol/L	Negative Trace 1.5 3.9 7.8 ≥15.6	Negative 0.5 1.5 4.0 8.0 16.0	Negative Trace 0.5 1.5 3.9 ≥7.8 ≥7.8 ≥7.8 ≥7.8
ERY (Erythrocytes) Ery/µL	Negative Trace-Lysed Trace-Intact Ca 25 Ca 80 Ca 200	Negative Non Hemolyzed Trace Non Hemolyzed Moderate Hemolyzed Trace Small (+) (25) Moderate (++) (80) Large (+++) (200)	Negative Trace Trace Trace 25 80 200

Blood Gas Tests

The following reference intervals and critical values were standardized for the province in preparation for Connect Care Implementation through Clinical Knowledge and Content Management (CKCM; Blood Gas Standardization of Reference Intervals & Critical Values). The Working Group assigned to this was created in consultation with the Critical Care Strategic Clinical Network, the Provincial Respiratory Professional Practice Council, and Laboratory Point of Care Testing Network, with additional experts consulted as required.

Arterial

Analyte	Reference Interval	Units	Critical Values	
pH	7.35 – 7.45	None	< 7.20	> 7.60
pCO2	35 – 45	mmHg	<20	>70
pO2	70 – 90	mmHg	<56	None
Bicarbonate (HCO3)	20 – 27	mmol/L	< 10	> 40
Total CO2	Not Reported	-	-	-
Base Excess	-4 to 1	mmol/L	None	None
Oxygen Saturation	90 – 100	%	None	None
Oxyhemoglobin	92 – 98	%	None	None
Carboxyhemoglobin	0.0 – 3.0	%	None	>15
Methemoglobin	0.0 – 1.5	%	None	>10
Deoxyhemoglobin	Not Reported	-	-	-
AaDO2	<15 Room Air <100 100%O2	mmHg	None	None

Venous

Analyte	Reference Interval	Units	Critical Values	
pH	7.30 – 7.40	None	< 7.15	> 7.55
pCO2	35 – 50	mmHg	< 15	>55 if pH < 7.2
pO2	30 – 50	mmHg	None	None
HCO3	20 – 27	mmol/L	< 10	>40
Total CO2	Not Reported	-	-	-
Base Excess	-4 to 1	mmol/L	None	None
Oxygen Saturation	50 – 80	%	None	None
Oxyhemoglobin	50 – 80	%	None	None
Carboxyhemoglobin	0.0 – 3.0	%	None	>15%
Methemoglobin	0.0 – 1.5	%	None	>10%
Deoxyhemoglobin	Not Reported	-	-	-

Capillary Blood Gas

Analyte	Reference Interval	Units	Critical Values	
pH	7.32 – 7.42	None	< 7.20	> 7.50
pCO2	35 – 45	mmHg	< 25	> 70
pO2	None	mmHg	None	None
HCO3	20 – 27	mmol/L	<10	>40
Total CO2	Not Reported	-	-	-
Base Excess	-6 to 1	mmol/L	None	None
Oxygen Saturation	90 – 100	%	None	None
Oxyhemoglobin	85 – 95	%	None	None
Carboxyhemoglobin	0.0 – 3.0	%	None	>15%
Methemoglobin	0.0 – 2.0	%	None	>10%
Deoxyhemoglobin	Not Reported	-	-	-

Mixed Venous

Analyte	Reference Interval	Units	Critical Values	
pH	7.30 – 7.40	None	None	None
pCO2	35 – 50	mmHg	None	None
pO2	None	mmHg	None	None
HCO3	None	mmol/L	None	None
Total CO2	Not Reported	-	-	-
Base Excess	None	mmol/L	None	None
Oxygen Saturation	None	%	None	None
Oxyhemoglobin	None	%	None	None
Carboxyhemoglobin	0.0 – 3.0	%	None	>15
Methemoglobin	0.0 – 1.5	%	None	>10
Deoxyhemoglobin	Not Reported	-	-	-

Central Venous

Analyte	Reference Interval	Units	Critical Values	
pH	7.30 – 7.40	None	None	None
pCO2	35 – 45	mmHg	None	None
pO2	None	mmHg	None	None
HCO3	None	mmol/L	None	None
Total CO2	Not Reported	-	-	-
Base Excess	None	mmol/L	None	None
Oxygen Saturation	None	%	None	None
Oxyhemoglobin	None	%	None	None
Carboxyhemoglobin	0.0 – 3.0	%	None	>15
Methemoglobin	0.0 – 1.5	%	None	>10
Deoxyhemoglobin	Not Reported	-	-	-

ECMO

Analyte	Reference Interval	Units	Critical Values	
pH	7.30 – 7.45	None	None	None
pCO2	35 – 50	mmHg	None	None
pO2	None	mmHg	None	None
HCO3	None	mmol/L	None	None
Total CO2	Not Reported	-	-	-
Base Excess	None	mmol/L	None	None
Oxygen Saturation	None	%	None	None
Oxyhemoglobin	None	%	None	None
Carboxyhemoglobin	None	%	None	None
Methemoglobin	None	%	None	None
Deoxyhemoglobin	Not Reported	-	-	-

Cord Blood Gas - Arterial

Analyte	Reference Interval	Units	Critical Values	
pH	7.2 – 7.4	None	<7.15	None
pCO2	35 – 70	mmHg	None	None
pO2	Not Reported	mmHg	-	-
HCO3	17 – 27	mmol/L	None	None
Total CO2	Not Reported	-	-	-
Base Excess	-9 to +2	mmol/L	< -10	None
Oxygen Saturation	Not Reported	-	-	-

Cord Blood Gas - Venous

Analyte	Reference Interval	Units	Critical Values	
pH	7.25 – 7.45	None	<7.15	None
pCO2	30 – 55	mmHg	None	None
pO2	Not Reported	mmHg	-	-
HCO3	16 – 25	mmol/L	None	None
tCO2	Not Reported	-	-	-
Base Excess	-10 to 0	mmol/L	< -10	None
Oxygen Saturation	Not Reported	-	-	-

pH Fluid

Analyte	Reference Interval	Units	Critical Values	
pH	>=7.20	None	None	None

D. Hematology, Coagulation and Flow Cytometry

I. Hematology and Coagulation Reference Range changes

Coagulation Test	Reference Range	Critical Level
PTT	26-38	>120
PT INR	0.8-1.2	>5.0
Fib	2.0-4.0	<1.0
AT	>=0.80	
Protein C	>=0.70	
Protein S activity	>=0.65	
Protein Antigen (Free)	>=0.65	

ESR Age Reference Ranges	Female	Male	X/Unknown
Pediatric <18years	0-10	0-10	0-10
Adult >= 18 years	0-20	0-15	0-15

CSF Reference Ranges

RBC Reference Range = 0

Total Nucleated Cell (TNC) Count Reference Ranges

<31 days of age = 0-30

> 30 days old = 0-5

Other Fluids

Appends to all Cell Count, Body Fluid (ie. non-CSF fluid) Total Nucleated Cell (TNC) counts

- Transudate expected TNC <1000 $x10^6$/L
- Exudate expected TNC >1000 x 10^6/L

Spun appearance for non-CSF fluids will NOT be reported.

Cytospin/diff not required until TNC>200 with the exception of Peritoneal Dialysates ($\geq$100 TNC)

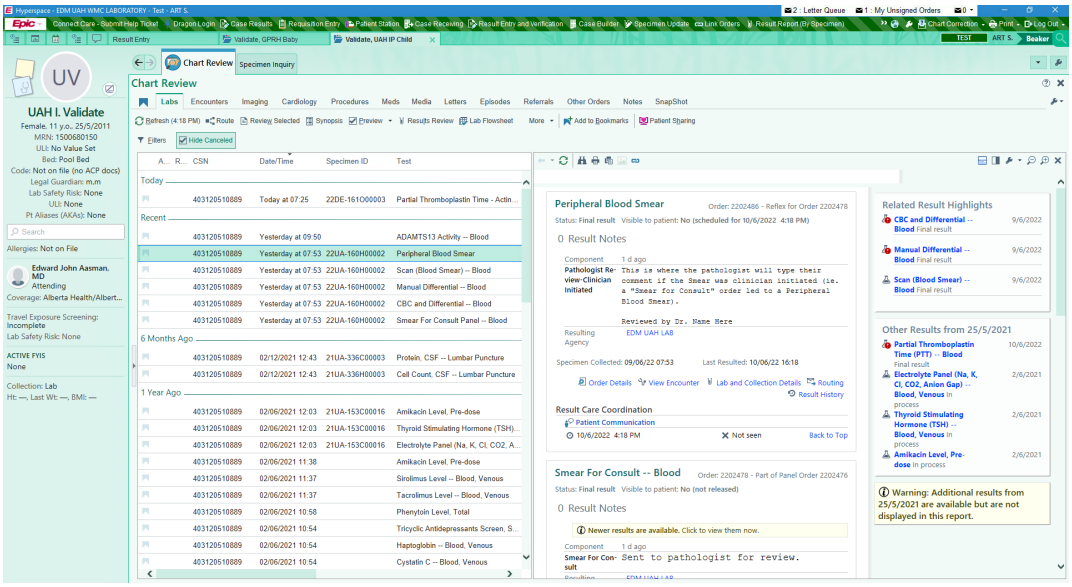
Hematology Parameter	Age Range	Reference Range	Units
WBC	0 - 23 hours	9.0-30.0	$x10^9/L$
	1 - 6 days	9.4-34.0	
	7 - 13 days	5.0-21.0	
	14 - 29 days	5.0-20.0	
	1 - 6 mths	5.0-19.5	
	6 mths - 1 yr	6.0-17.5	
	1 - < 2 yrs	6.0-17.0	
	2 - < 4 yrs	5.5-17.0	
	4 - <6 yrs	4.0-15.5	
	6 - <12 yrs	4.5-14.5	
	12 - < 16 yrs	4.5-13.0	
	16 - < 18 yrs	4.5-13.0	
	> 18 yrs	4.0-11.0	
RBC	0 - 23 hrs	3.90-5.50	$x10^{12}/L$
	1 - 6 days	4.00-6.60	
	7 - 13 days	3.90-6.30	
	14 - 29 days	3.60-6.20	
	1 - < 2 mths	3.00-5.40	
	2 - < 3 mths	2.70-4.90	
	3 - < 6 mths	3.10-5.20	
	6 mths - < 2 yrs	3.50-5.60	
	2 - < 3 yrs	3.50-5.60	
	3 - < 6 yrs	3.80-5.60	
	6 - < 12 yrs	3.80-5.60	
	> 12 yrs female	3.80-5.20	
	12 - < 18 yrs Male	4.00-5.80	
	> 18 yrs Male	4.30-6.00	
HB	0 - 23 hrs	135-195	g/L
	1 - 6 days	145-225	
	7 - 13 days	135-215	
	14 - 29 days	125-205	
	1 - < 2 mths	100-180	
	2 - < 3 mths	90-140	
	3 - < 6 mths	95-147	
	6 mths - < 2 yrs	105-145	
	2 - < 3 yrs	110-135	
	3 - < 12 yrs	110-157	
	> 12 yrs female	120-160	
	12 - < 18 yrs Male	125-170	
	> 18 yrs Male	135-175	

Hematology Parameter	Age Range	Reference Range	Units
HCT	0 - 23 hrs	0.42-0.60	L/L
	1 - 6 days	0.45-0.67	
	7 - 13 days	0.42-0.66	
	14 - 29 days	0.39-0.63	
	1 - < 2 mths	0.31-0.55	
	2 - < 3 mths	0.28-0.42	
	3 - < 6 mths	0.29-0.45	
	6 mths - < 2 yrs	0.31-0.44	
	2-< 6 yrs	0.34-0.46	
	6 - < 12 yrears	0.34-0.46	
	12 - <18 yrs Male	0.36-0.50	
	> 12 yrs Female	0.36-0.48	
	> 18 yrs Male	0.40-0.52	
MCV	0 - 23 hrs	98-118	fL
	1 - 6 days	95-121	
	7 - 13 days	88-126	
	14 - 29 days	86-124	
	1 - < 2 mths	85-123	
	2 - < 3 mths	77-115	
	3 - < 6 mths	74-108	
	6 mths - < 2 yrs	70-90	
	2 - < 6 yrs	75-95	
	6 - < 12 yrears	75-95	
	12 - 18 yrs	78-100	
	> 18 yrs	80-100	
MCH	No Value		
MCHC	<6mth	290-360	g/L
	>6 mth	310-360	
RDW	All Ages	<16	%
Platelet	All Ages	140-450	$x10^9/L$
NRBC	<8 days	<30	/100 WBC
	8 days -150	<1	
Relative Retics	≤30 days	2.0-6.0	%
	>29 days	0.4-2.0	
Absolute Retics	≤30 days	70-400	$X10^9/L$
	>29 days	20-120	

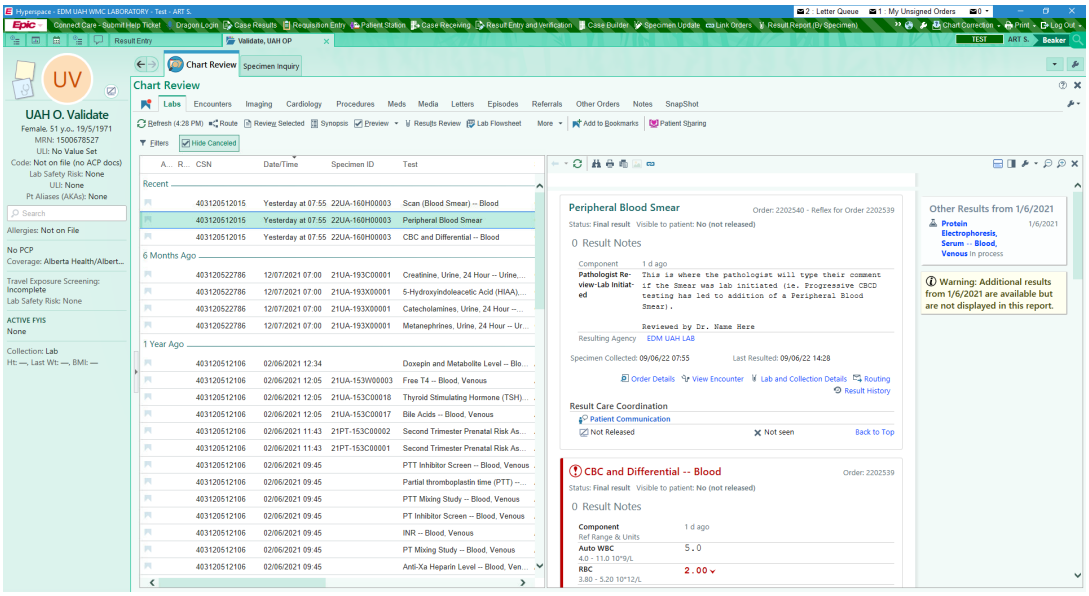
Hematology Parameter	Age Range	Reference Range	Units
Absolute Neut	0 - 23 hrs	5.0-26.0	$x10^9/L$
	1 - 6 days	5.0-21.0	
	7 - 13 days	1.5-10.0	
	14 - 29 days	1.0-9.5	
	1 - < 3 mths	1.0-9.0	
	3 - < 6 mths	1.0-9.0	
	6 mths - <1 yr	0.6-8.5	
	1 yr - < 2 yrs	0.6-8.5	
	2 yrs - < 4 yrs	0.8-8.5	
	4 yrs - < 6 yrs	0.8-8.5	
	6 - < 8 yrs	0.8-8.5	
	8 - < 10 yrs	0.8-8.0	
	10 - < 16 yrs	1.8-8.0	
	16 < 18 yrs	1.8-8.0	
	> 18 yrs	1.8-7.5	
Immature Gran (Automated)	All Ages	0-0.1	$x10^9/L$
Absolute Lymph	0 - 23 hrs	2.0-11.5	$x10^9/L$
	1 - 6 days	2.0-17.0	
	7 - 13 days	2.0-17.0	
	14 - 29 days	2.0-17.0	
	1 - < 2 mths	2.5-16.5	
	2 - < 3 mths	2.5-16.5	
	3 - < 6 mths	2.5-16.5	
	6 mths - <1 yr	2.7-12.5	
	1 yr - < 2 yrs	2.7-12.5	
	2 yrs - < 4 yrs	2.0-9.5	
	4 yrs - < 6 yrs	1.3-8.0	
	6 - < 8 yrs	1.3-8.0	
	8 - < 10 yrs	1.3-8.0	
	10 - < 16 yrs	1.5-6.5	
	16 < 18 yrs	0.5-5.2	
	> 18 yrs	0.5-4.5	
Absolute Mono	< 1 mth	< 1.9	$x10^9/L$
	> 1 mth	0.0-1.1	
Absolute Eos	0 days - 1 mth	0.0-2.0	$x10^9/L$
	> 1 mth	0.0-0.7	
Absolute Baso	<1mth	0.0-0.4	$x10^9/L$
	>1mth	0.0-0.3	
	8 days -150	<1	
	> 30 days	0.4-2.0	

II. Blood Smears

- "Smear for Consult" – these are Clinician orderable tests requesting pathologist review.
    - Initially a technologist may review the slide. If there is nothing abnormal seen, no (or minimal) numeric abnormalities, and no abnormal analyzer flags then the Smear for Consult will not be further reviewed by a pathologist. If there is a reason that requires a pathologist specifically, please contact the lab within 7 days to provide that reason.
    - If the initial technologist review does reveal findings of potential clinical significance, then a "Peripheral Blood Smear" will be added-on, which a pathologist will result.
- "Peripheral Blood Smear" – these are pathologist resulted tests. They may arise in one of two ways:
    - If a "Smear for Consult" is ordered by a clinician and passes initial review by a technologist (as described above). Note that under this circumstance one can tell that a Clinician had requested this testing directly because the report indicates: "Pathologist Review-Clinician Initiated"



    - The other reason a "Peripheral Blood Smear" may be resulted is when specific abnormalities are identified on a CBC/D that trigger a pathologist review. In this circumstance the clinician did not initially request the "Peripheral Blood Smear" but instead it was added-on as a reflex test per laboratory protocol, as part of progressive testing. If the pathologist sees something that may be of additional clinical significance (beyond what is reported on the CBCD, Manual Differential and Scan) they will document their impression; if something critical is found then the clinician ordering the CBC/D will be contacted directly. Otherwise, the pathologist will just include a note indicating that they have reviewed the smear. Note that under this circumstance one can tell that the "Peripheral Blood Smear" originated because of lab protocol (instead of a direct Clinician order) because the report indicates: "Pathologist Review-Lab Initiated":



III. Bone Marrows

- For clinicians performing a bone marrow aspiration and/or trephine biopsy:

- Recommend ordering a "Bone Marrow Panel (Proc Panel)" in Epic. This automatically orders a Panel of tests which includes a:
    - Bone Marrow Cell Differential
    - Bone Marrow Exam
    - Leukemia/Lymphoma Immunophenotyping
    - Cytogenetic Analysis
    - HOLD DNA FOR MOLECULAR PATHOLOGY
    - HOND RNA FOR MOLECULAR PATHOLOGY
- In addition, a CBCD and Reticulocyte count should be collected within 24 hours (before or after) bone marrow collection. If this has not been completed at the time of marrow procurement, then the clinician has the option to include orders for CBCD and Reticulocyte Count when ordering the Bone Marrow Panel; note that these are not included by default.
- A Bone Marrow Panel does not include the following which must be ordered individually if/when needed (indicate Specimen Src: Bone Marrow Aspirate when ordering):
    - Bone Marrow Culture
    - Mycobacteria Culture
    - Fungal Culture
    - Viruses – must order each specific type of test needed individually
        - If uncertain of what testing to order, please page/call the Virologist On-Call to discuss.

- Bone Marrow results in Netcare:

- All bone marrow reports generated in Connect Care will now appear in the Pathology folder in Netcare.

IV. PTT and Heparin Nomogram

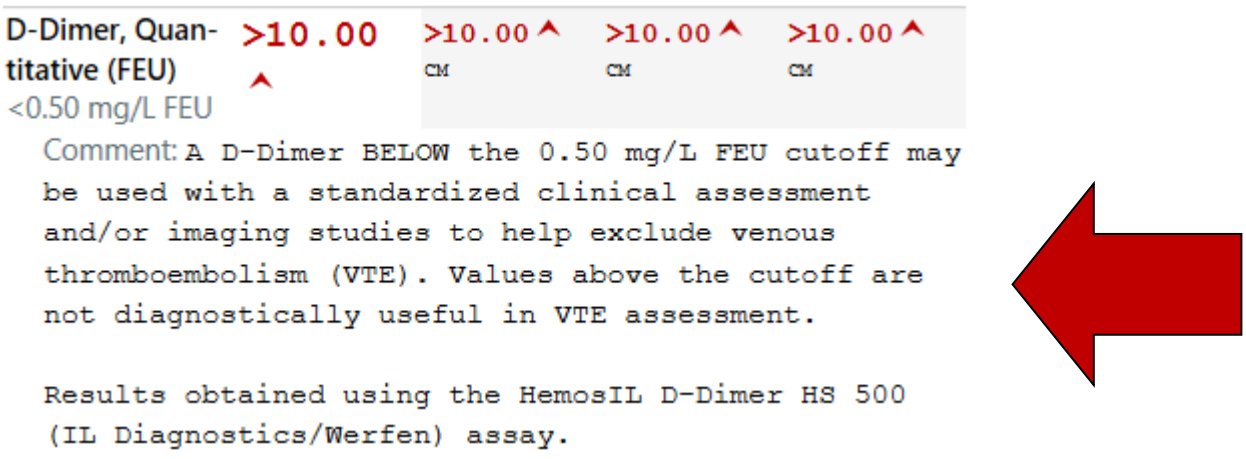
With the standardization requirement in both pharmacy and lab, it was a challenge to create a single heparin nomogram that would work with the different reference ranges generated by the various reagent / analyzer combination. The document in the link below describes how this has been accomplished.

- https://insite.albertahealthservices.ca/Main/assets/cis/tms-cis-provincially-standardized-ptt-comments.pdf

V. D-Dimer

- Across Alberta, there are a variety of different D-Dimer methods in use due to differing analyzers, patient volumes, and historic commercial contracts.
    - Each method has a single manufacturer-determined clinical cutoff for Venous Thromboembolism (VTE) exclusion, which undergoes a limited verification by the lab prior to test implementation.
    - APL does not have the ability to perform the outcomes studies required to validate alternative cutoffs.
    - Similar performance between assay methods cannot be guaranteed due to lack of an international D-Dimer reference standard.
        - Some assays are well-studied in the age-adjusted cutoff literature, while evidence for others may be limited or non-existent.
        - Most widely available age-adjustment calculators online do not account for differences between assay types/manufacturers.
        - Even assays with the same VTE cut-off (e.g. 0.50 mg/L FEU) may show very different reactivity at values other than this cut-off.
- The assay method is included as a result comment at ConnectCare sites (see example below).
- When considering whether to apply alternative cutoffs, providers are advised to verify the method used for each patient (do not assume the testing was performed at your local lab), and to be familiar with the evidence for the method.

Example of D-Dimer Method information in ConnectCare:



VI. Flow cytometry

- The B, T, and NK Enumeration test is no longer available in the North Sector.
  - Instead, T-cell Subsets, or B Cell Enumeration can be ordered separately.
  - NK cell enumeration is not routinely available but can be obtained as part of an Immunodeficiency Screening Panel for testing in Calgary.

- Leukemia/Lymphoma Immunophenotyping (by Flow Cytometry)
  - Clinicians are required to answer a hard stop question to specify the clinical indication.
  - This will allow the laboratory to determine which antibody panels are needed for analysis.
    - Please note: "Pancytopenia (Bone Marrow ONLY)" can only be performed on bone marrow and will be auto-cancelled if requested on peripheral blood in North Sector.

- Hereditary Spherocytosis
  - "Hereditary Spherocytosis by Flow Cytometry" is adequate for diagnosis of Hereditary Spherocytosis in the vast majority of individuals and can be ordered directly in Epic.
  - "Hereditary Spherocytosis by Flow Cytometry and Osmotic Fragility" is no longer available. Please see the following link for details: Discontinuation of Osmotic Fragility Testing (albertahealthservices.ca)

VII. Body Fluid Crystals

- Assessing for joint fluid crystals:
  - Order "Body Fluid Crystals"
  - Specify Specimen Type as "Synovial Fluid"
  - Specify the joint aspirated under Specimen Source (e.g. "Knee, Left")
- Assessing any other aspirate type (i.e.. other than joint fluid) for monosodium urate crystals:
  - Order "Body Fluid Crystals"
  - Specify "Other" under Specimen Type
  - Specify the anatomic site (where the aspirate was collected) under Specimen Source.
- Bile fluid assessment for Cholesterol crystals is not an orderable test.

VIII. Fluid Cell Counts

- There are 3 types of Cell Count tests available:

- Cell Count, CSF – this test should only be ordered on Cerebrospinal Fluid (CSF) samples.
- Cell Count, Body Fluid – for all other (ie. non-CSF) body fluid cell counts, please order this test.
- Cell Count, CRRT Effluent
  - This is not a true body fluid, but rather an effluent produced during Continuous Renal Replacement Therapy (CRRT).
  - See the following Laboratory Bulletin for details: New test in Connect Care - Cell Count, CRRT Effluent (Continuous Renal Replacement Therapy) (albertahealthservices.ca)

IX. Erythrocyte Sedimentation Rate (ESR)

- The C-Reactive Protein (CRP) is preferred over the ESR in most circumstances. See the following Laboratory Bulletin for details on when and how CRP will be automatically substituted for the ESR:

- Changes to Erythrocyte Sedimentation Rate (ESR) Ordering in Connect Care (albertahealthservices.ca)

E. Transfusion & Transplantation Medicine

I.Transfusion Medicine:

There are several resources available pertaining to transfusion medicine in the Connect Care Knowledge Library and the Learning Home Dashboard. The most comprehensive resource for EPIC / WellSky information is called the Blood Administration Guide. It can be found by searching Blood administration guide | Insite (albertahealthservices.ca) There are also 6 modules within My Learning Link dedicated to different aspects of Blood Administration. More generic transfusion medicine resources continue to be available on Insite and AHS websites (https://insite.albertahealthservices.ca/lab/Page7421.aspx and https://www.albertahealthservices.ca/lab/Page3318.aspx).

For all sites, staff will need to utilize the Provincial Transfusion Service Identification System (TSIN) cards. TSIN Completion Guide (albertahealthservices.ca)

- The clinical history questions (Transfusion and pregnancy history) required for the extension of the TS to 30 days must be completed when ordering in Epic: tms-cis-tr-CMIO-Preop-Ordering-Blood-for-OR.pdf (albertahealthservices.ca)
- Day Surgery and Operating Rooms: Blue RTSIS bands will transition to red TSIN bands. Refer to Epic Storyboard or contact TM for confirmation of expiry date.

Since transfusion of red cells, platelets, plasma and cryoprecipitate requires administration within an approved facility, pre-transfusion testing, and blood component requests will be restricted to authorized prescribers who have privileges within those environments. Prescribers should only use Transfusion Medicine Requisition (Community) (albertahealthservices.ca) in the following circumstances:

- During ConnectCare Downtimes to request any transfusion medicine testing, or blood components and plasma protein products/derivatives,
- If they are an authorized community providers (e.g. Midwives) in setting that does not use Connect Care.

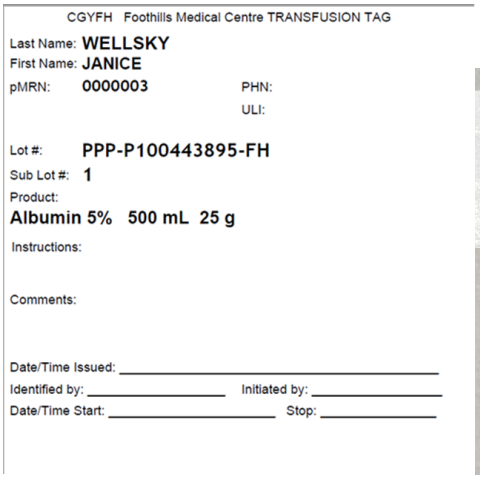
Transfusion Prenatal testing requests from Community providers who do not use Connect Care should continue to be ordered on the Canadian Blood Services requisition. The results of testing performed by the Canadian Blood Services' Prenatal program will now be visible in Connect Care as conversion laboratory results.

- However, for Rh negative prenatal and postpartum patients, please ensure ordering of Prenatal and Postnatal Evaluation to ensure that eligibility for Rh Immune Globulin can be assessed.

For patients who are admitted under an alias name and have Type and Screen testing performed using that alias, do not remove the alias arm band or the TSIN band until the Type and Screen expires or is recollected with the real identity of the patient.

It is very important to ensure that the orders for transfusion are placed in the correct facility and encounter for where the actual transfusion is to occur to avoid loss of orders or components being sent to the incorrect location. It is also important to note that since the transfusion medicine laboratories are seen as a separate facility to the site laboratory, it is not possible to do "add-ons" within the EPIC system and there must be submission of provincial Lab Add-on/Order Modification requisition. It can be found on the AHS Forms & Requisition page under Provincial Documents (All Zones).

The format for the lot numbers of Plasma Protein Products (PPP) will have "PPP-" added to the beginning of the lot number, and site code (e.g., "-FH") to the end of the lot number. The middle section will be the actual lot number of the PPP. See example:

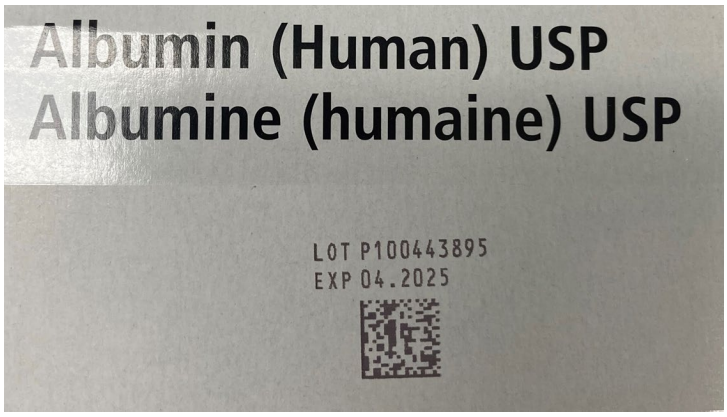

CGYFH Foothills Medical Centre TRANSFUSION TAG

Last Name: WELLSKY
First Name: JANICE
pMRN: 0000003 PHN:
ULI:

Lot #: PPP-P100443895-FH
Sub Lot #: 1
Product:
Albumin 5% 500 mL 25 g
Instructions:

Comments:

Date/Time Issued: _____
Identified by: _____ Initiated by: _____
Date/Time Start: _____ Stop: _____



When performing clerical check of PPP, compare the middle section of the lot number on the tag to the lot number that is on the vial.

II. Histocompatibility testing

All testing on transplant patients who reside in Alberta should be ordered directly in Connect Care to allow for improved clarity and appropriate specimen transfer between the two testing laboratories in the province.

F. Anatomic Pathology

Preliminary results

In EPIC and in some of the downstream electronic applications, preliminary reports will be overwritten by final reports on the patient chart once the final report is verified. However, the preliminary result will incorporated within the final report.

Biomarker results

Biomarker results will now be reported as addendum reports to the corresponding surgical specimen. These are available in NetCare by hovering the cursor over the surgical case specimen and a "corrected" text box will signal that the biomarker report is available.

Cytology

Cytology specimens will have a new maximum of 8 parts per case. Cases are produced by encounter, and cases with more than 8 parts will be issued additional report(s).

G. Genetics and Genomics

First Trimester Prenatal Risk Assessment

During Launch 6, there was standardization by Zone for where the first trimester prenatal risk assessment bloodwork will be tested (First Trimester Prenatal Risk Assessment for Aneuploidy Screening – Launch 6 Testing Changes (albertahealthservices.ca)). Authorizing prescribers are responsible for ensuring that the correct requisition is used:

o When it is collected in North and Edmonton Zone, it will be tested in Edmonton.

o When it is collected in Calgary and South Zone, it will be tested in Calgary.

o When it is collected in Central zone, the location of testing is determined by the first trimester prenatal risk assessment requisition the patient presents with at the collection site.

H. Referred Out Testing (External Send Outs)

Referred out tests are laboratory tests not performed by Alberta Precision Laboratories as per the Services Agreement. High volume referred out tests are orderable in Connect Care and their test name ends in "REF" (they can be searched for in the Procedure Catalogue). Any referred out test that is not orderable in Connect Care requires a referral lab requisition including clinical indication for testing.

- Specimens will be collected, processed, and transported according to the qualified referral laboratories requirements.
- Refer to referral laboratory websites for collection information.
- Any referred out testing questions should be directed to APL Laboratory Information Centre (APL LIC). The APL LIC will triage questions to the most appropriate medical/scientific personnel based on test discipline. To support appropriate test use and quality patient care, some referred out tests will be reviewed and approved for external send out by a team of medical/scientific personnel.