Appendix A - Major Changes for Laboratory Medicine with Connect Care in the North Sector

Contents

A. 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 can be found at the end of this document:
    - CA125

      Female: <35 kU/L
      Male: No reference intervals available

      Patient identifies as gender X, or gender is unknown. Interpret result based on an appropriate reference interval listed above.

    - 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 ≥11 years the following comment will append:

      Follicular: 1.0-13.0 IU/L
      Luteal: 1.0-17.0 IU/L
      Midcycle: 8.0-76.0 IU/L
      Post-menopausal: 16.0-54.0 IU/L
      Male 11-70y: 1.0-9.0 IU/L
      Male >=71y: 3.0-35.0 IU/L

      Patient identifies as gender X, or gender is unknown. Interpret result based on an appropriate reference interval listed above.

      U/X 11-<18yrs: Clinical correlation with puberty status suggested.

- Progesterone

  <14 years:

  Reference Intervals:
  Female: <1.4 nmol/L
  Male: <3.0 nmol/L

  Patient identifies as gender X, or gender is unknown. Interpret result based on an appropriate reference interval listed above.

  14 – 150 years:

  Reference Intervals:
  Female:
  Follicular: <5.0 nmol/L
  Luteal: 15.0 – 90.0 nmol/L
  Postmenopausal: <3.0 nmol/L

  Male: <3.0 nmol/L

  Patient identifies as gender X, or gender is unknown. Interpret result based on an appropriate reference interval listed above.

B. Clinical Microbiology

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

For ordering instructions refer to the December 15, 2020 bulletin "New Connect Care Orders for COVID-19 and Other Respiratory Virus Test": https://www.albertahealthservices.ca/assets/wf/lab/if-lab-hp-bulletin-new-connect-care-orders-for-covid-19-and-other-respiratory-virus-tests.pdf

A few notable changes have occurred since Dec 2020:

- For patients "admitted or ED patient likely to be admitted" or "ED patient likely to be discharged" if COVID-19 symptoms are present then "rapid COVID-19" testing will be automatically selected.
- For patients with ILI, if influenza and rsv testing is required, you must select "Influenza and RSV NAT"
- A specific smart group with default for ETT/BAL can be added to your preference list upon request if you order this testing on ETT and BALs more frequently than other specimen sources.

IF your site has ID NOW COVID-19 testing available:

- Order the required COVID-19 PCR/NAT testing in Connect Care based on patient status and symptoms
- Follow your local processes to arrange for ID NOW testing.
- Patients testing positive for ID NOW, the second sample collected for COVID-19 PCR testing will have this test cancelled as no confirmation is required. The second sample collected will be forwarded to ProvLab for variant testing.

2. Pediatric Blood Culture

In EPIC. For patients weighing > 30kg use the "Blood Culture Panel-Pediatric (weight based)" order set. If >30kg use the "Blood culturesx2". Some preference lists may have the order "Blood culture, Routine" added, DO NOT use this, instead replace it with the appropriate order set depending on if needed for pediatric and/or adults. These order sets were made to optimize the sensitivity of blood

cultures and help identify line infections or contaminants.

- The following table will also display in the pediatric (<30kg) order set to guide blood culture collections:

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

*More blood (up to 4mL per bottle) can be collected if clinically appropriate. See laboratory blood collection guidelines in the test directory for more specific weight-based maximum blood volume draw in 24 hours.
Blood cultures should always be collected from two (2) sites in patients >30kg and is suggested for all patients except neonates. Collection from two sites identifies blood culture contaminants and/or line infections.

3. Note that you will see the acronym "NAT" in many tests. These are "nucleic acid tests" which include viral loads, polymerase chain reaction (PCR), or other molecular tests.

C. Clinical Biochemistry

1.Standardization in Test Reporting

24 hour Urine Changes

- Standardized acceptable time for 24 hour urine collection: 22 to 26 hours
- Standardized reporting units: unit/day (e.g. 24 hour urine urate to be reported as mmol/day)

Anion Gap

- Edmonton Zone standardized reference interval for M, F, and U/X:
  - 5-10 mmol/L

N-Terminal Prohormone B Type Natriuretic Peptide (NT PROBNP) Send Out

- This test code is only for those requesting NT-proBNP level when local site cannot meet the specific clinical needs.
- Specimens will be sent to a referral lab within Alberta (e.g. UAH) to perform the testing and will not have a same day turnaround time.

Beta hCG, Quantitative

- Units are standardized to IU/L
- The testing method and WHO calibrator used will be displayed as part of the reporting comment

Bilirubin

- Standardization in available tests to order:
    - 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 and 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

Creatine Kinase

- New provincial standardized reference intervals
    - Male, Unknown, Gender X: 30 – 350 U/L
    - Female: 30 – 200 U/L

Electrolyte Panel, Blood

- Only one electrolyte panel (consisting of Sodium, Potassium, Chloride, CO2 and Anion Gap) is available
- The full electrolyte panel is available at all locations (including community)
- The APL/Dynalife community requisition has been updated to only have check boxes for Sodium and Potassium. To receive the full electrolyte panel, 'Electrolyte Panel' should be written in on the requisition.

Glucose meter check

- This new test 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

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 (specify)

Osmolal Gap

- These are orderable tests:
  - Osmolal Gap
  - Osmolality
  - Osmolal Gap, Unaccounted
  - Osmolality, Calculated
- 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 will no longer reflex to differential alcohol screen testing (Test code: ALC).

2. Clinical Biochemistry Reference Interval and Critical Value Standardization

Lab reported Urinalysis using Cliniteck Advantus

Urinalysis will be standardized to align reporting using SI units across the province.

Parameter	Grades	Reference interval
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

*Clinitek reporting has been updated since Wave 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 below table for new reporting information.

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

Analyte	Age	Gender* (M, F, U, X)	Reference Interval	Units	Critical Value
Alkaline Phosphatase (ALP)	0 d – 14 d	M, F, U, X	70 - 320	U/L	None
	15 d – 364 d	M, F, U, X	130 - 500		
	1 yr – 12 yr	M, F, U, X	130 - 430		
	13 yr – 14 yr	M	130 -500		
	15 yr – 17 yr	M	60 - 250		
	13 yr – 14 yr	F	60 - 225		
	15 yr – 17 yr	F	50 - 140		
	13 yr – 14 yr	U, X	60 - 500		
	15 yr – 17 yr	U, X	50 - 250		
	18 yr – 150 yr	M, F, U, X	40 - 120		
Calcium	0 d – 10 d	M, F, U, X	1.80 - 2.90	mmol/L	<1.65 & >3.25
	11 d – 365 d		2.20 - 2.80		
	> 1 yr		2.10 - 2.60		
Chloride	0 d – 150 yr	M, F, U, X	98 – 112	mmol/L	None
Creatine Kinase	All ages	M, U, X	30 – 350	U/L	
		F	30 – 200		
Osmolality, urine	0 – 150 yr	M, F, U, X	50 – 1400	mmol/kg	
Phosphate	0 - 14 days	M, F, U, X	1.40 - 2.70	mmol/L	<0.40
	15d-30d		1.60-2.70		
	31d-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		
Sodium	0 d – 150 yr	M, F, U, X	135 – 145	mmol/L	<120 & >155
Total CO2	0 d - 150 yr	M, F, U, X	20 – 32	mmol/L	None
Total Protein	0-364 d	M, F, U, X	40-70	g/L	None
	365d-150 yr		62-82		
Urea	0 d - 2 yr	M, F, U, X	1.0 - 7.5	mmol/L	None
	2 yr-17 yr	M, F, U, X	2.0 -7.0		
	18 yr-55 yr	F	2.0-7.0		
	18 yr – 55 yr	M	3.0-8.0		
	18 yr – 55 yr	U, X	2.0-8.0		
	>55 yr	F	3.0-8.0		
	>55 yr	M, U, X	3.0 -9.0		

B. Therapeutic Drug Monitoring and Toxicology Tests

- 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 Document.*
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	
Phenytoin, total	≤ 3 months: 25 – 55 >3mo: 40-80	umol/L	≤ 3 months: >80 > 3 months: >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	
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 neurotoxicitcity.* *Note: Testing performed using Seimens immunoassay. Vancomycin levels may be undetectable or falsely low in patients with elevated immunoglobulins. Contact laboratory senior staff to arrange for alternate testing. Routine monitoring of vancomycin levels is not generally recommended. Refer to Vancomycin Dosing/Monitoring Guidelines, AHS Bugs and Drugs Online Document."*
Vancomycin, Other	N/A	mg/L	>60.0	*Vancomycin levels greater than 15 mg/L increase risk of neurotoxicitcity.* *Note: Testing performed using Seimens immunoassay. Vancomycin levels may be undetectable or falsely low in patients with elevated immunoglobulins. Contact laboratory senior staff to arrange for alternate testing. Routine monitoring of vancomycin levels is not generally recommended. Refer to Vancomycin Dosing/Monitoring Guidelines, AHS Bugs and Drugs Online Document.*

Methanol/Ethylene Glycol

- An unaccounted gap will not be automatically performed when either methanol or ethylene glycol requested
- Progressive testing algorithm will be discontinued. Requests for methanol and ethylene glycol will proceed and will not be dependent on the unaccounted osmol gap

Barbiturate Screen, Serum

- Testing discontinued

Benzodiazepine Screen, Serum

- Testing discontinued

Change to comment associated with ethanol results.

- This result must not be used or disclosed for potentially medicolegal or other non-medical purposes.

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

Urine Drug Testing

- Order/collection question: Reason for Request. This request mirrors information collected on paper requisition.
- Order/Collection questions related to urine temperature. This is not a hard stop question but allows sites that are currently performing urine temperature to identify whether the temperature was acceptable.
- Order/Collection questions related to whether the patient presented with appropriate identification.
- There are 2 orderable drug testing panels:
    - Urine Opioid Dependency Panel – meant to be ordered for patients who are in Opioid Dependency Programs (also referred to as Opioid Agonist Therapy)
    - Urine General Toxicology Panel – ordered on patients other than those in Opioid Dependency Programs.
    - These panels are not new as they have been in place for over 2 years. However, the change may not have been readily apparent to sites utilizing an old version of the paper requisition.

C. Point of Care Testing (POCT)

1. Connectivity of POCT devices

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 directly flow from the device through the new POCT middleware into the electronic medical record (i.e. connectable) or be manually entered into EPIC using Enter/Edit functionality and resulted in the electronic medical record (non-connectable).

Launch 4 Go-Live device workflows:

- Connected devices:
  - Roche Accu-Chek Inform II Glucose Meter
  - Abbott i-STAT1 and i-STAT Alinity
  - Radiometer ABL90 Flex Plus
  - Siemens Clinitek Status Plus
  - Werfen GEM 5000
  - Siemens DCA Vantage
  - Siemens CoaguChek XS Pro
  - Werfen Avoximeter 1000E (documents in development, see Connect Care Resources)

- Unconnected devices:
  Patient results from unconnected POCT devices will require **manual** entry into EPIC using the **EPIC "Enter/Edit"** function directly by the person performing the test. See your clinical practice area Connect Care training documents for instruction.

Adhere to the following requirements when performing POCT:

- Healthcare Professionals / Providers must:
  - Receive POCT certification requirements to access devices.
    - Zone POCT department will provide device access through the POCT middleware system.
  - Barcode scan or manually enter their AHS employee ID barcode number to access POCT devices.
- Patient identification:
  - Each patient must be identified using the valid, EPIC-generated patient encounter number (Contact Serial Number **[CSN]**).
  - Use of the correct CSN is **REQUIRED**. This is **NEW**!!
  - CSN usage ensures that results flow correctly and uninterrupted to EPIC.
  - For additional CSN education, see *AHS My Learning Link: POCT-Connect Care Requirements*.

2. POCT Reference Interval and Critical Value Standardization

a) Anion Gap

- Standardization of reference intervals by POCT device (Launch 4 sites included below):

Testing Site	Instrument	Reference Interval (mmol/L)
Royal Alexandra Hospital	Radiometer	4 – 16

b) 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 4 sites included below):

Testing Site	Instrument	Reference Interval (mmol/L)
Royal Alexandra Hospital	Radiometer	1.10 – 1.48 (<15 d) 1.09 – 1.25 (15 d – 150 y)

c) 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) and **Automated** (Clinitek Status®+) testing. All reporting units for urinalysis testing in EPIC 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).

Table 1. Urinalysis result reporting for Connect Care

Test component	Siemens Clinitek Status	Manual Dipstick Urinalysis	Connect Care (EPIC) Result Reporting
	Device result reporting	Test strip vial 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	≤1.005	1.000	<1.005
(Specific Gravity)		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)	Negative	Negative	Negative
Leu/µL	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

Test component	Siemens Clinitek Status	Manual Dipstick Urinalysis	Connect Care (EPIC) Result Reporting
	Device result reporting	Test strip vial reporting	
	≥3.0	3.0	≥3.0
		≥20	≥3.0
GLU (Glucose)	Negative	Negative	Negative
mmol/L	5.5	5.5	5.5
	14	14	14
	28	28	28
	≥55	55	≥55
		≥111	≥55
KET (Ketone)	Negative	Negative	Negative
mmol/L	Trace		Trace
		0.5	0.5
	1.5	1.5	1.5
	3.9	4.0	3.9
	7.8		≥7.8
		8.0	≥7.8
	≥15.6		≥7.8
		16.0	≥7.8
ERY (Erythrocytes)	Negative	Negative	Negative
Ery/µL	Trace-Lysed	Non Hemolyzed Trace	Trace
		Non Hemolyzed Moderate	Trace
	Trace-Intact	Hemolyzed Trace	Trace
	Ca 25	Small (+) (25)	25
	Ca 80	Moderate (++) (80)	80
	Ca 200	Large (+++) (200)	200

d) 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). 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. 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 Manual Search: 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).**

Transfusion Prenatal testing should continue to be ordered on the Canadian Blood Services requisition. Work is underway to build a reference laboratory interface to allow results to flow back to the Connect Care chart. 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.

Type and Screen requests will be resulted with three separate components – Type and Screen ABORh, Type and Screen Antibody Screen and Type and Screen Expiry Date. The applicable Transfusion Service Identification Number (aka BBIN/TSIN band number) will be reported as part of the Type and Screen Expiry Date test. All three elements are required to consider a type and screen complete. 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.

Since transfusion of Red cells, platelets, plasma and cryoprecipitate requires administration within an approved facility, pretransfusion testing and component requests will be restricted to physicians who have privileges within those environments. 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.

E. Anatomic Pathology

Clinical History

Please ensure that clinical history / clinical question is provided as part of the submission order with specimen to ensure that the appropriate processing occurs.

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.

Biomarker results

Biomarker results will now be reported as addendum reports to the corresponding surgical specimen. These are available 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 5 parts per case. Cases are produced by Encounter, and cases with more than 5 parts will be issued additional report(s).

F. Hematology , Coagulation and Flow Cytometry

1. **Hematology and Coagulation Reference Range changes and critical values –** see end of this document

2. Blood Smears –

"Peripheral Blood Smears" will be resulted in EPIC/ConnectCare as each lab goes Live in each wave. These results will also be available in NetCare, but not other legacy systems. There are two types of reports which differ in the mechanism by which they are ordered. However, both are resulted under the Test title "Peripheral Blood Smear".

- Smear for Consult – these are Clinician ordered tests for Pathologist review. Note that a technologist will review all of these requests for appropriateness.
  - If the morphology is normal, there are no (or minimal) numeric abnormalities and there are no abnormal analyzer flags the smear will be cancelled with a comment that indicates a pathologist has NOT reviewed the slide. However, under this circumstance a technologist will always review the slide morphology to ensure nothing potentially significant (eg. blasts, schistocytes, spherocytes) is missed.
  - If there is any other concern, please contact the lab within 7 days to provide a clinical reason that smear requires review by pathologist. Clinicians will have an opportunity to re-activate the smear if they can provide a reason why pathologist review is necessary.
- Smear to Pathologist – these are not directly ordered by a Clinician. They are accessioned when specific abnormalities are identified on the CBC/D that trigger a pathologist review. 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 include a note indicating that they have reviewed the smear as part of laboratory protocol but have no additional comment.

Peripheral Blood Films resulted at labs not yet live in EPIC/ConnectCare will continue to report in legacy systems. Results will also continue to be available in NetCare.

Caution: patients are not necessarily collected at the same site at which the clinician placed the order. For example a patient seen at the University of Alberta Hospital (wave 1 site) may elect to have their blood collected at the Grey Nuns Hospital (subsequent wave site), and therefore have results reported in the legacy system only. Check NetCare if an expected report is not available in either system.

3. Bone Marrows

- For clinicians performing a bone marrow aspiration and/or trephine biposy:
  - 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. Previously, most of these reports appeared in the Hematology folder in Netcare.
- For the Edmonton Zone, all sites reported bone marrows within Connect Care following wave 1 launch.

4. Coagulation

- **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

- Hemostasis and Thrombosis laboratory tests will frequently have clinical questions associated with the order. Please complete these questions to ensure that the most appropriate testing is performed and no delays or cancellations ensue.

5. Flow cytometry

- Leukemia/Lymphoma Immunophenotyping (by Flow Cytometry)
    - FACS (Acute Leukemia Flow Cytometry) and XFACS (Lymphoma Flow Cytometry) will roll together into one “Leukemia/Lymphoma Immunophenotyping” Test.
    - However, clinicians will be given a hard stop question requiring a clinical indication to be selected that will allow the lab to run the correct panel.
- The hard stop answers are: Lymphoma-Lymphoproliferative Disorder, Acute Leukemia, Plasma Cell Neoplasia, Minimal Residual Disease, and Pancytopenia (Bone Marrow ONLY). Of these selections, only the Lymphoma-Lymphoproliferative Disorder answer is usually needed on peripheral blood. The other indications usually require bone marrow testing; “Pancytopenia (Bone Marrow ONLY)” can only be performed on bone marrow and will be auto-cancelled if requested on peripheral blood.

- 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" may be needed in some select cases and requires booking for collection in Edmonton through Client Response (780-407-7484).

6. 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 (eg. "Knee, Left")
- Assessing any other aspirate type (ie. 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.

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	

Coagulation Test	Reference Range	Critical Level
PTT	24 - 39	>120
PT INR	0.8 - 1.0	>5.0
Fib	2.0 -4.0	<1.0
AT3	>= 0.80	
Protein C	>= 0.70	
Factors except for FVIII	>= 0.50	
FVIII (clot and chrom)	0.50-1.50	

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

RBC Reference Range = 0

Total Nucleated Cell (TNC) Count Reference Ranges

< 31 days of age ref range = 0-30

> 30 days old, ref range 0 -5

Other Fluids

Appends to all body 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 (≥ 100 TNC)

CBC Critical Notifiables

Hemoglobin 0-7 days <80 g/L or >239 g/L

>7 days <70 g/L or >239 g/L

Platelet Inpatient <10 x 10 9/L

Outpatient <20 x 109/L

WBC <0.6 or >99.9

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	$x10^9/L$
Absoulte 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	
Absoulte 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	
NRBC	<8 days	<30	/100 WBC
	8 days -150	<1	
Relative Retics	< 30 days	2.0-6.0	%
	> 30 days	0.4-2.0	
Absoulte Retic	< 30 days	70-400	$x10^9/L$
	> 29 days	20-120	