MAYO CLINIC LABORATORIES

Test Definition: CBC

Complete Blood Cell Count (CBC) with Differential, Blood

Overview

Useful For

Screening tool to confirm a hematologic disorder, to establish or rule out a diagnosis, to detect an unsuspected hematologic disorder, or to monitor effects of radiation or chemotherapy

Reflex Tests

Test Id	Reporting Name	Available Separately	Always Performed
DIFFR	Morphology Eval (special Smear)	No	No
PINTP	Peripheral Smear Interpretation	No	No

Testing Algorithm

Testing begins with an automated 5-part differential. If manual differential is needed, it will be reflexed and performed if specimen is 24 hours or less post-draw.

If the automated 5-part differential is invalid or when abnormal results are identified upon microscopic evaluation, a morphology evaluation is performed at an additional charge. If the smear morphology is adequate and confirms the results of the automated 5-part differential, the automated differential results will be verified and reported.

If pathologist expertise is needed for clinically significant diagnosis, a peripheral blood smear review is performed at an additional charge.

Method Name

RF/DC (Radio Frequency/Direct Current) Detection/Hydrodynamic Focusing (DC Detection), Flow Cytometry (Using a Semiconductor Laser)/Sodium Lauryl Sulfate (SLS) Hemoglobin

NY State Available

Yes

Specimen

Specimen Type

Whole Blood EDTA

Specimen Required

Container/Tube: Lavender top (EDTA)

Specimen Volume: 3 mL

Collection Instructions: Send whole blood specimen in original tube. **Do not aliquot**.

Specimen Minimum Volume

0.5 mL

Reject Due To

Gross hemolysis	Reject
Gross lipemia	OK
Gross icterus	OK
Clotted	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Whole Blood EDTA	Refrigerated (preferred)	48 hours	
	Ambient	24 hours	

Clinical & Interpretive

Clinical Information

Red blood cells (RBCs), white blood cells (WBCs), and platelets are produced in the bone marrow and released into the peripheral blood. The primary function of the RBC is to deliver oxygen to tissues. WBCs are key components of the immune system. Platelets play a vital role in blood clotting.

Mean corpuscular volume (MCV) is a measure of the size of the average RBC. Anemias are characterized as microcytic (MCV <80), macrocytic (MCV >100), or normocytic. The red cell distribution width (RDW) is a measure of the degree of variation in RBC size (anisocytosis). RDW may be helpful in distinguishing between some anemias. For example, iron deficiency anemia is characterized by a high RDW, while thalassemia is characterized by a low RDW.

These counts are used as clinical guides in the diagnosis or monitoring of many diseases.

Reference Values

Red blood cell count (RBC)
Males:
0-14 days: 4.10-5.55 x 10(12)/L
15 days-4 weeks: 3.16-4.63 x 10(12)/L
5 weeks-7 weeks: 3.02-4.22 x 10(12)/L
8 weeks-5 months: 3.43-4.80 x 10(12)/L
6 months-23 months: 4.03-5.07 x 10(12)/L
24 months-35 months: 3.89-4.97 x 10(12)/L
3-5 years: 4.00-5.10 x 10(12)/L

6-10 years: 4.10-5.20 x 10(12)/L
11-14 years: 4.20-5.30 x 10(12)/L
15-17 years: 4.30-5.70 x 10(12)/L
> or =18 years: 4.35-5.65 x 10(12)/L

Females:
0-14 days: 4.12-5.74 x 10(12)/L
15 days-4 weeks: 3.32-4.80 x 10(12)/L
5 weeks-7 weeks: 2.93-3.87 x 10(12)/L
8 weeks-5 months: 3.45-4.75 x 10(12)/L
6 months-23 months: 3.97-5.01 x 10(12)/L
24 months-35 months: 3.84-4.92 x 10(12)/L
3-5 years: 4.00-5.10 x 10(12)/L
6-10 years: 4.10-5.20 x 10(12)/L
11-14 years: 4.10-5.10 x 10(12)/L
15-17 years: 3.80-5.00 x 10(12)/L
> or =18 years: 3.92-5.13 x 10(12)/L

Hemoglobin
Males:
0-14 days: 13.9-19.1 g/dL
15 days-4 weeks: 10.0-15.3 g/dL
5 weeks-7 weeks: 8.9-12.7 g/dL
8 weeks-5 months: 9.6-12.4 g/dL
6 months-23 months: 10.1-12.5 g/dL
24 months-35 months: 10.2-12.7 g/dL
3-5 years: 11.4-14.3 g/dL
6-8 years: 11.5-14.3 g/dL
9-10 years: 11.8-14.7 g/dL
11-14 years: 12.4-15.7 g/dL
15-17 years: 13.3-16.9 g/dL
> or =18 years: 13.2-16.6 g/dL

Females:
0-14 days: 13.4-20.0 g/dL
15 days-4 weeks: 10.8-14.6 g/dL
5 weeks-7 weeks: 9.2-11.4 g/dL
8 weeks-5 months: 9.9-12.4 g/dL
6 months-35 months: 10.2-12.7 g/dL
3-5 years: 11.4-14.3 g/dL
6-8 years: 11.5-14.3 g/dL
9-10 years: 11.8-14.7 g/dL
11-17 years: 11.9-14.8 g/dL
> or =18 years: 11.6-15.0 g/dL

Hematocrit
Males:
0-14 days: 39.8-53.6%
15 days-4 weeks: 30.5-45.0%
5 weeks-7 weeks: 26.8-37.5%
8 weeks-5 months: 28.6-37.2%
6 months-23 months: 30.8-37.8%
24 months-35 months: 31.0-37.7%
3-7 years: 34-42%
8-11 years: 35-43%
12-15 years: 38-47%
16-17 years: 40-50%
> or =18 years: 38.3-48.6%

Females:
0-14 days: 39.6-57.2%
15 days-4 weeks: 32.0-44.5%
5 weeks-7 weeks: 27.7-35.1%
8 weeks-5 months: 29.5-37.1%
6 months-23 months: 30.9-37.9%
24 months-35 months: 31.2-37.8%
3-7 years: 34-42%
8-17 years: 35-43%
> or =18 years: 35.5-44.9%

Mean corpuscular volume (MCV)
Males:
0-14 days: 91.3-103.1 fL
15 days-4 weeks: 89.4-99.7 fL
5 weeks-7 weeks: 84.3-94.2 fL
8 weeks-5 months: 74.1-87.5 fL
6 months-23 months: 69.5-81.7 fL
24 months-35 months: 71.3-84.0 fL
3-5 years: 77.2-89.5 fL
6-11 years: 77.8-91.1 fL
12-14 years: 79.9-93.0 fL
15-17 years: 82.5-98.0 fL
> or =18 years: 78.2-97.9 fL

Females:
0-14 days: 92.7-106.4 fL
15 days-4 weeks: 90.1-103.0 fL
5 weeks-7 weeks: 83.4-96.4 fL

8 weeks-5 months: 74.8-88.3 fL
6 months-23 months: 71.3-82.6 fL
24 months-35 months: 72.3-85.0 fL
3-5 years: 77.2-89.5 fL
6-11 years: 77.8-91.1 fL
12-14 years: 79.9-93.0 fL
15-17 years: 82.5-98.0 fL
> or =18 years: 78.2-97.9 fL

Red cell distribution width (RDW)
Males:
0-14 days: 14.8-17.0%
15 days-4 weeks: 14.3-16.8%
5 weeks-7 weeks: 13.8-16.1%
8 weeks-5 months: 12.4-15.3%
6 months-23 months: 12.9-15.6%
24 months-35 months: 12.5-14.9%
3-5 years: 11.3-13.4%
6-17 years: 11.4-13.5%
> or =18 years: 11.8-14.5%

Females:
0-14 days: 14.6-17.3%
15 days-4 weeks: 14.4-16.2%
5 weeks-7 weeks: 13.6-15.8%
8 weeks-5 months: 12.2-14.3%
6 months-23 months: 12.7-15.1%
24 months-35 months: 12.4-14.9%
3-5 years: 11.3-13.4%
6-17 years: 11.4-13.5%
> or =18 years: 12.2-16.1%

White blood cell count (WBC)
Males:
0-14 days: 8.0-15.4 x 10(9)/L
15 days-4 weeks: 7.8-15.9 x 10(9)/L
5 weeks-7 weeks: 8.1-15.0 x 10(9)/L
8 weeks-5 months: 6.5-13.3 x 10(9)/L
6 months-23 months: 6.0-13.5 x 10(9)/L
24 months-35 months: 5.1-13.4 x 10(9)/L
3-5 years: 4.4-12.9 x 10(9)/L
6-17 years: 3.8-10.4 x 10(9)/L
> or =18 years: 3.4-9.6 x 10(9)/L

Females:
0-14 days: 8.2-14.6 x 10(9)/L
15 days-4 weeks: 8.4-14.4 x 10(9)/L
5 weeks-7 weeks: 7.1-14.7 x 10(9)/L
8 weeks-5 months: 6.0-13.3 x 10(9)/L
6 months-23 months: 6.5-13.0 x 10(9)/L
24 months-35 months: 4.9-13.2 x 10(9)/L
3-5 years: 4.4-12.9 x 10(9)/L
6-17 years: 3.8-10.4 x 10(9)/L
> or =18 years: 3.4-9.6 x 10(9)/L

Platelet count
Males:
0-14 days: 218-419 x 10(9)/L
15 days-4 weeks: 248-586 x 10(9)/L
5 weeks-7 weeks: 229-562 x 10(9)/L
8 weeks-5 months: 244-529 x 10(9)/L
6 months-23 months: 206-445 x 10(9)/L
24 months-35 months: 202-403 x 10(9)/L
3-5 years: 187-445 x 10(9)/L
6-9 years: 187-400 x 10(9)/L
10-13 years: 177-381 x 10(9)/L
14-17 years: 139-320 x 10(9)/L
> or =18 years: 135-317 x 10(9)/L

Females:
0-14 days: 144-449 x 10(9)/L
15 days-4 weeks: 279-571 x 10(9)/L
5 weeks-7 weeks: 331-597 x 10(9)/L
8 weeks-5 months: 247-580 x 10(9)/L
6 months-23 months: 214-459 x 10(9)/L
24 months-35 months: 189-394 x 10(9)/L
3-5 years: 187-445 x 10(9)/L
6-9 years: 187-400 x 10(9)/L
10-13 years: 177-381 x 10(9)/L
14-17 years: 158-362 x 10(9)/L
> or =18 years: 157-371 x 10(9)/L

Neutrophils, absolute
Males:
0-14 days: 1.60-6.06 x 10(9)/L
15 days-4 weeks: 1.18-5.45 x 10(9)/L
5 weeks-7 weeks: 0.83-4.23 x 10(9)/L
8 weeks-5 months: 0.97-5.45 x 10(9)/L

6 months-23 months: 1.19-7.21 x 10(9)/L
24 months-35 months: 1.54-7.92 x 10(9)/L
3-5 years: 1.60-7.80 x 10(9)/L
6-16 years: 1.40-6.10 x 10(9)/L
17 years: 1.80-7.20 x 10(9)/L
> or =18 years: 1.56-6.45 x 10(9)/L

Females:
0-14 days: 1.73-6.75 x 10(9)/L
15 days-4 weeks: 1.23-4.80 x 10(9)/L
5 weeks-7 weeks: 1.00-4.68 x 10(9)/L
8 weeks-5 months: 1.04-7.20 x 10(9)/L
6 months-23 months: 1.27-7.18 x 10(9)/L
24 months-35 months: 1.60-8.29 x 10(9)/L
3-5 years: 1.60-7.80 x 10(9)/L
6-14 years: 1.50-6.50 x 10(9)/L
15-17 years: 2.00-7.40 x 10(9)/L
> or =18 years: 1.56-6.45 x 10(9)/L

Lymphocytes, absolute
Males:
0-14 days: 2.07-7.53 x 10(9)/L
15 days-4 weeks: 2.11-8.38 x 10(9)/L
5 weeks-7 weeks: 2.47-7.95 x 10(9)/L
8 weeks-5 months: 2.45-8.89 x 10(9)/L
6 months-23 months: 1.56-7.83 x 10(9)/L
24 months-35 months: 1.13-5.52 x 10(9)/L
3-5 years: 1.60-5.30 x 10(9)/L
6-11 years: 1.40-3.90 x 10(9)/L
12-17 years: 1.00-3.20 x 10(9)/L
> or =18 years: 0.95-3.07 x 10(9)/L

Females:
0-14 days: 1.75-8.00 x 10(9)/L
15 days-4 weeks: 2.42-8.20 x 10(9)/L
5 weeks-7 weeks: 2.29-9.14 x 10(9)/L
8 weeks-5 months: 2.14-8.99 x 10(9)/L
6 months-23 months: 1.52-8.09 x 10(9)/L
24 months-35 months: 1.25-5.77 x 10(9)/L
3-5 years: 1.60-5.30 x 10(9)/L
6-11 years: 1.40-3.90 x 10(9)/L
12-17 years: 1.00-3.20 x 10(9)/L
> or =18 years: 0.95-3.07 x 10(9)/L

Monocytes, absolute
Males:
0-14 days: 0.52-1.77 x 10(9)/L
15 days-4 weeks: 0.28-1.38 x 10(9)/L
5 weeks-7 weeks: 0.28-1.05 x 10(9)/L
8 weeks-5 months: 0.28-1.07 x 10(9)/L
6 months-23 months: 0.25-1.15 x 10(9)/L
24 months-35 months: 0.19-0.94 x 10(9)/L
3-5 years: 0.30-0.90 x 10(9)/L
6-17 years: 0.20-0.80 x 10(9)/L
> or =18 years: 0.26-0.81 x 10(9)/L

Females:
0-14 days: 0.57-1.72 x 10(9)/L
15 days-4 weeks: 0.42-1.21 x 10(9)/L
5 weeks-7 weeks: 0.28-1.21 x 10(9)/L
8 weeks-5 months: 0.24-1.17 x 10(9)/L
6 months-23 months: 0.26-1.08 x 10(9)/L
24 months-35 months: 0.24-0.92 x 10(9)/L
3-5 years: 0.30-0.90 x 10(9)/L
6-17 years: 0.20-0.80 x 10(9)/L
> or =18 years: 0.26-0.81 x 10(9)/L

Eosinophils, absolute
Males:
0-14 days: 0.12-0.66 x 10(9)/L
15 days-4 weeks: 0.08-0.80 x 10(9)/L
5 weeks-7 weeks: 0.05-0.57 x 10(9)/L
8 weeks-5 months: 0.03-0.61 x 10(9)/L
6 months-23 months: 0.02-0.82 x 10(9)/L
24 months-35 months: 0.03-0.53 x 10(9)/L
3-11 years: 0.00-0.50 x 10(9)/L
12-17 years: 0.10-0.20 x 10(9)/L
> or =18 years: 0.03-0.48 x 10(9)/L

Females:
0-14 days: 0.09-0.64 x 10(9)/L
15 days-4 weeks: 0.06-0.75 x 10(9)/L
5 weeks-7 weeks: 0.04-0.63 x 10(9)/L
8 weeks-5 months: 0.02-0.74 x 10(9)/L
6 months-23 months: 0.02-0.58 x 10(9)/L
24 months-35 months: 0.03-0.46 x 10(9)/L
3-11 years: 0.00-0.50 x 10(9)/L
12-17 years: 0.10-0.20 x 10(9)/L

> or =18 years: 0.03-0.48 x 10(9)/L

Basophils, absolute
Males:
0-14 days: 0.02-0.11 x 10(9)/L
15 days-7 weeks: 0.01-0.07 x 10(9)/L
8 weeks-35 months: 0.01-0.06 x 10(9)/L
3-17 years: 0.00-0.10 x 10(9)/L
> or =18 years: 0.01-0.08 x 10(9)/L

Females:
0-14 days: 0.02-0.07 x 10(9)/L
15 days-4 weeks: 0.01-0.06 x 10(9)/L
5 weeks-7 weeks: 0.01-0.05 x 10(9)/L
8 weeks-5 months: 0.01-0.07 x 10(9)/L
6 months-35 months: 0.01-0.06 x 10(9)/L
3-17 years: 0.00-0.10 x 10(9)/L
> or =18 years: 0.01-0.08 x 10(9)/L

Interpretation

Results outside of normal value ranges may reflect a primary disorder of the cell-producing organs or an underlying disease. Results should be interpreted in conjunction with the patient's clinical picture and appropriate additional testing performed.

Cautions

Questionable results are detected by in-house checking criteria based on quantitative and qualitative parameters.

A complete blood count with 5-part differential is most consistently accurate when performed within 24 hours of collection. Beyond 24 hours, obtaining a differential count may not always be possible due to cellular degradation.

Defined laboratory instrument or patient flagging criteria may trigger peripheral blood smear review resulting in consultant readout of hematologic abnormalities.

Manual differential cannot be performed for specimens greater than 24 hours post-draw.

The 5-part differential may be cancelled if specimen quality is insufficient.

Clinical Reference

1. Adel K, Raizman J, Chen Y, et al. Complex biological profile of hematologic markers across pediatric, adult, and geriatric ages: establishment of robust pediatric and adult reference intervals on the basis of the Canadian Health Measures Survey. Clin Chem. 2015;61(8):1075-1086
2. CLSI. Defining, Establishing, and Verifying Reference Intervals in the Clinical Laboratory; Approved Guideline, Third Edition. CLSI document EP28-A3c. Wayne, PA, Clinical and Laboratory Standards Institute, 2008
3. Soldin J, Brugnara C, Wong EC. Pediatric Reference Intervals. Fifth Edition. AACC Press. Washington, DC, 2005. ISBN 1-594250-32-4

4. McKenzie SB, Landis-Piwowar K, Williams L. Clinical Laboratory Hematology. 4th ed. Pearson; 2019

Performance

Method Description

Complete blood cell count with differential
The Sysmex XN 9100 performs hematology analysis according to the hydrodynamic focusing (DC detection), flow cytometry method (semiconductor laser), and sodium lauryl sulfate (SLS)-hemoglobin method.(Instruction manual: Automated Hematology Analyzer XN series [XN-9000/XN-9100] North American Edition, Code No. BF691913 en-am. Sysmex Corp; rev: 09/2022)

Morphology evaluation
Microscopic examination of a Wright-Giemsa stained smear.(Unpublished Mayo method)

Peripheral smear evaluation
A hematopathologist reviews the Wright-stained peripheral blood smear and an interpretation is provided.

PDF Report

No

Day(s) Performed

Monday through Sunday

Report Available

Same day/1 day

Specimen Retention Time

1 day

Performing Laboratory Location

Mayo Clinic Laboratories - Rochester Main Campus

Fees & Codes

Fees

- Authorized users can sign in to Test Prices for detailed fee information.
- Clients without access to Test Prices can contact Customer Service 24 hours a day, seven days a week.
- Prospective clients should contact their account representative. For assistance, contact Customer Service.

Test Classification

This test has been cleared, approved, or is exempt by the US Food and Drug Administration and is used per

manufacturer's instructions. Performance characteristics were verified by Mayo Clinic in a manner consistent with CLIA requirements.

CPT Code Information

85025
85007 (if appropriate)
85060 (if appropriate)

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
CBC	CBC with Differential, B	57021-8

Result ID	Test Result Name	Result LOINC® Value
HGB	Hemoglobin	718-7
HCT	Hematocrit	4544-3
RBC	Erythrocytes	789-8
MCV	MCV	787-2
RDW	RDW	788-0
WBC	Leukocytes	6690-2
NEUAA	Neutrophils, Abs	751-8
LYMAA	Lymphocytes, Abs	731-0
MONAA	Monocytes, Abs	742-7
EOSAA	Eosinophils, Abs	711-2
BASAA	Basophils, Abs	704-7
PLTC	Platelet Count	777-3