KAISER PERMANENTE®

| | |
|---|---|
| **DOCUMENT NUMBER:** RIV-PPP-1059 | |
| **DOCUMENT TITLE:** Peripheral Blood Smear Morphology Review | |
| **DOCUMENT NOTES:** | |

| | |
|---|---|
| **LOCATION:** RIV-rel | **VERSION:** 02 |
| **DOC TYPE:** RIV PPP | **STATUS:** Release |

| | |
|---|---|
| **EFFECTIVE DATE:** 25 Sep 2025 | **NEXT REVIEW DATE:** 25 Sep 2027 |
| **RELEASE DATE:** 25 Sep 2025 | **EXPIRATION DATE:** |

| | |
|---|---|
| **AUTHOR:** | **PREVIOUS NUMBER:** |
| **OWNER:** | **CHANGE NUMBER:** RIV-CR-0540 |

# Peripheral Blood Smear Morphology Review

**Purpose**

This procedure provides criteria for the microscopic assessment of red blood cell (RBC), leukocyte or white blood cell (WBC), and platelet morphology.

**Scope**

This procedure is intended for trained Clinical Laboratory Scientist (CLS) working in the hematology section.

**Policy**

- The laboratory defines the qualitative or semi-quantitative grading system used for morphologic findings on RBC, WBC, and platelets on blood films prepared for CLS review.

**Specimen sources**

- Wright-stained blood film from whole blood collected with EDTA (ethylene di-amine tetra-acetic acid).

**Stability and storage**

- General conditions suitable for acceptability of complete blood count (CBC) apply to peripheral blood smear morphology. Specimens from which blood films are prepared are kept at room temperature and stored at 2-8°C after analysis. Prolonged storage of specimens in EDTA may result in morphologic changes in leukocytes (cytoplasmic vacuolization).

**Safety**

Follow general safety reminders.
Used glass slides for blood film preparation must be placed in a puncture-resistant plastic sharps container for disposal.

**Equipment**

The following list of equipment is utilized for microscopic examination:

- Cellavision
- Microscope

**Before you begin**

- Ensure that the quality of blood film staining process has been reviewed and deemed acceptable prior to starting blood film reviews.

**Grading Observations**

Cell Morphology is graded based on percentage of occurrence or observation in the entire cell population.

NOTE: The following conversion formula can be used to assist the CLS in converting the number of items per HPF to Percent:

Cells per HPF: 150-200
Assumption: $\frac{\text{50-100 cells}}{200} = \frac{\text{2.5-5.0 cells}}{100}$ OR 2.5-5.0%

| Morphology | 1+ | 2+ | 3+ |
|---|---|---|---|
| Xxx cells | 5-10/HPF | 11-20/HPF | >21/HPF |

**Standard Settings, RBC Morphology**

The following tables contain the **Sysmex standard settings** based on the International Council for Standardization in Haematology (ICSH) recommended nomenclature and grading of peripheral blood cell morphological features. Final patient results are based on the morphological evaluations of the CLS after review of the entire cell population.

**Note: Refer to Attachment A for standard Cellavision settings.**

**RBC Morphology**: indicate whether Normal or Abnormal

| **Morphology DTA** | **Grading: Few (1+)** | **Grading: Mod (2+)** | **Grading: Many (3+)** |
|---|---|---|---|
| **Polychromasia**: means that the red cells are stained with shades of bluish grey and often seen when there is intense erythropoietic drive or extramedullary erythropoiesis. | <5% of red cells | 5 – 20% of red cells | >20% of red cells |
| **Hypochromia**: refers to red cells staining usually palely. Two possible causes for this observation are lowered hemoglobin concentration and abnormal thinness of the red cells. Correlate observation with mean corpuscular hemoglobin (MCH) value. | MCH: 21-24 pg/cell | MCH: 18-21 pg/cell | MCH <18 pg/cell |

*Continued on next page*

# Peripheral Blood Smear Morphology Review, Continued

Standard Settings, RBC Morphology, Continued

| Morphology DTA | Grading: Few (1+) | Grading: Mod (2+) | Grading: Many (3+) |
|---|---|---|---|
| **Poikilocytosis:** refers to increased variation in shape of red cells. Poikilocytes are produced in many types of abnormal erythropoiesis. | <5% of red cells | 5 – 20% of red cells | >20% of red cells |
| **Anisocytosis:** refers to increased variation in size of red cells indicative of abnormal erythropoiesis. It can be the presence of macrocytes, microcytes, or both along with normal size red cells. Correlate observation with red cell distribution (RDW) value. | RDW: 16.1-18.0% | RDW: 18.0-21.0 % | RDW >21.0 |
| **Microcytosis:** red cells smaller than normal. Correlate value with mean corpuscular volume (MCV). | • Defer to Cellavision grading<br>• 78-82 fL (Sysmex) | • Defer to Cellavision grading<br>• 65-77 fL (Sysmex) | • Defer to Cellavision grading<br>• <65 fL |
| **Macrocytosis:** red cells larger than normal. Correlate value with MCV. | • Defer to Cellavision grading.<br>• 99-109 (Sysmex) | • Defer to Cellavision grading.<br>• 110-120 (Sysmex) | • Defer to Cellavision grading.<br>• >120 |

*Continued on next page*

# Peripheral Blood Smear Morphology Review, Continued

**Standard Settings, RBC Morphology, Continued**

| Morphology DTA | Grading: Few (1+) | Grading: Mod (2+) | Grading: Many (3+) |
|---|---|---|---|
| **Acanthocytes:** refers to red cells in which there are a small number of spicules (spine) of inconstant length, thickness and shape, irregularly disposed over the surface of the cell. They usually have little or no central pallor like a spherocyte. They are present following splenectomy and in hyposplenism as well as in anemia. | <5% of red cells | 5 – 20% of red cells | >20% of red cells |
| **Basophilic Stippling:** means the presence of numerous basophilic granules distributed throughout the red cells. It is usually indicative of disturbed rather than increased erythropoiesis and occurs in many blood diseases, infections, liver disease and heavy metal poisoning. | <5% of red cells | 5 – 20% of red cells | >20% of red cells |
| **Burr Cells:** also called echinocytes. These are red cells that have an abnormal cell membrane characterized by many small, evenly spaced thorny projections. Sometimes exhibiting central pallor, burr cells appear in a variety of conditions relating to lipid metabolism, liver disease and as EDTA staining artifact. | <5% of red cells | 5 – 20% of red cells | >20% of red cells |

*Continued on next page*

# Peripheral Blood Smear Morphology Review, Continued

**Standard Settings, RBC Morphology,** Continued

| Morphology DTA | Grading: Few (1+) | Grading: Mod (2+) | Grading: Many (3+) |
|---|---|---|---|
| **Dimorphic Cells** refers to a mixture of red cells of two populations, that can be normochromic normocytic cells along with hypochromia or polychromasia, microcytosis or macrocytosis or two abnormal cell populations as well. | <5% of red cells | 5 – 20% of red cells | >20% of red cells |
| **Elliptocytes:** are elongated oval red cells appearing like rod-shaped or pencil forms. These appear increased in iron deficiency anemia, in hereditary elliptocytosis and in marrow infiltrative process. | <5% of red cells | 5 – 20% of red cells | >20% of red cells |
| **Ovalocytes:** are red cells that are oval or egg-shaped. About 1% is present in a normal CBC. They are increased in hereditary ovalocytosis, in all types of anemias, and thalassemia. | <5% of red cells | 5 – 20% of red cells | >20% of red cells |

*Continued on next page*

# Peripheral Blood Smear Morphology Review, Continued

**Standard Settings, RBC Morphology,** Continued

| Morphology DTA | Grading: Few (1+) | Grading: Mod (2+) | Grading: Many (3+) |
|---|---|---|---|
| **Spherocytes:** are cells that are more spheroidal (less disc-like) than normal red cells but maintain a regular outline. They lack a central pallor or show eccentric pallor, not a round pale space. They may result from genetic defects of the red cell membrane as in hereditary spherocytosis or from the interaction between immunoglobulin- or complement-coated red cells as in delayed transfusion reactions, ABO hemolytic disease of the newborn, and hemolytic anemia. | <5% of red cells | 5 – 20% of red cells | >20% of red cells |
| **Stomatocytes:** are red cells in which the central biconcave area appears slit-like in stained films. They are observed in rare types of hemolytic anemia, hereditary stomatocytosis, in liver disease, alcoholism, and in myelodysplastic syndromes. | <5% of red cells | 5 – 20% of red cells | >20% of red cells |
| **Target Cell:** are red cells in which there is a central round stained area and a peripheral rim of hemoglobinised cytoplasm separated by non-staining or more lightly staining cytoplasm. They are seen in films of patients with chronic liver disease, in iron deficiency anemia, and in thalassemia and hemoglobinopathies. | <5% of red cells | 5 – 20% of red cells | >20% of red cells |

*Continued on next page*

# Peripheral Blood Smear Morphology Review, Continued

**Standard Settings, RBC Morphology,** Continued

| Morphology DTA | Grading: Few (1+) | Grading: Mod (2+) | Grading: Many (3+) |
|---|---|---|---|
| **Tear Cell:** is a red-cell shaped like a tear-drop. Often also called dacryocyte, they are found in diseases with bone marrow fibrosis, acute leukemias, severe iron deficiency and thalassemia major. | <5% of red cells | 5 – 20% of red cells | >20% of red cells |
| **Howell Jolly Body:** is observed as small round cytoplasmic inclusion that stains purple and represents nuclear remnant. They are regularly present after splenectomy and when there is splenic atrophy, sometimes in pernicious anemia and celiac disease. | <2% of red cells | 2 – 3% of red cells | >3% of red cells |
| **Pappenheimer bodies** are small peripherally sited basophilic (almost black) erythrocyte inclusions. Smaller than Howell-Jolly bodies, they are composed of hemosiderin and related to sideroblastic erythropoiesis and hyposplenism. | <2% of red cells | 2 – 3% of red cells | >3% of red cells |
| **Bite Cell:** refers to abnormally shaped red cells with one or more semicircular portions removed from the cell margin, known, and looking as "bites". These may result from removal of denatured hemoglobin by the pitting action of the spleen or from mechanical damage. | <1% of red cells | 1 – 2% of red cells | >2% of red cells |
| **Blister Cells:** are also known as hemi-ghost or ghost cells – cells with almost empty membranes containing negligible hemoglobin. | <1% of red cells | 1 – 2% of red cells | >2% of red cells |

*Continued on next page*

# Peripheral Blood Smear Morphology Review, Continued

**Standard Settings, RBC Morphology,** Continued

| Morphology DTA | Grading: Few (1+) | Grading: Mod (2+) | Grading: Many (3+) |
|---|---|---|---|
| **Crenated Cells:** refers to red cells that have developed numerous projections on their surface. These can be acanthocytes and burr cells. | Report the more specific acanthocytes and burr cells | Report the more specific acanthocytes and burr cells | Report the more specific acanthocytes and burr cells |
| **Heinz Body:** are not easily visible and identifiable under Romanowsky-stained blood film. | | | |
| **Helmet Cells:** are red cells showing with a straight order and angulated edges, and without central pallor, thereby looking like a helmet. Commonly seen in hemolytic anemia, they also appear as a consequence of mechanical artificial heart valve. | <1% of red cells | 1 – 2% of red cells | >2% of red cells |
| **Parasites: Any value greater than 0% on seemingly looking parasites must be referred to pathologist for smear review and grading.** On Cellavision, this can be falsely flagged with stain artifacts. **Reminder:** Verify that Cellavision value is below threshold of 0% to prevent reporting a false result of 'Few'. | <1% of red cells | 1 – 2% of red cells | >2% of red cells |
| **Rouleaux** formation is the appearance of four or more red blood cells organized in a linear arrangement, which stimulates a "stack of coins." True rouleaux is present in the thin area of the blood film; it's normal in the thick area. | <1% of red cells | 1 – 2% of red cells | >2% of red cells |

*Continued on next page*

# Peripheral Blood Smear Morphology Review, Continued

**Standard Settings, RBC Morphology,** Continued

| Morphology DTA | Grading: Few (1+) | Grading: Mod (2+) | Grading: Many (3+) |
|---|---|---|---|
| **Schistocytes:** are erythrocyte fragments smaller than normal red cells and of varying shapes. These appear in a wide range of conditions including anemias, thalassemia, and mechanical stresses but most importantly in thrombotic microangiopathy (TMA). | <1% of red cells | 1 – 2% of red cells | >2% of red cells |
| **Sickle Cells:** appear as boat-shaped form of red cells and sickles. They are common in fresh blood drawn from adults with homozygosity for hemoglobin S or when the blood is subjected to anoxia. | <1% of red cells | 1 – 2% of red cells | >2% of red cells |
| **Siderocytes:** are red cells containing basophilic granules (Pappenheimer bodies) of non-heme iron or ferritin. They can always be found after splenectomy, often in large numbers. | <1% of red cells | 1 – 2% of red cells | >2% of red cells |

**Standard Settings, WBC Morphology**

The following tables contain the **Sysmex standard settings** based on the International Council for Standardization in Haematology (ICSH) recommended nomenclature and grading of peripheral blood cell morphological features. Final patient results are based on the morphological evaluations of the CLS after review of the entire cell population.

**Note: Refer to Attachment A for standard Cellavision settings.**

**White Blood Cell Morphology**

| Morphology DTA | Grading: Few (1+) | Grading: Mod (2+) | Grading: Many (3+) |
|---|---|---|---|
| **Atypical Lymphs**: are immature cells deviating from normal lymphocytes. | <3% of all lymphocytes | 3-10% of all lymphocytes | >10% of all lymphocytes |
| Auer Rods: are large, crystalline, cytoplasmic inclusion bodies resembling needles, most often observed in myeloid blast cells. | <1% of myeloid cells | 1-3% of myeloid cells | >3% of myeloid cells |
| **Dohle Bodies:** are small light blue-gray, oval basophilic leukocyte inclusions located in the peripheral cytoplasm of nucleus, generally in neutrophils and rarely in monocytes. They are thought to be remnants of endoplasmic reticulum. | 5-25% of all neutrophils and bands | 26-50% of all neutrophils and bands | >50% of all neutrophils and bands |
| **Hypersegs:** are segmented neutrophils with six or more lobes or considered also when more than 5% have five lobes, as a normal neutrophil has 3-5 lobes. Five-lobe types of neutrophils constitute less than *5%*. They can be seen after cytotoxic and antimetabolite treatment. | 5-10% of all neutrophils and bands | 11-20% of all neutrophils and bands | >20% of all neutrophils and bands |
| **Pelger Huet:** neutrophil cells show only two discrete equal-sized lobes connected by a thin chromatin bridge. It is seen in autosomal inherited condition where there is failure of normal granulocyte segmentation. | <2% of all neutrophils and bands | 2-8% of all neutrophils and bands | >8% of all neutrophils and bands |

*Continued on next page*

# Peripheral Blood Smear Morphology Review, Continued

**Standard Settings, WBC Morphology,** Continued

| Morphology DTA | Grading: Few (1+) | Grading: Mod (2+) | Grading: Many (3+) |
|---|---|---|---|
| **Plasmacytes:** appear as ovoid cells with an eccentric nucleus with a strongly basophilic cytoplasm. | • Non-Cellavision sites: <3% of all leukocytes.<br>• *Sysmex Cellavision sites:* Based on CLS semi-quantitation, assign one (1) image to equate less than 3% of all lymphs | • Non-Cellavision sites: 3-10% of all leukocytes.<br>• *Sysmex Cellavision sites:* Based on CLS semi-quantitation, assign two (2) images to equate less than 3 to 10% of all lymphocytes | • Non-Cellavision sites: >10% of all leukocytes.<br>• *Sysmex Cellavision sites:* Based on CLS semi-quantitation, assign three (3) images to equate greater than 10% of all lymphocytes |
| **Reactive Lymphs:** show a range of differentiation with a mixture of Downey type-I, type II, and type III cells. They may appear to "hug" adjacent red blood cells. They can be seen in a variety of conditions but are often increased in infectious mononucleosis due to EBV infection. Flow cytometry suggested. | • Non-Cellavision sites: <3% of all lymphocytes.<br>• *Sysmex Cellavision sites:* Based on CLS semi-quantitation, correlate and assign one (1) image to equate less than 3% of all lymphs | • Non-Cellavision sites: 3-10% of all lymphocytes.<br>• *Sysmex Cellavision sites:* Based on CLS semi-quantitation, correlate and assign two (2) images to equate less 3 to 10% of all lymphocytes | • Non-Cellavision sites: >10% of all lymphocytes.<br>• *Sysmex Cellavision sites:* Based on CLS semi-quantitation, correlate and assign three (3) images to equate greater than 10% of all lymphocytes |

*Continued on next page*

# Peripheral Blood Smear Morphology Review, Continued

**Standard Settings, WBC Morphology,** Continued

| Morphology DTA | Grading: Few (1+) | Grading: Mod (2+) | Grading: Many (3+) |
|---|---|---|---|
| **Sezary Cells:** are best identified by pathologists. Refer to pathologist's review. | | | |
| **Smudge Cells:** are remnants of cells that lack any identifiable cytoplasmic membrane or nuclear structure. They are mechanically distorted white cells, primarily lymphoid cells, which appear smudged in the Romanowsky-stained blood smear. Significant numbers of smudge cells are a characteristic of chronic lymphocytic leukemia (CLL), usually preventable by adding a drop of 22% albumin. A review of the leukocyte differential and correlation with the smear review should be done. | • Non-Cellavision sites: 16-30% of all white cells.<br>• Sysmex Cellavision sites: 16-30 cells<br>• Preparation of albuminized slide is recommended | • *Non-Cellavision sites:* 31-50% of all white cells.<br>• Sysmex Cellavision sites: 31-50 cells<br>• Prep of albuminized slide is indicated. | • *Non-Cellavision sites:* >50% of all white cells.<br>• Sysmex Cellavision sites: >50 cells<br>• Prep of albuminized slide is indicated. |
| **Toxic Granulation:** appears as coarse, lavender granules in the cytoplasm of neutrophils and bands in clinical conditions associated with severe infection. | 5-25% of all neutrophils and bands | 26-50% of all neutrophils and bands | >50% of all neutrophils and bands |
| **Vac Granulation:** the presence of vacuoles of variable size in the neutrophils and bands is usually indicative of severe sepsis. It can also be due to alcohol toxicity or acute liver failure. | 5-25% of all neutrophils and bands | 26-50% of all neutrophils and bands | >50% of all neutrophils and bands |
| **Vac NonGran:** refers to dysplastic granulocytes (neutrophils, bands, metamyelocytes and myelocytes) lacking cytoplasmic granules with some presence of vacuoles. | 5-10% of all granulocytes | 11-30% of all granulocytes | >30% of all granulocytes |

**Standard Settings, Platelets**

Platelet Estimate: Correlate slide review with platelet count obtained.

| | |
|---|---|
| Increased | More than 25 platelets/100X or >400,000 |
| Adequate | Less than 25 platelets/100X but greater than 7 platelets/l00X or 130-400,000 |
| Decreased | Less than 7 platelets/l00X or <130,000 |

**Platelet morphology:**

| Morphology DTA | Grading: Few (1+) | Grading: Mod (2+) | Grading: Many (3+) |
|---|---|---|---|
| **Bizarre Plts:** are abnormal platelets, sometimes have a balloon-shaped bulge of their cell membrane. They may also show as many small platelets. Most likely reflecting maturation disturbances of megakaryopoiesis, they are commonly seen in myelodysplastic syndromes (MDS) and sometimes in other leukemia types after a recent chemotherapy. | 1-2% of all platelets | 2-5% of all platelets | >5% of all platelets |
| **Giant Plts:** are of the same size as a lymphocyte or larger than red cell, typically irregularly shaped or agranular. CLS exercises discretion on Cellavision grading. | *If necessary to report: 5-10% of all platelets | 11-20% of all platelets | >20% of all platelets |
| **Large Plts:** are larger than normal but smaller than giant platelets, about the size of red cells. Usually about 4-7 um, round or ovoid, pale blue or colorless, containing purplish-red granules. CLS exercises discretion on Cellavision grading. | *If necessary to report: 5-10% of all platelets | 11-20% of all platelets | >20% of all platelets |
| **Platelet Satellite:** refers to the rosette formation by platelets around the periphery of white cells, primarily around neutrophils and bands. | 5-25% of all neutrophils and bands | 26-50% of all neutrophils and bands | >50 % of all neutrophils and bands |
| **Platelet Clumps:** is when platelets are observed to be sticking together. Refer to local protocol in resolving preanalytical specimen issues related to platelet clumping and addressing platelet count. | Small | Large | Abundant or sheets |

**Albumin Slide Preparation**

- It is recommended and may be necessary depending on the amount of smudge cells, to prepare an albuminized smear from the whole blood specimen.
- The degree of smudging can be reduced by preparing a 1:5 or 1:10 mixture of blood with 22% bovine albumin before making the smear. The albumin acts as a cellular cushion for fragile WBCs and improves accuracy in counting a white blood cell differential.

**Resulting**

Follow workflow that corresponds to morphology review platform.

**Result Flagging**

Any grading of presence of the listed red cell, white cell and platelet morphology will flag as abnormal in Cerner and KP Health Connect.

**Limitations**

Blood smear morphology and findings can be affected by the following:

- Delay in making the slide after blood is drawn
- Delay in staining the slide after it is made
- Exposure to extreme temperature
- Clotting
- Quality of smear thickness, too thick or too thin

**Non-Controlled Documents**

The following non-controlled documents support this policy.


| |
|---|
| Bain, B.J., Bates, I., Laffan, M.A., & Lewis, S.M., 12th Ed. (2017). *Dacie and Lewis Practical Haematology*. Elsevier. |
| Gulati, G. 2nd Ed. (2018). *Blood Cell Morphology: Grading Guide.* American Society for Clinical Pathology (ASCP) Press. |
| Gulati, G., & Caro, J. 3rd Ed. (2021) *Blood Cells: Morphology and Clinical Relevance.* American Society for Clinical Pathology (ASCP) Press. |
| Palmer, L. et al. ICSH recommendations for the standardization of nomenclature and grading of peripheral blood cell morphological features, International Journal. Lab. Hem. 2015, 37, 287–303 |
| Wekster, B. B., Schechter, G.P., & Ely, S.A., 2nd Ed. (2018). *Wintrobe's Atlast of Clinical Hematology.* Wolters Kluwer. |


**Author**

- SCPMG Hematology Working Group

# Attachment A: Standard Cellavision settings

**IMPORTANT! These settings may be used by other systems connecting to the current database. See Instructions for use.**

**Grading Limits (%)**

| | 1(Slight) | 2(Moderate) | 3(Marked) |
|---|---|---|---|
| Polychromatic cells: | 1 | 5 | 21 |
| Hypochromatic cells: | 6 | 25 | 50 |
| Microcytes: | 6 | 25 | 50 |
| Macrocytes: | 6 | 25 | 50 |
| Poikilocytosis: | 10 | 25 | 50 |
| Target cells: | 5 | 10 | 30 |
| Schistocytes: | 1 | 3 | 6 |
| Helmet cells: | 1 | 3 | 6 |
| Sickle cells: | 5 | 10 | 30 |
| Spherocytes: | 1 | 3 | 6 |
| Elliptocytes: | 6 | 20 | 50 |
| Ovalocytes: | 6 | 20 | 50 |
| Teardrop cells: | 1 | 3 | 6 |
| Stomatocytes: | 5 | 10 | 30 |
| Acanthocytes: | 5 | 10 | 30 |
| Echinocytes: | 10 | 25 | 50 |

| | 1(Slight) | 2(Moderate) | 3(Marked) |
|---|---|---|---|
| Howell - Jolly: | 99 | 99 | 99 |
| Pappenheimer: | 99 | 99 | 99 |
| Basophilic stippling: | 99 | 99 | 99 |
| Parasites: | 99 | 99 | 99 |
| Dimorphic: | 99 | 99 | 99 |
| Crenated RBC: | 99 | 99 | 99 |
| Rouleaux: | 99 | 99 | 99 |
| Bite Cells: | 99 | 99 | 99 |
| Blister Cells: | 99 | 99 | 99 |

**Size limits (micrometers)**

Microcytes ≤ 6 < Normal < 8.5 ≤ Macrocytes

**Anisocytosis limits (area distributon width %)**

| Anicosytosis (CV) | 1(Slight) | 2(Moderate) | 3(Marked) |
|---|---|---|---|
| | 15 | 20 | 25 |

*Regional Parent Document Reference Number: SCPMG-PPP-0498 Rev: 02*

## Signature Manifest

**Document Number:** RIV-PPP-1059 **Revision:** 02
**Title:** Peripheral Blood Smear Morphology Review
**Effective Date:** 25 Sep 2025

All dates and times are in Pacific Standard Time.

### Peripheral Blood Smear Morphology Review

### Operations Director Approval

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Annaleah Raymond (Q741709) | Laboratory Operations Director | 25 Sep 2025, 11:37:41 AM | Approved |

### Medical Director Approval

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Mark Taira (P161328) | CLIA Director | 25 Sep 2025, 12:58:40 PM | Approved |