RDW-- Interpreting the Full Blood Count

The most important components of a Full Blood Count report are, of course, the Haemoglobin, the White Cell Count and Differential and the Platelet Count. However, modern haematology machines that produce the FBC results are able to calculate several other derived parameters that provide more information. These are the red cell and platelet indices - MCV, MCH, MCHC, RDW and the MPV and PDW. They can help a lot in diagnosis, but they are under utilised because many doctors are less familiar with them. Some have only recently been routinely added to FBC reports and their significance may not be well known. The RDW is one example.

Interpretation of the RDW

Microscopic examination of a blood film gives an impression of the variation of red cell size, which is reported as 'anisocytosis'. This is, however, quite subjective and can only be quantified very roughly. Modern automated electronic haematology instruments are all able to assess the volume of red cells very easily and accurately, allowing a precise measure of this variability of red cell volume. This measure is called the 'Red Cell Volume Distribution Width', or RDW for short. This is expressed as a Coefficient of Variation (CV) and is defined as follows:

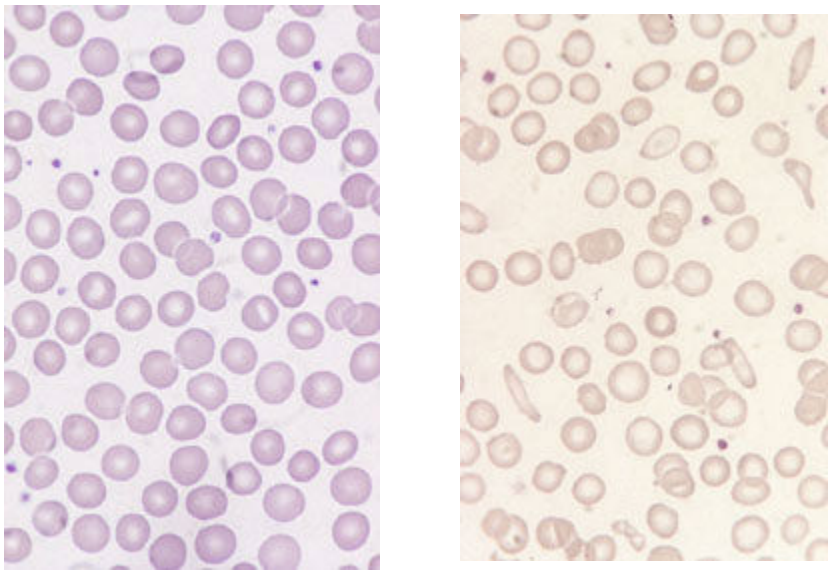
$$CV = \frac{\text{Standard Deviation of red cell size}}{\text{MCV}}$$

	MCV LOW	**MCV NORMAL**	**MCV HIGH**
RDW HIGH	Iron Deficiency Hbg Disease S/Beta Thalassaemia Hb1AC MAHA Severe anaemia of chronic disorders	Early Iron Deficiency Early B12/Folate defficency Sickle Cell Anaemia Sickle/C Disease	B12/Folate deficiency Immune Haemolytic anaemia Cold Agglutinins Alcoholism
RDW NORMAL	Thalassaemia trait Anaemia of Chronic Disorders Hereditary Spherocytosis	Normal Myelodysplasia	Aplastic Anaemia

	Sickle Cell trait		

RDW is a numerical measure of anisocytosis. It may be useful in distinguishing certain causes of anaemia, in particular, in distinguishing Iron Deficiency (RDW raised) from Thalassaemia (RDW usually normal) and in distinguishing Megaloblastic Anaemia (RDW usually raised) and other causes of macrocytosis (RDW more likely to be normal).

Note that only raised RDW are of significance and subnormal values do not occur. The RDW is a more sensitive measure of abnormality in microcytic, rather than macrocytic disorders, and is only of help if the haemoglobin is low.



These blood films illustrate the variation in red cell size in normal blood (left picture) and moderate iron deficiency (right picture). While the normal film shows little variation in red cell size, the iron deficient cells shows variations in size (anisocytosis) and shape (poikilocytosis), as well as microcytosis (low average cell size) and hypochromasia (increased central pallor). The anisocytosis in this film is increased as it is post-transfusion and shows some dimorphism.

Anisocytosis may be caused by or feature of the following.

Miscellaneous syndromes

- **Myelodysplastic syndrome**

Haematological abnormalities

- **Sideroblastic anaemia**

Biochemical abnormalities

- **Folate deficiency**

Mendelian inherited conditions

- **Diamond-Blackfan anemia**
- **Haemoglobin Bart's**
- **Hemoglobin H disease**

Autosomal dominant conditions

- **4-hydroxyphenylpyruvate hydroxylase deficiency**

Autosomal recessive conditions

- **Beta thalassaemia (severe / homozygous)**
- **Congenital dyserythropoietic anaemia type 2**

Nutritional conditions

- **Folate deficiency**
- **Iron deficiency**
- **Kwashiorkor (protein deficiency)**
- **Vitamin A deficiency**
- **Vitamin B12 deficiency**

Iatrogenic conditions

- **Blood transfusion and complications**

Red blood cell distribution width

Human red blood cells

The **red blood cell distribution width**, or **RDW**, is a measure of the variation of red blood cell width that is reported as part of a standard complete blood count. Usually red blood cells are a standard size. Certain disorders, however, cause a significant variation in cell size. Higher RDW values indicate greater variation in size. Normal range in human red blood cells is 11 - 15%. If anemia is observed, RDW test results are often used together with MCV results to figure out what the cause of the anemia might be. It is mainly used to differentiate between iron deficiency anemia, in which RDW is elevated, and other microcytic anemias. It may denote hereditary spherocytosis. An elevated RDW, i.e. red blood cells of unequal sizes, is known as anisocytosis.
Mathematically the RDW is calculated with the following formula:
RDW = (Standard deviation of red cell width ÷ mean cell width) × 100

CLINICAL RESEARCH: HEART FAILURE
Red Cell Distribution Width as a Novel Prognostic Marker in Heart Failure

Objectives: The goal of this study was to identify potentially novel laboratory markers of risk in chronic heart failure patients.

Background: Although a variety of prognostic markers have been described in heart failure, a systematic assessment of routine laboratory values has not been reported.

Methods: All 2,679 symptomatic chronic heart failure patients from the North American CHARM (Candesartan in Heart Failure: Assessment of Reduction in Mortality and Morbidity) program had a

wide range of laboratory measures performed at a core facility, enabling us to assess the relationship between routine blood tests and outcomes using a Cox proportional hazards model. We then replicated our findings in a cohort of 2,140 heart failure patients from the Duke Databank.

Results: Among 36 laboratory values considered in the CHARM program, higher red cell distribution width (RDW) showed the greatest association with morbidity and mortality (adjusted hazard ratio 1.17 per 1-SD increase, $p < 0.001$). Higher RDW was among the most powerful overall predictors, with only age and cardiomegaly showing a better independent association with outcome. This finding was replicated in the Duke Databank, in which higher RDW was strongly associated with all-cause mortality (adjusted hazard ratio 1.29 per 1 SD, $p < 0.001$), second only to age as a predictor of outcome.

Conclusions: In 2 large contemporary heart failure populations, RDW was found to be a very strong independent predictor of morbidity and mortality. Understanding how and why this marker is associated with outcome may provide novel insights into heart failure pathophysiology.

Abbreviations and Acronyms
ACE = angiotensin-converting enzyme
HR = hazard ratio