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Redscore: Supporting Hematology –A Simple Tool for the Longitudinal Monitoring of the Red Blood Cell Series

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Abstract

In current clinical practice, many activities joined to the high volume of laboratory data can hinder a physician´s ability to detect subtle yet significant trends in a patient´s red blood cell series. Redscore is a weighted algorithmic index designed to integrate RBC, HGB and MCV, in a cost-free mathematical tool to simplify the interpretation of their deviations, allowing for earlier clinical intervention before major complications arise. While traditional indices (RBC, HGB, MCV) and their established reference values limits provides the essential data, Redscore acts as a "clinical magnifying glass" synthesizing these parameters into a single, intuitive value. This approach addresses the need for more sensitive indicators in clinical practice employing principles of longitudinal monitoring and delta checks to capture subtle physiological shifts even when individual values remain within standard reference intervals without increasing healthcare costs [1-5].

Keywords: Dynamic monitoring, predictive analytics, magnifying glass, timely alerts.

Introduction

Methods

The model facilitates continuous monitoring of trends reflected in blood values over time. The formula utilizes the upper reference values for each test to establish a baseline or weighted value of them for any given observation.

$$\left\{\left(\frac{RBC_p - RBC_{Ref.}}{2 \times RBC_{Ref.}} + \frac{HGB_p - HGB_{Ref.}}{1.35 \times HGB_{Ref.}} + \frac{MCV_p - MCV_{Ref.}}{3 \times MCV_{Ref.}}\right) \times 90\right\} + 100$$

Where p is the patient value and Ref. corresponds to the upper reference value. The denominators (2, 1.35 and 3) function as adjustment factors to normalize the magnitude and clinical sensitivity of each variable.

Results

Clinical case application

The clinical utility of the proposed index is demonstrated in the following table which illustrates the longitudinal data from a two-year follow-up of a female patient with hypermenorrhea and its relation with the Redscore (%).

Table 1: Longitudinal Hematological data and Redscore percentage progression

Observation	1	2	3	4	5	6	7	8	9	10	11	12	13	14
RBC (x106µl)	5.3	5.0	5.0	4.9	4.6	4.4	4.3	4.4	5.0	4.5	5.2	5.5	4.9	5.1
HGB (g/dl)	14.7	14.5	11.8	11.6	11.1	9.4	9.1	9.6	11.3	10.5	12.3	13.5	12.3	13.5
MCV (fl)	81.3	82.3	72.4	71.7	74.5	68.1	66.9	71.1	71.3	73.1	75.2	73.6	75.0	80.0
Redscore (%)	94.0	90.8	76.0	74.1	70.1	59.0	56.4	60.8	73,5	66.2	80.8	88.2	78.1	86.6

Reference limits were obtained from the specific hematology analyzer used during clinical monitoring. While these may show minor variances from WHO standards the Redscore effectively captures the relative trend at clinical progression of the patient.

The relationship between the traditional indices and Redscore percentage is presented in the following figures. These variables are plotted separately to account the differences in scale, ensuring that the objective behavior and fluctuations of each parameter are accurately visualized

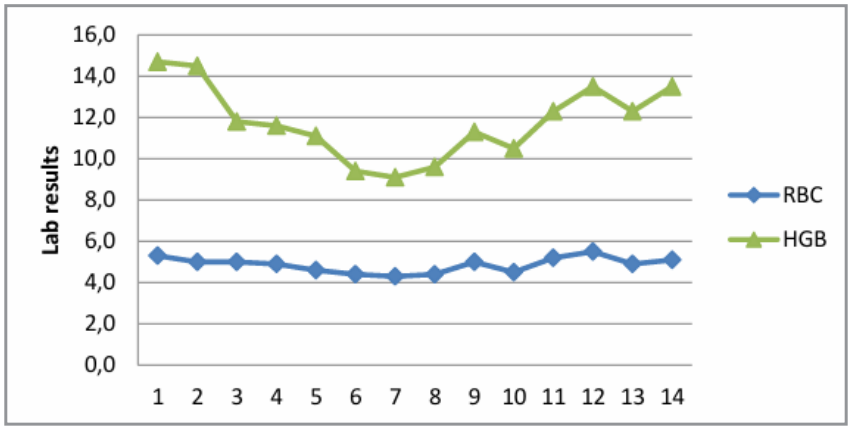

Figure 1: Comparative trends between hemoglobine (HGB) and red blood cells

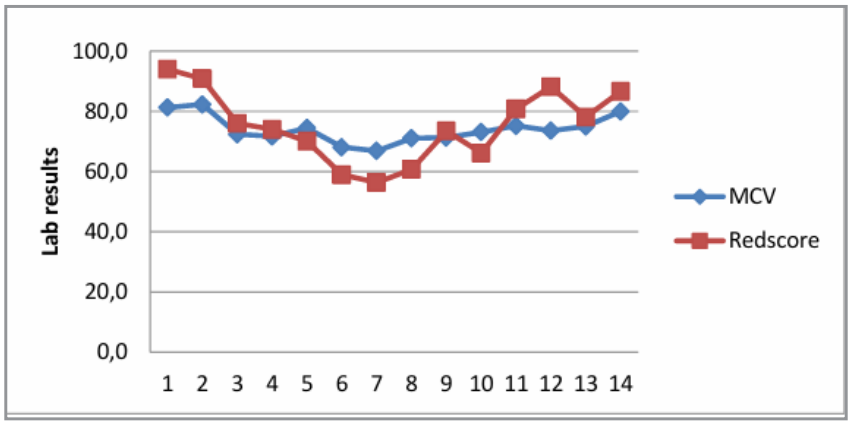

Figure 2: Longitudinal correlation between mean corpuscular volume (MCV) and Redscore index (%)

Data Analysis

The Redscore effectively amplifies physiological shifts that may appear as "stable" within traditional reference ranges. For instance:

- **Early detection:** Comparing sequences 1-2 and 3-4, despite seemingly stable hemoglobin levels; the Redscore initiated a downward trend, providing an early warning of erythropoietic stress could be in progress, before the anemia becomes clinically avert.
- **Sensitivity to anemic progression:** between sequences 6 and 8, the index accurately mirrored the decline and subsequent recovery of hemoglobin, but with greater magnification highlighting the severity of the anemic process prior to treatment response.
- **Predictable clinical reality:** in sequences 12 and 14, although the hemoglobin results were identical (13.5 g/dl) nevertheless, the Redscore showed different values. This variation, influenced by the RBC and MCV, suggests that the patient had not yet reached full homeostasis, and then these values suggest a new underlying detriment is revealed or the effect of palliative post-treatment recovery phase is in course that would otherwise be missed.

By plotting these variables separately, we prevent differences in order to magnitude from obscuring the objective of individual parameters. The Redscore does not deviate from numerical or clinical reality; rather, it provides a magnification effect that alerts the clinician to subtle changes before they become clinically evident. Continuous monitoring through Redscore offers significant benefits for both, the clinician and the patient itself or its parents in monitoring and managing any hematological condition related to this new index. I proposed the "%" symbol as its formal unit of magnitude, to standardize the clinical interpretations. This choice driven by two primary factors:

- **Clinical intuition:** percentage provides an immediate, intuitive understanding of how close a patient is to their functional homeostasis.
- **Longitudinal Sensitivity:** by expressing the result as a percentage, the subtle shifts become more apparent to both the clinician and the patient, fostering better treatment adherence and proactive monitoring.

Discussion

The magnitude of a truly significant change will depend on each metric specific gravity. Redscore serves as an integrated

response to laboratory data, showing increases or decreases that allow for the analysis of possible trends at any point in time. This provides an earlier visualization of shifts in the erythron´s status and patient evolution compared to looking at isolated, non –linear data. This complementary index is designed to provide the clinician timely alerts of subtle shift which, over time, could trigger major complications or lead to a predictable clinical deterioration.

Establishing that 100 % represents the desirable clinical maximum to be achieved, but the real objective is solely to attain functional normality for everyone, acknowledging the inherent biological variability of each individual upon which standard reference ranges are established. Variations towards the left (lower values) warn of potential detriment, whereas values exceeding it, alert the clinician to compensatory responses or pathological excesses (e.g. polycythaemia).

This tool does not seek to replace diagnostics criteria but rather provides a dynamic monitoring index that could be expressed as a percentage to given an extra sense to the clinician, of the patient´s hematological evolution that enhances the physician´s diagnostic intuition.

Redscore would be of great utility in monitoring of pediatric patients at risk of subclinical iron deficiencies, or women of childbearing age with folic acid deficiency. In these cases, response time is critical to prevent irreversible damage, which is often limited to a few days or weeks-a timeframe that routine monthly, semi-annual or annual follow-ups fail to counteract effectively.

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