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RESEARCH OF MATHEMATICAL METHODS AND MEDICAL ALGORITHMS FOR DIFFERENTIAL DIAGNOSTICS BASED ON LABORATORY DATA

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Abstract

Introduction. Anemia comprises heterogeneous disorders that share reduced hemoglobin yet differ by etiology and morphology. Routine hematology analyzers generate rich, time-varying signals that remain underused for differential diagnosis.

Aim. To formalize and test mathematical models and rule-based/algorithmic workflows that discriminate major anemia types using routinely available laboratory data, and to outline a tractable pathway for clinical implementation.

Materials and Methods. We analyzed routine hemograms on Sysmex XE-2100 and KX-21N with HGB, HCT, RBC, MCV, MCH, MCHC, RDW, PLT, WBC, and reticulocyte indices Ret%, Ret, IRF%, LFR%, MFR%, HFR%, RET-Y, Ret-He. We modeled treatment dynamics in iron-deficiency and vitamin B12–deficiency anemia using a generalized S-function. Fit metrics were not reported in the sources. Algorithmic differential diagnosis covered normocytic and other forms using WHO thresholds, ferritin, and vitamin B12.

Results. In the microspherocytosis study 41 patients were examined, 17 men and 24 women, age 23 to 61 years. RDW was 13.6±0.5% in controls and 17.6±3.9% in the main group with p=0.0001. Thickness of microerythrocytes was 2.3±0.2 μm in controls and 2.9±0.2 μm in the main group with p=0.001. Mean erythrocyte thickness was 2.1±0.2 μm and 2.6±0.3 μm with p=0.005. Microcell sphericity index was 2.8±0.2 and 2.2±0.2 with p=0.003. Erythrocyte sphericity index was 3.7±0.3 and 2.3±0.1 with p=0.005. Mean erythrocyte diameter was 7.5±0.2 μm and 6.6±0.2 μm with p=0.005. The share of microcytes was 12.6±6.7% and 68.7±16.9% with p=0.005. Normocytes were 72.9±7.3% and 30.4±16.5% with p=0.005. Macrocytes were 14.5±11.8% and 1.9±1.2% with p=0.005. In the retrospective routine dataset 364 of 400 records were retained, which is 91%, with 11 hematological indicators.

Conclusion. A combined modeling-plus-algorithmic framework built on routine laboratory data can structure differential diagnosis of anemia and prioritize confirmatory tests. The approach is implementable on existing analyzers and amenable to software deployment.

Key words: anemia, differential diagnosis, normocytic anemia, iron-deficiency, vitamin B12–deficiency, hereditary spherocytosis.

Introduction. Anemias represent a heterogeneous group of conditions characterized by a common feature of reduced hemoglobin but differing in etiology and morphology, which complicates the initial dilution of cases by cause and often leads to errors in patient routing and suboptimal assignment of confirmatory tests [1, 2].

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In real-world practice, decisions are typically made based on routine complete blood count parameters (Hb, MCV, MCH, RDW, etc.) supplemented with ferritin, vitamin B12, and reticulocyte indices [3, 4].

However, phenotype overlap (e.g., iron deficiency versus anemia of chronic disease in the context of inflammation) and the effects of therapy limit the accuracy of simple rules based on static data snapshots [5].

In recent years, extended erythrocyte and reticulocyte parameters of automated analyzers – Ret-He/CHr, IRF, MicroR, Hypo-He, as well as their ratios -have been shown to significantly improve the accuracy of the primary diagnostic step and better distinguish major types of anemia, including functional iron deficiency in the context of inflammation and congenital hemolytic anemias [6-8].

A probable weak point of most studies is the incomplete integration of «on-treatment dynamics» into algorithms: in most cases, analyses remain cross-sectional.

Approaches incorporating treatment-response dynamics (for example, diagnostic graphs/indices of the Thomas family, combining sTfR, ferritin, Ret-He) demonstrated high discriminatory power, particularly under inflammatory conditions where static ferritin thresholds lose reliability [5].

This indirectly points to the unrealized potential of a «response model+decision algorithm» built on existing platforms (Sysmex XE/XN, ADVIA, etc.), while most clinics already possess the necessary data channels [9, 10].

A separate applied task is a reproducible «verification pathway» for rare forms, primarily hereditary spherocytosis, with multicenter studies showing that a stepwise scheme using RET/IRF, morphometry, and the glycerol test provides high sensitivity and specificity in routine cohorts [11, 12].

Some algorithms have been validated on specific platforms, and transferability across analyzer product lines still requires caution.

Based on this, the aim of the present work is to formulate and technically describe a combined approach – «mathematical response model+clinical decision algorithms» – for the differential diagnosis of anemia using routine blood parameters and reticulocyte indices, compatible with standard laboratory platforms, and to assess its applicability for triage and prioritization of confirmatory tests.

Materials and Methods.

Study Design

A methodological study on the formalization and technical description of algorithms for the differential diagnosis of anemias based on routine laboratory data, and on the approximation of the temporal dynamics of hematological parameters using a generalized S-function. The work included four blocks:

1. Mathematical modeling of hemogram parameter trajectories during therapy for iron-deficiency and B12-deficiency anemias;
2. An algorithm for the diagnosis of anemias not related to iron metabolism, with an emphasis on normocytic forms;
3. A three-stage laboratory protocol for hereditary microspherocytosis/spherocytosis;
4. A morphological algorithm for primary branching based on red blood cell indices with calculation of the integral M-pathology index, followed by biochemical clarification.

Equipment and Laboratory Methods

Hematology analyzers Sysmex XE2100 were used for the hemogram panel, and Sysmex KX-21N for the complete blood count in the microspherocytosis block. Microscopy with Pappenheimer stain and red blood cell morphometry were performed using the «VideoTest-Morphology» system, with evaluation of thickness, sphericity, and diameter. Osmotic and

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kinetic tests were carried out, including the glycerol lysis test for membrane stability and measurement of erythrocyte destruction rate on the Sapphire 400. Flow cytometry was performed on the FC 500 with measurement of mean fluorescence intensity.

Baseline Parameters

The hemogram panel included HGB, HCT, RBC, RDW, WBC, LYMPF, PLT, MPV, MCHC, as well as reticulocyte indices: Ret%, Ret, IRF%, LFR%, MFR%, HFR%, RET-Y, Ret-He. These parameters were used for constructing trajectories in time series modeling, as well as decision nodes in diagnostic algorithms.

Mathematical Model

The dynamics of hemogram parameters during therapy were described by the generalized function S = S(x) with the parameters of initial level S_0, extreme value M, and stabilization level Sst. Formal-analytical relationships are presented in Formulas (1, 2).

$$S = HGe^{1-\dot{G}} + S_{st}\ , \tag{1}$$

$$G = D^c - u^c + 1\ ,\ \text{а}\ \ D = u\frac{x-a}{b-a} \tag{2}$$

Algorithms of Differential Diagnosis

A step-by-step decision-making scheme integrates morphological classification and the color index with subsequent etiological detailing (Figure 1). The nodes include differentiation according to normocytic, microcytic, and macrocytic patterns, followed by transition to specific diagnostic branches.

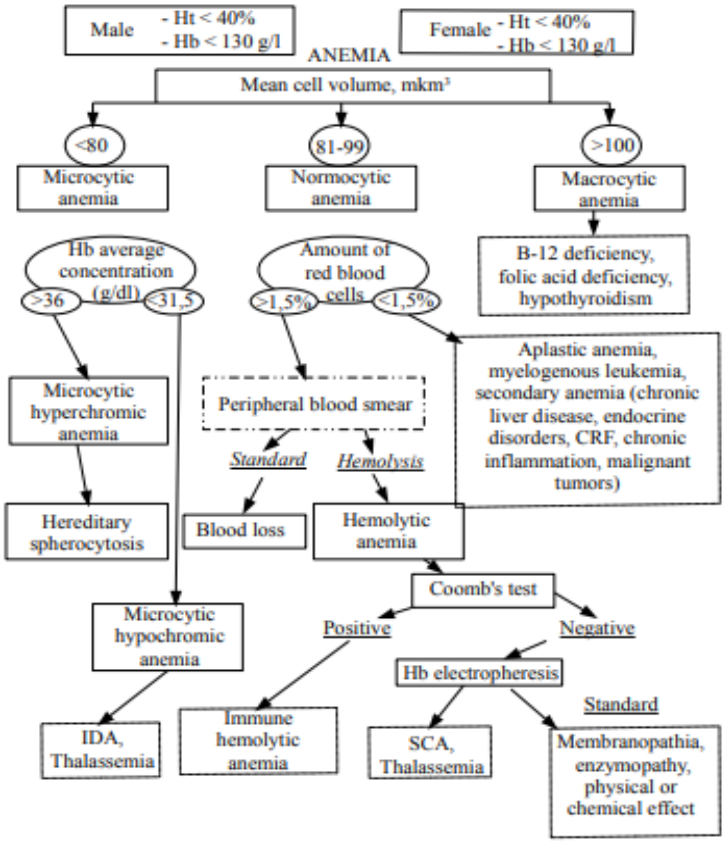

Figure 1. Algorithm of differential diagnosis of anemia not related to iron metabolism

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A separate branch (Figure 2) provides for the consideration of nutritional deficiencies, anemia in chronic kidney disease, hemolytic forms (including autoimmune and hereditary microspherocytic), enzymopathies (pyruvate kinase deficiency, glucose-6-phosphate dehydrogenase deficiency), paroxysmal nocturnal hemoglobinuria, aplastic anemia, and secondary bone marrow processes. The sequence of laboratory specification is determined by the structure of the scheme, without evaluative characteristics.

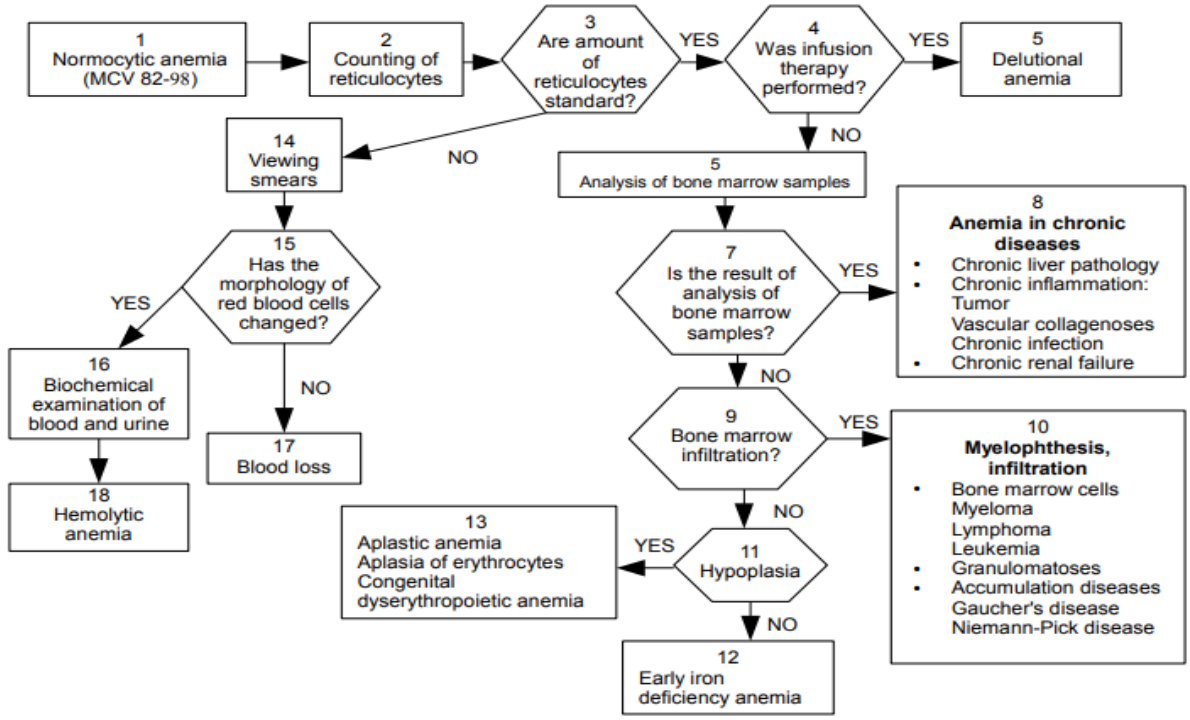

Figure 2. Algorithm of diagnosis of normocytic anemia

Morphological Algorithm and Integral Calculation of M-Pathology

The primary decision on the presence/absence of anemia and the presumed morphotype is made according to the algorithm (Figure 3) based on the indices HGB, HCT, MCHC, MCH, MCV, and RBC. The integral indicator MMM is calculated using formula (3) as a weighted sum of the normalized components mHGB, mHCT, mMCHC, mMCH, mMCV, and mRBC, with weights of 0.5, 0.1, 0.1, 0.1, 0.1, and 0.1, respectively. Biochemical refinement is performed using ferritin thresholds (60/40/20 μg/L) according to Formula (3); for the iron-deficiency branch, Formula (4) Mida is applied, while for the macrocytic branch, thresholds of vitamin B12 (400/100 ng/mL) and Formula (5) Mb12 are used.

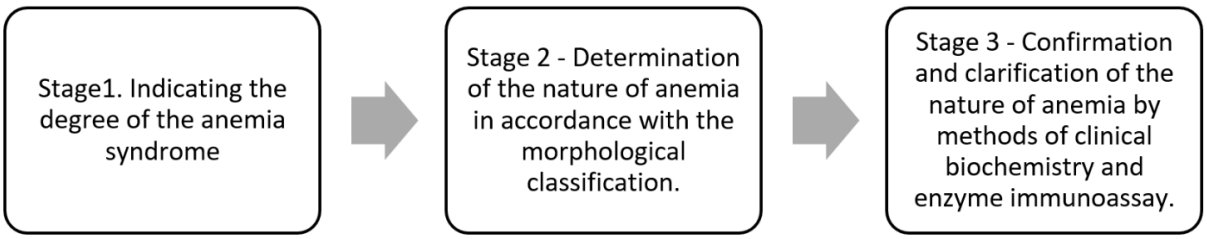

Figure 3. Stages of diagnosis of anemia

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Statistical Analysis

Data processing and reproducible calculations were performed in Python using the pandas library. The operations included importing the source tables, preprocessing (format alignment, range control), and generating auxiliary visualizations of the feature set structure and the correlation matrix, without analytical interpretation.

Results. According to Sysmex KX-21N data, in the control group and the main group (HC), the mean values (±SD) and p-levels for erythrocyte parameters are presented (Table 1). Hemoglobin was 137.6 ± 9.3 g/L versus 118.8 ± 32.8 g/L (p=0.07), hematocrit — 0.40 ± 0.02 L/L versus 0.40 ± 0.10 (p=0.06), red blood cell count — 4.7 ± 0.2 versus 4.3 ± 0.9 $\times 10^{12}$/L (p=0.09). For indices, MCH was 28.6 ± 1.3 versus 27.6 ± 2.2 pg (p=0.05), MCHC — 34.7 ± 0.9 versus 36.7 ± 1.0 g/L (p=0.62), MCV — 83.1 ± 1.7 versus 81.7 ± 14.6 fL (p=0.71). A significant difference was observed for RDW: 13.6 ± 0.5% in the control group and 17.6 ± 3.9% in the HC group (p=0.0001).

Table 1. Erythrocyte parameters in patients with congenital microspherocytic anemia obtained using the sysmex kx 21n analyzer

Parameter	Control group	Main group (HC)	*p*-value
Hb, g/l	137.6 ± 9.3	118.8 ± 32.8	0.07
Hct, l/l	0.40 ± 0.02	0.4 ± 0.1	0.06
RBC, x10^{12}/l	4.7 ± 0.2	4.3 ± 0.9	0.09
MCH, pg	28.6 ± 1.3	27.6 ± 2.2	0.05
MCHC, g/l	34.7 ± 0.9	36.7 ± 1.0	0.62
MCV, fl	83.1 ± 1.7	81.7 ± 14.6	0.71
RDW, %	13.6 ± 0.5	17.6 ± 3.9	0.0001

Based on morphometric analysis («VideoTest-Morphology»), in the main group (Table 2) greater thickness of microcytes was observed (Tmer 2.9 ± 0.2 vs. 2.3 ± 0.2 μm; p=0.001), as well as of erythrocytes (Ter 2.6 ± 0.3 vs. 2.1 ± 0.2; p=0.005). Lower sphericity indices were noted both for microcytes (R_mer 2.2 ± 0.2 vs. 2.8 ± 0.2; p=0.003) and for erythrocytes overall (R_er 2.3 ± 0.1 vs. 3.7 ± 0.3; p=0.005); and a smaller mean erythrocyte diameter (Der 6.6 ± 0.2 vs. 7.5 ± 0.2 μm; p=0.005). The size distribution was shifted towards microcytosis: the proportion of microcytes was 68.7 ± 16.9% vs. 12.6 ± 6.7% (p=0.005), with a decrease in the proportion of normocytes 30.4 ± 16.5% vs. 72.9 ± 7.3% (p=0.005) and macrocytes 1.9 ± 1.2% vs. 14.5 ± 11.8% (p=0.005).

Table 2. Values of erythrocyte indices obtained using the hardware-software complex «videotest-morphology»

Researching parameters	Control group	Main group (HC)	*p*-value
Thickness of erythrocytes of microcytes (Tmer), microns	2.3 ± 0.2	2.9 ± 0.2	0.001
Thickness of erythrocytes (Ter)	2.1 ± 0.2	2.6 ± 0.3	0.005
Erythrocyte sphericity index of microcytes (R mer)	2.8 ± 0.2	2.2 ± 0.2	0.003
Erythrocyte sphericity index (Rer)	3.7 ± 0.3	2.3 ± 0.1	0.005
Erythrocyte average diameter (Der)	7.5 ± 0.2	6.6 ± 0.2	0.005
Microcyte content (% micr.)	12.6 ± 6.7	68.7 ± 16.9	0.005
Normocyte content (% norm.)	72.9 ± 7.3	30.4 ± 16.5	0.005

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Researching parameters	Control group	Main group (HC)	*p*-value
Macrocyte content (% macr.)	14.5 ± 11.8	1.9 ± 1.2	0.005

Threshold zones for classifying the degree of pathology (Table 3) based on six parameters (HGB, HCT, MCH, MCHC, MCV, RBC): zone P0 (normal/absence of morphotype), zone P1.0 (confirmation), and intermediate intervals “P by formula” with normalizing expressions. For the lower boundary intervals, the formulas are defined as follows: (125−x)/(125−115) for HGB 115–125 g/L; (0.38−x)/(0.38−0.30) for HCT 0.30–0.38; (32−x)/(32−28) for MCHC 28–32 g/dL; (27−x)/(27−18.5) for MCH 18.5–27 pg; (80−x)/(80−64) for MCV 64–80 fL; (4.0−x)/(4.0−3.5) for RBC 3.5–4.0×10^{12}/L. For the upper boundary zones, the formulas are specified as (x−34)/(36.4−34) for MCHC 34–36.4 g/dL and (x−95)/(129−95) for MCV 95–129 fL. The notation x corresponds to the individual patient value.

Table 3. Calculating pathology degree by results of patient

Parameters	HGB, g/l	HCT	MCH, pg	MCHC, g/dl	MCV, fl	RBC, ×1012/л
P0	≥125	≥ 0,38	27-34	≥ 32	80-95	≥4,0
P1.0	≤115	≤0,30	≤18,5 ≥36,4	≤28	≤64 ≥129	≤3,5
P by formula	125-115	0,38-0,30	27-18,5	32-28	80-64	4,0-3,5
Formula	$\frac{125-x}{125-115}$	$\frac{0.38-x}{0.38-0.30}$	$\frac{32-x}{32-28}$	$\frac{27-x}{27-18.5}$	$\frac{80-x}{80-64}$	$\frac{4.0-x}{4.0-3.5}$
P by formula			34-36,4		95-129	
Formula			$\frac{x-34}{36.4-34}$		$\frac{x-95}{129-95}$	

The matrix of pairwise correlations (Figure 4) between hematological parameters and reticulocyte indices reflected the direction and relative strength of associations between the variables.

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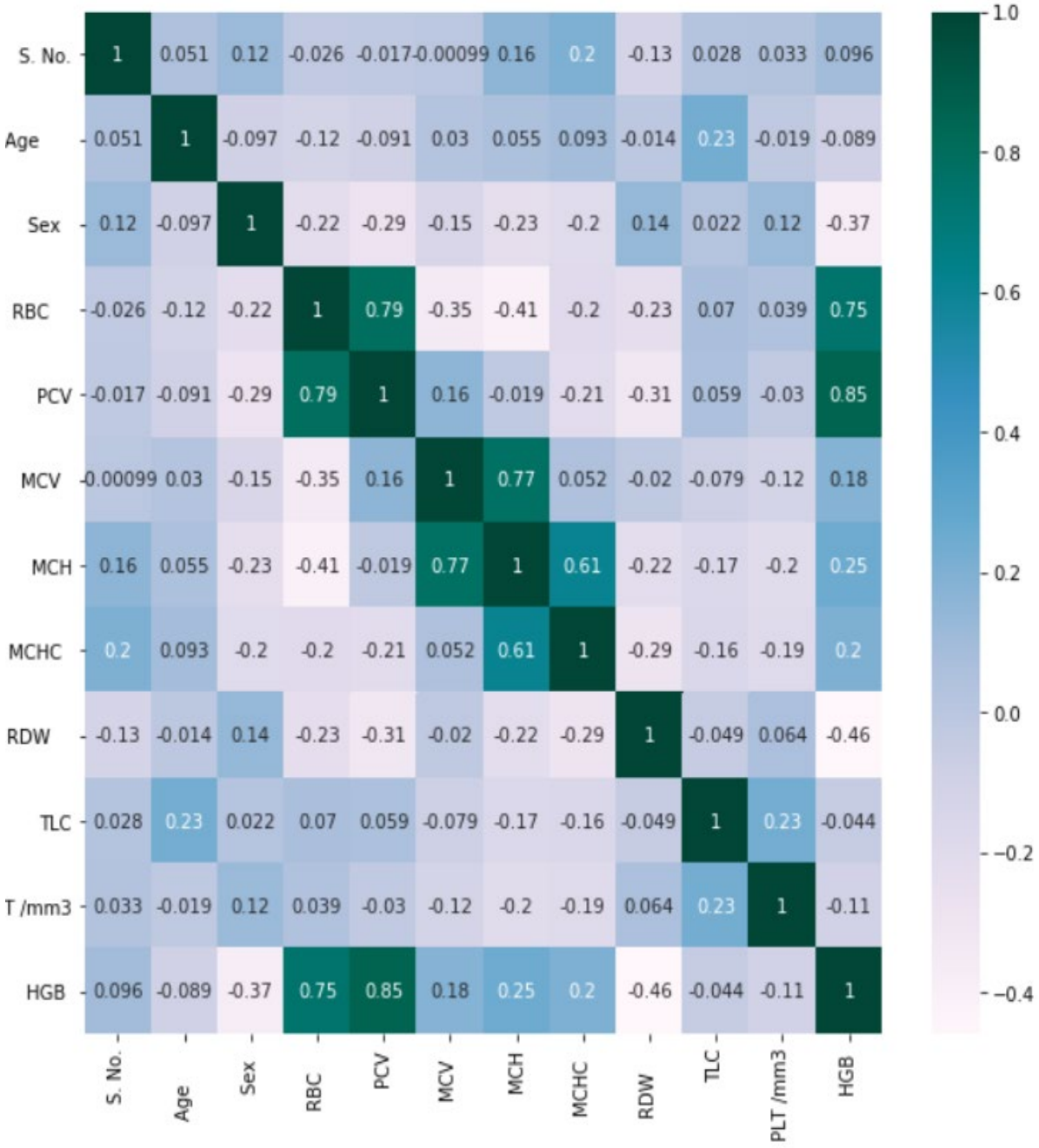

Figure 4. Correlation analysis results.

Discussion. The proposed combination of «routine parameter algorithms+treatment dynamics model» addresses a common problem in the initial diagnosis of anemia, where simplified rules based on MCV/RDW, ferritin, and vitamin B12 dominate in practice [13].

The addition of reticulocyte indices (Ret-He, RET-Y, IRF, LFR/MFR/HFR) and formalized dynamics is intended to increase diagnostic certainty at an early stage and reduce the need for confirmatory testing [14, 15].

Probably, the strength of this approach is its reliance on existing data sources; its weakness is the lack of formally calculated metrics for accuracy, calibration, and clinical utility, which currently limits comparability with published algorithms.

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Modeling the response to therapy using a generalized S-function potentially allows for faster differentiation of iron deficiency and B12 deficiency anemia along the Ret-He/RET-Y/IRF trajectories within 7–14 days [16].

This information is lost in static rules. The fact that fitting and validation metrics (approximation error, robustness to initial conditions) were not provided in the sources leaves open the question of the model's reproducibility in independent cohorts. This assumption requires prospective testing.

The minimum diagnostic set appears reasonable: in addition to the basic CBC indices, it is worth adding at least Ret-He and one immature reticulocyte indicator (e.g., IRF). Given the heterogeneity of laboratory equipment, two configurations are appropriate: an "extended" one for the Sysmex XE-2100 and a «light» one for the KX-21N. A formal cost-accuracy analysis is needed here: to what extent does the increase in accuracy justify additional indices and reconfiguration of the LIS [17].

In normocytic and mixed segments, the accuracy of most rules typically decreases due to overlapping phenotypes and the influence of inflammation. Including reticulocyte indicators can compensate for some of this loss, especially with elevated CRP, but without stratified sensitivity/specificity estimates by subgroups (age, gender, concomitant iron/B12 therapy at entry), the conclusion remains tentative. I would use adaptive thresholds with local recalibration.

The presented differences in morphometry (increased thickness, decreased diameter, increased proportion of microcytes, and changes in sphericity indices at $p \leq 0.005$ in all comparisons) confirm the biological validity of the parameters. However, this approach should be compared with reference methods (EMA binding, osmotic fragility test) in terms of sensitivity, specificity, and logistics; without such a benchmark, it is difficult to assess the true clinical value [18].

Transferability of solutions between platforms requires separate calibration and preanalytical control. Even with identical index nomenclature, differences in calculation algorithms and analyzer settings lead to threshold shifts. Cross-validation and local customization of rules for specific equipment are recommended.

The robustness of the conclusions has not yet been demonstrated: there are no sensitive assays with alternative WHO thresholds, outlier processing (winsorization), different strategies for handling missing values, or stratification by inflammation. Without reporting AUC, sensitivity/specificity, PPV/NPV, calibration slope, and Brier score, as well as decision-curve analysis, it is difficult to compare the benefits of algorithms with existing diagnostic pathways.

Potential clinical and organizational benefits include reduced time to correct diagnosis, a reduction in unnecessary confirmatory tests, and prioritization of rare diseases for in-depth evaluation. This assumption should be confirmed by a prospective time-to-decision assessment and cost modeling, considering the cost of additional indices and upgrades.

Study limitations

A retrospective design, a single-temporal cross-section (September–December 2020), a size of 364 records after preprocessing, incomplete biomarker coverage (not all patients have ferritin, B12, or CRP), and a lack of formal accuracy and calibration metrics. These factors may overstate optimism and limit external validity.

Conclusion. The software-based implementation of mathematical methods and medical diagnostic algorithms has the potential to reduce common diagnostic errors and lower the proportion of undiagnosed anemia cases. The present study includes the development and presentation of several diagnostic tools: a universal algorithm for the diagnosis of all anemia types, an algorithm for morphological classification, an algorithm for diagnosing normocytic

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anemia, and an algorithm for anemia diagnosis based on the criteria established by the World Health Organization.

Conflicts of interest.
We declare no conflict of interest.
Authors' contribution.
M.Uvaliyeva, F.S. Amenova, A.S. Mukatay, A.S. Bukunova, B. Karimkyzy collectively participated in formulating the overall study concept, carrying out the research, processing and interpreting the results, and preparing the manuscript. The authors confirm that this work has not been published previously and is not under review elsewhere.
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ЗЕРТХАНАЛЫҚ МӘЛІМЕТТЕР НЕГІЗІНДЕ ДИФФЕРЕНЦИАЛДЫ ДИАГНОСТИКАНЫҢ МАТЕМАТИКАЛЫҚ ӘДІСТЕРІ МЕН МЕДИЦИНАЛЫҚ АЛГОРИТМДЕРІН ЗЕРТТЕУ

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Түйіндеме

Кіріспе. Анемия гемоглобин деңгейінің төмендеуімен сипатталатын, бірақ этиологиясы мен морфологиясы бойынша әртүрлі болып келетін гетерогенді аурулар тобына жатады. Рутинді гематологиялық анализаторлар уақытқа байланысты өзгеретін ауқымды сигналдар береді, алайда олар дифференциалды диагностикада жеткілікті қолданылмайды.

Мақсаты. Қолжетімді зертханалық көрсеткіштер негізінде анемияның негізгі түрлерін ажыратуға арналған математикалық модельдер мен ережеге/алгоритмге негізделген әдістерді әзірлеу және клиникалық тәжірибеге енгізудің ықтимал жолын көрсету.

Материалдар мен әдістер. Sysmex XE-2100 және KX-21N анализаторларының деректері пайдаланылды: HGB, HCT, RBC, MCV, MCH, MCHC, RDW, PLT, WBC, сондай-ақ ретикулоцит индекстері (Ret%, Ret, IRF%, LFR%, MFR%, HFR%, RET-Y, Ret-He). Темір тапшылығы және B12 витамині тапшылығы анемияларындағы емдеу динамикасы жалпыланған S-функция арқылы модельденді. Бейімделу метрикалары бастапқы дереккөздерде көрсетілмеген. Дифференциалды диагностика алгоритмі нормоцитарлы және басқа түрлерін ДДСҰ шектері, ферритин мен B12 витамині деңгейлеріне сүйене отырып қамтыды.

Нәтижелер. Микросфероцитозбен жүргізілген зерттеуде 41 науқас қаралды (17 ер адам, 24 әйел), жасы 23–61 жас аралығында. Бақылау тобында RDW – 13,6±0,5%, ал негізгі топта – 17,6±3,9% (p=0,0001). Микроэритроцит қалыңдығы – тиісінше 2,3±0,2 мкм және 2,9±0,2 мкм (p=0,001). Орташа эритроцит қалыңдығы – 2,1±0,2 мкм және 2,6±0,3 мкм (p=0,005). Микрожасушалардың сферикалық индексі – 2,8±0,2 және 2,2±0,2 (p=0,003). Эритроциттердің сферикалық индексі – 3,7±0,3 және 2,3±0,1 (p=0,005). Орташа эритроцит диаметрі – 7,5±0,2 мкм және 6,6±0,2 мкм (p=0,005). Микроциттердің үлесі – 12,6±6,7% және 68,7±16,9% (p=0,005). Нормоциттер – 72,9±7,3% және 30,4±16,5

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% (p=0,005). Макроциттер – 14,5±11,8% және 1,9±1,2% (p=0,005). Ретроспективті қолжетімді деректер жиынтығында 400 жазбаның 364-і (91%) пайдаланылды, соның ішінде 11-і гематологиялық көрсеткішпен болды.

Қорытынды. Қолжетімді зертханалық деректерге негізделген модельдеу мен алгоритмдік әдістерді біріктіру анемияның дифференциалды диагностикасын құрылымдауға және растаушы зерттеулерді басымдықпен таңдауға мүмкіндік береді. Ұсынылған тәсілді қолданыстағы анализаторларда іске асыруға және бағдарламалық қамтамасыз етуге енгізуге болады.

Түйінді сөздер: анемия, дифференциалды диагноз, нормоциттік анемия, теміртапшылық, В12 дәрумені тапшылығы, тұқым қуалайтын сфероцитоз.

ИССЛЕДОВАНИЕ МАТЕМАТИЧЕСКИХ МЕТОДОВ И МЕДИЦИНСКИХ АЛГОРИТМОВ ДИФФЕРЕНЦИАЛЬНОЙ ДИАГНОСТИКИ НА ОСНОВЕ ЛАБОРАТОРНЫХ ДАННЫХ

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Аннотация

Введение. Анемия представляет собой гетерогенную группу нарушений, объединённых снижением уровня гемоглобина, но различающихся по этиологии и морфологии. Рутинные гематологические анализаторы генерируют богатые, временные сигналы, которые остаются недостаточно используемыми для дифференциальной диагностики.

Цель. Формализовать и протестировать математические модели и алгоритмические/правил-ориентированные рабочие схемы, позволяющие различать основные типы анемий на основе рутинных лабораторных данных, а также наметить практический путь клинической реализации.

Материалы и методы. Проанализированы рутинные гемограммы, выполненные на Sysmex XE-2100 и KX-21N, с показателями HGB, HCT, RBC, MCV, MCH, MCHC, RDW, PLT, WBC и ретикулоцитарными индексами Ret%, Ret, IRF%, LFR%, MFR%, HFR%, RET-Y, Ret-He. Динамика лечения железодефицитной и B12-дефицитной анемии моделировалась с использованием обобщённой S-функции. Метрики аппроксимации в источниках не приводились. Алгоритмическая дифференциальная диагностика охватывала нормоцитарные и другие формы с использованием порогов ВОЗ, ферритина и витамина B12.

Результаты. В исследовании микросфероцитоза были обследованы 41 пациент (17 мужчин и 24 женщины) в возрасте от 23 до 61 года. RDW составлял 13,6±0,5% в контроле и 17,6±3,9% в основной группе (p=0,0001). Толщина микроэритроцитов составила 2,3±0,2 мкм в контроле и 2,9±0,2 мкм в основной группе (p=0,001). Средняя толщина эритроцитов составила 2,1±0,2 мкм и 2,6±0,3 мкм (p=0,005). Индекс сферичности микроцитов был равен 2,8±0,2 и 2,2±0,2 (p=0,003). Индекс сферичности эритроцитов – 3,7±0,3 и 2,3±0,1 (p=0,005). Средний диаметр эритроцитов – 7,5±0,2 мкм и 6,6±0,2 мкм (p=0,005). Доля микроцитов составила 12,6±6,7% и 68,7±16,9% (p=0,005). Нормоциты –

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72,9±7,3% и 30,4±16,5% (p=0,005). Макроциты – 14,5±11,8% и 1,9±1,2% (p=0,005). В ретроспективном рутинном наборе данных было сохранено 364 из 400 записей (91%) с 11 гематологическими показателями.

Заключение. Комбинированный подход, основанный на моделировании и алгоритмических схемах с использованием рутинных лабораторных данных, позволяет структурировать дифференциальную диагностику анемий и расставлять приоритеты для подтверждающих тестов. Данный подход может быть реализован на существующих анализаторах и легко адаптирован к программному внедрению.

Ключевые слова: анемия, дифференциальная диагностика, нормоцитарная анемия, железодефицит, В12-дефицит, наследственный сфероцитоз.