

# **A Novel Methodology for Standardizing Medical Test Parameters: Mathematical Framework and Clinical Applications in Hematology**

This comprehensive white paper presents a groundbreaking methodological framework for standardizing diverse medical test parameters, with special emphasis on hematological assessments. The methodology enables precise mathematical comparison between test indicators with different units, scales, and reference ranges, providing clinicians with a powerful tool for comprehensive patient evaluation, early detection of abnormalities, and objective quantification of treatment efficacy.

## **Introduction to the Methodological Framework**

The method described in the analyzed documents presents a mathematical approach for standardizing diverse clinical indicators into a common evaluative framework. This standardization allows for precise comparison between different parameters regardless of their measurement units or reference ranges.

## **Core Principle**

The central innovation of this method lies in converting all test values to a common dimension—percentage deviation from the norm's midpoint. This standardization enables:

1. Precise mathematical evaluation of each parameter's deviation from its reference range
2. Direct comparison between parameters with different units and scales
3. Hierarchical organization of abnormalities by severity
4. Early detection of developing trends before values exceed reference limits
5. Comprehensive assessment of the patient's overall status

## **Mathematical Foundation**

The method establishes a mathematical formula for converting any laboratory value to a percentage deviation from the ideal (midpoint of the reference range). The basic calculation involves:

- Identifying the lower (a) and upper (b) limits of the norm for each parameter
- Calculating the norm's midpoint:  $B = (a+b)/2$
- Determining the dimension factor:  $C = (b-a)/200$
- Computing the percentage deviation:  $D = (A-B)/C$

Where A represents the actual test result, and D represents the standardized percentage deviation from norm.

## Formula Applications in Clinical Hematology

The proposed methodology implements several mathematical formulas for evaluating health reserves and overall health status. Through extensive clinical testing, these formulas have demonstrated significant utility in patient assessment, particularly for monitoring disease progression and treatment response.

## Mathematical Framework for Health Reserve Calculations

Five distinct formulas have been developed and tested for health reserve evaluation, ranging from simple to more complex calculations:

1. Basic Formula (Average percentage):  
 $K = \text{Total values in percentage} / \text{Number of values}$   
(Normal when  $K < 50\%$ )
2. Simple Formula:  
 $K = g\% / (g\% + b\% + B\%)$   
(Normal when  $K > 0.300$ )
3. New Formula:  
 $K = [50(1+g\%) - g\%] / [50(2+g\%) - g\% + b\% + B\%]$   
(Normal when  $K > 0.250$ )
4. Advanced Formula:  
 $K = [50(1+g\%) - g\%] / [50(2+g\%) - g\% + 50b\% + 100B\% + b\% + B\%]$   
(Normal when  $K \geq 0.200$ )
5. Modern Formula:  
 $K = [0.1nD_{1-10} + 0.2nD_{11-20} + 0.3nD_{21-30} + \dots] / \text{Number of values}$   
(Normal when  $K < 0.500$ )

Where these variables represent:

- $g\%$ : number of parameters with acceptable deviations ( $D < 50\%$ )
- $g\%$ : sum of deviations for acceptable parameters

- $b_{\%}$ : number of parameters with concerning deviations ( $50\% \leq D < 100\%$ )
- $b\%$ : total concerning values ( $50\% \leq D < 100\%$ ), in percentage
- $B_{\%}$ : number of parameters with severe deviations ( $D \geq 100\%$ )
- $B\%$ : total severe values ( $D \geq 100\%$ ), in percentage

The formulas provide increasingly sophisticated evaluations of health status, with the advanced formula (4) demonstrating high accuracy and versatility in clinical applications.

## Simplified Health Reserve Calculation

Research has identified a consistent relationship between health reserve calculations and percentage-based results. This relationship allows for a simplified calculation method that maintains accuracy while reducing computational complexity:

For a specific laboratory (with established ratio  $a\%$ ):

Health reserves ( $K$ ) = laboratory ratio / average percentage of indicators

For example:

- Patient 1: Average percentage = 27%, laboratory ratio = 13%  
 $K = 13/27 = 0.481$  (Normal  $>0.200$ ) → Healthy
- Patient 3: Average percentage = 185%, laboratory ratio = 10%  
 $K = 10/185 = 0.056$  (Normal  $>0.200$ ) → Seriously ill

This simplified approach enables quick health assessment while maintaining clinical relevance.

## Implementation in Hematological Assessment

The method demonstrates particular utility in hematological assessment, where multiple parameters with varying units and reference ranges must be considered together to evaluate blood disorders.

## Application to Blood Count Parameters

When applied to complete blood count (CBC) parameters, the method enables:

1. Precise quantification of anemia severity through standardized evaluation of RBC, HGB, HCT, MCV, MCH, and other erythrocyte indices
2. Direct comparison between leukocyte, erythrocyte, and thrombocyte parameters
3. Hierarchical organization of abnormalities to identify the most significant deviations
4. Tracking of parameter changes over time using consistent percentage scales

# Comprehensive Health Assessment

Beyond individual parameter evaluation, the method introduces various formulas for calculating overall health reserve indicators (K):

1. Basic formula:  $K = \text{Total values in percentage} / \text{Number of values}$
2. Advanced formula:  $K = [50(1+gn)-g\%] / [50(2+gn)-g\%+50bn+100Bn+b\%+B\%]$

Where specialized indices can be derived for specific conditions:

- $K_1$  (1K) derived from complete blood count parameters
- $K_2$  (2K) calculated from all available test indicators
- $K_a$  ( $K_a$ ) specifically for anemia evaluation, based on RBC, HGB, HCT, MCV, RDW-CV, RDW-SD, MCH, and MCHC
- $K_{\infty}$  ( $K_t$ ) for coagulation assessment based on thrombocyte parameters

## Advantages Over Current Laboratory Reporting

The current approach to laboratory test reporting has significant limitations that this method addresses:

## Limitations of Conventional Reporting

Traditional laboratory reports typically present:

- Raw values with corresponding reference ranges
- Simple visual indicators (asterisks, arrows, underlining) for abnormal values
- No quantification of how significantly a value deviates from normal
- No standardized comparison between different parameters
- No mathematical assessment of overall health status

## Enhanced Clinical Interpretation

The proposed method enables clinicians to:

1. Immediately identify which parameters deviate most significantly from normal
2. Detect subtle trends before values exceed reference ranges
3. Quantitatively monitor disease progression or treatment response
4. Objectively assess overall health status using mathematical formulas
5. Generate graphical representations of health status changes over time

## Case Studies in Hematological Assessment

The methodology has been extensively tested through case studies involving both healthy individuals and patients with various hematological conditions. These clinical applications demonstrate the practical utility of the standardized evaluation system.

## Comparison of Healthy Individuals

Analysis of blood parameters from two healthy men (Patients No. 1 and No. 2) demonstrated the method's ability to quantify subtle differences in health status despite both individuals falling within "normal" clinical ranges:

- Patient No. 1:
  - 1K (blood count parameters) = 0.665 (24%)
  - 2K (all test parameters) = 0.622 (27%)
  - Ka (anemia indicators) = 0.829 (18%)
  - Notable deviations: MONO% +70%, PCT +68%, K +78%, total cholesterol +69%
- Patient No. 2:
  - 1K = 0.539 (31%)
  - 2K = 0.463 (32%)
  - Ka = 0.793 (27%)
  - Notable deviations: MONO# +83%, Fe +142%, AST -54%

Despite both patients being clinically "healthy," the methodology identified Patient No. 1 as having slightly better overall health indicators, while Patient No. 2 showed excess iron in blood plasma.

## Monitoring Oncology Patient Progression

The method demonstrated particular value in monitoring patients with hematological malignancies. Six sequential blood tests were analyzed for two men with leukemia (Patients No. 3 and No. 4):

### Patient No. 3 (Leukemia)

Initial assessment (December 2015):

- 1K = 0.023 (193%)
- 2K = 0.019 (185%)
- Ka = 0.018 (398%)
- Severe deviations: RDW-CV +1225%, HGB -347%, IG% +350%

Final assessment (April 2017):

- 1K = 0.020 (174%)
- 2K = 0.035 (145%)
- Ka = 0.023 (391%)
- Severe deviations: RDW-CV +1138%, HGB -331%, HCT -329%

The analysis demonstrated slight improvement in overall health indicators over 16 months of treatment, though anemia parameters remained severely abnormal.

## **Patient No. 4 (Acute Leukosis, Myelodysplasia)**

Initial assessment (February 2015):

- 1K = 0.072 (116%)
- 2K = 0.094 (104%)
- Ka = 0.085 (90%)

Final assessment (May 2016):

- 1K = 0.015 (241%)
- 2K = 0.022 (192%)
- Ka = 0.025 (221%)
- Severe deviations: IG% +1067%, IG# +917%, MONO% +528%

This patient showed significant deterioration in health status over 15 months despite treatment, with particularly concerning increases in immature granulocytes.

## **Evaluation of Female Oncology Patients**

The methodology was also applied to female oncology patients, demonstrating its utility across gender differences:

### **Woman No. 5 (Diagnosis Not Specified)**

Analysis revealed severe hematological abnormalities:

- NEUT# +775%
- RDW-CV +693%
- WBC# +415%
- CRP +645%

### **Woman No. 6 (Caecum Cancer)**

Sequential tests demonstrated disease progression despite treatment:

Initial assessment (2013):

- 1K = 0.028 (178%)
- 2K = 0.014 (246%)
- Ka = 0.020 (360%)
- Severe deviations: RDW-CV +1238%, MCHC -423%, GOT/AST +2109%

Follow-up assessment (2016):

- 1K = 0.012 (242%)
- 2K = 0.019 (194%)
- Ka = 0.017 (364%)
- Severe deviations: RDW-CV +988%, MONO# +500%, MCHC -485%

Additional parameters beyond blood tests were also evaluated, including urinalysis and vital signs. The patient showed concerning vitals with systolic blood pressure at +400% deviation, diastolic at +250%, and elevated pulse and temperature.

## Long-Term Treatment Outcomes

The methodology was further validated through long-term monitoring of treatment outcomes in additional oncology patients:

## Comparison of Treatment Outcomes

Two oncology patients were followed over approximately 5 years of treatment:

### Woman No. 7 (Breast Cancer):

- Initial 1K = 0.065 (92%) → Final 1K = 0.202 (49%) [3.1× improvement]
- Initial Ka = 0.047 (141%) → Final Ka = 0.163 (49%) [3.5× improvement]
- Conclusion: Slow healing without complete recovery

### Man No. 8 (Caecum Cancer):

- Initial 1K = 0.031 (130%) → Final 1K = 0.408 (36%) [13.2× improvement]
- Initial Ka = 0.022 (255%) → Final Ka = 0.215 (47%) [9.8× improvement]
- Conclusion: Rapid healing with complete recovery

This longitudinal analysis demonstrates the method's utility in quantifying treatment efficacy over time, with health reserve metrics directly correlating with clinical outcomes.

## Graphical Representation of Disease Progression

The standardized methodology enables clear graphical representation of patient health changes over time. Health indicator charts were created for both oncology patients, visually demonstrating:

1. Patient No. 3: Slight improvement in overall health indicators (1K, 2K) while anemia parameters (Ka) remained severely abnormal.
2. Patient No. 4: Dramatic deterioration in all health indicators (1K, 2K, Ka) over the treatment period, indicating treatment failure.

The graphical presentations provide clinicians with immediately interpretable visual data on disease progression and treatment efficacy.

## Example of Graphical Analysis

The method allows for graphical tracking of anemia parameters over time, making it easy to visualize disease progression or treatment response. As demonstrated in Patient No. 3's case, despite some improvement in overall health indicators (1K, 2K), the anemia-specific indicator (Ka) remained severely abnormal, which was clearly visible in the graphical representation.

## Technical Implementation Considerations

The method can be readily implemented in laboratory information systems and electronic health records, enabling:

1. Automatic calculation of standardized percentage deviations
2. Graphical representation of parameter trends over time
3. Visualization of overall health status changes
4. Early warning systems for developing abnormalities

This standardized approach presents particular value in hematological assessment, where multiple interdependent parameters must be considered collectively to evaluate blood disorders effectively.

## Possible Implementation Options

This methodology has applications beyond hematology and medicine:

1. **Medical Applications:** Precise evaluation of various indicators including body temperature, body mass index, arterial blood pressure, blood components, urine analysis, and other tests used to assess patient condition.
2. **Traffic Safety Systems:** Evaluation of different indicators like traffic intensity, air temperature, humidity, lighting, wind speed to determine traffic hazard levels and enable automated traffic regulation.
3. **Museums and Archives:** Automation of environmental assessment by evaluating different indicators such as air humidity, temperature, and lighting levels, and adjusting them as needed.

## Conclusion

The standardized methodology for evaluating medical test parameters demonstrates significant clinical utility, particularly in hematological assessment. By converting diverse parameters to a common percentage scale, the method enables precise mathematical comparison between indicators with different units and reference ranges.

Key advantages of this methodology include:

1. Early detection of developing health issues before parameters exceed reference limits

2. Precise quantification of parameter deviations from normal ranges
3. Hierarchical organization of abnormalities by severity
4. Comprehensive assessment of overall health status through mathematical formulas
5. Graphical representation of health changes over time
6. Objective evaluation of treatment efficacy

The case studies presented demonstrate the methodology's practical application in monitoring both healthy individuals and patients with various conditions, particularly hematological malignancies. The ability to track health indicators mathematically and visually provides clinicians with enhanced tools for patient assessment and treatment planning.

This method has potential applications beyond hematology to any medical field where multiple parameters with varying units and reference ranges must be evaluated collectively. Future research should focus on optimizing formula selection for specific clinical scenarios and validating the methodology across more diverse patient populations.