White Paper: Advancing Quality With Serum Indices Quality Control

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Executive Summary

Preanalytical variability remains the single greatest source of error in clinical laboratory testing, with lipemia, icterus, and hemolysis (LIH) as frequent contributors. Serum indices quality control (QC) provides laboratories with a systematic and objective approach to detecting and mitigating LIH interference. To mitigate this, laboratories rely on detection of LIH either visually or with the instrument's serum indices capability. LIH Quality Control (QC) materials—specialized reagents designed to mimic these interferences are required to verify the reliability of serum index detection on automated analyzers. The adoption of automated serum indices QC, guided by international standards such as CLSI C56-A and ISO 15189:2022, has become critical for ensuring diagnostic accuracy, reducing turnaround delays, and protecting patient safety.

Background

Laboratory medicine plays a pivotal role in diagnosis and treatment, with more than 70% of clinical decisions relying on laboratory data. However, studies show that 60–70% of all errors in laboratory testing occur in the preanalytical phase, with hemolysis alone responsible for up to 70% of rejected samples [1].

Historically, technologists relied on visual inspection of specimens to identify LIH interference. Visual grading, however, is subjective, inconsistent, and unable to detect low-level interference. The introduction of automated serum indices detection systems on chemistry analyzers has transformed laboratory practice by providing semi-quantitative indices of hemolysis, bilirubin, and turbidity and improving interferent detection.

Mechanisms of Interference

Hemolysis is responsible for the release of intracellular contents (e.g., hemoglobin, potassium, LDH) altering test results. Hemoglobin absorbance, with a peak near 415 nm, also interferes with

many colorimetric assays. Icterus, due to elevated bilirubin concentration, interferes with peroxidase-based assays (e.g., glucose, cholesterol, triglycerides), often creating a negative bias. Lipemia due to high concentrations of triglyceride-rich lipoproteins scatters light, causing turbidity and electrolyte displacement, resulting in pseudo-hyponatremia and unreliable photometric results across a wide range of wavelengths [2, 3]. Together, these factors lead to false results, increased repeat testing, delayed reporting, and compromised patient care.

Standards and Regulatory Framework

The cornerstone of serum indices QC is CLSI C56-A: Hemolysis, Icterus, and Lipemia/Turbidity Indices as Indicators of Interference in Clinical Laboratory Analysis [2]. Key recommendations include:

- Establishing alert indices (cutoff thresholds) at concentrations corresponding to bias that exceeds acceptable limits.
- Mandating that manufacturers report interference claims in reagent labeling.
- Encouraging laboratories to verify thresholds and conduct QC validation in their environment.
- Promoting automated indices over visual assessment for objectivity and reproducibility.

ISO 15189:2022 further emphasizes risk-based quality control, urging laboratories to stratify risks and tailor QC based on analyte vulnerability and patient impact [4].

Clinical and Operational Value

When effectively implemented, serum indices QC delivers measurable benefits:

- **Accuracy**: Minimizes false results and diagnostic errors.
- **Efficiency**: Reduces costly retesting and shortens turnaround time.
- **Patient Safety**: Ensures critical analytes are reported with confidence.
- **Compliance**: Aligns laboratory operations with international standards (CLSI, ISO).

Added Value with Assurance™ Serum Indices QC from Sun Diagnostics

Serum indices quality control represents a vital safeguard in clinical chemistry. By systematically monitoring serum indices for detecting hemolysis, icterus, and lipemia with appropriate QC, laboratories can protect result integrity, improve efficiency, and ultimately enhance patient care. Aligning practice with CLSI C56-A and ISO 15189:2022 ensures both scientific rigor and regulatory compliance.

Given the added cost of LIH QC and the lack of specific regulations, laboratories may have difficulty justifying routine use of serum indices QC. The investment requires a balance between cost and potential error detection. Assurance Serum Indices Quality Control addresses this by

making this QC material inexpensive and easy to use. The materials are liquid, ready-to-use, with exceptional room temperature stability of at least 90 days. Lower cost and greater stability is achieved by using more stable proxies with similar absorbance characteristics than typical interferents. Because we are monitoring the performance of the analyzer's photometric system and not specific tests, the most important goal of serum indices QC is to monitor the precision of the absorbances used in the LIH algorithm. CLSI recommends daily monitoring of serum indices QC to ensure analyzer performance consistency. The use of Sun Diagnostic's Assurance Serum Indices QC makes this more economically feasible and practical for clinical laboratories.

References:

1. Nordin N, Ab Rahim S, Wan Omar W, et al. (March 30, 2024) Preanalytical Errors in Clinical Laboratory Testing at a Glance: Source and Control Measures. Cureus 16(3): e57243. DOI 10.7759/cureus.57243.

2. CLSI. Hemolysis, Icterus, and Lipemia/Turbidity Indices as Indicators of Interference in Clinical Laboratory Analysis; Approved Guideline. CLSI Document C56A. Wayne, PA: Clinical and Laboratory Standards Institute; 2012.

3. Adiga U. Serum Indices – A tool to Measure Interfering Substances in Blood Samples. International Journal of Pharmaceutical and Phytopharmacological Research 2019; 9:43-46.

4. ISO 15189:2022; Medical laboratories - Requirements for quality and competence.