



## Implications of Haemoglobin Testing for Transfusion Strategies

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### DESCRIPTION

Accurate haemoglobin assessment is essential for effective perioperative management, particularly in patients undergoing major surgery. Haemoglobin concentration guides transfusion decisions, influences fluid management and impacts postoperative outcomes. Conventional laboratory methods provide precise measurements but often involve time delays due to sample processing, transport and reporting. Delays can affect real-time clinical decision-making, particularly during active bleeding or hemodynamic instability. Point-Of-Care (POC) haemoglobin measurement devices have emerged as tools for rapid bedside assessment, offering the potential for immediate clinical intervention. The present study evaluates the accuracy of POC haemoglobin measurement in a surgical setting and explores its implications for transfusion practice.

Point-of-care haemoglobin devices employ various measurement principles, including spectrophotometry, co-oximetry and noninvasive optical methods. Devices such as the HemoCue series use spectrophotometric analysis of a small capillary, venous, or arterial blood sample. Noninvasive systems rely on multi-wavelength photoplethysmography to estimate haemoglobin concentration through skin and tissue. Each method offers distinct advantages and limitations, with accuracy influenced by sample type, perfusion status, ambient light and patient characteristics. Understanding these factors is necessary to assess the clinical reliability of POC measurements in dynamic surgical environments.

Upon patient enrolment, haemoglobin measurements were obtained at predefined perioperative time points: preoperative baseline, intraoperative intervals corresponding to significant blood loss and immediate postoperative assessment. Simultaneous samples were drawn for laboratory analysis using automated hematology analyzers calibrated according to institutional protocols. POC measurements were conducted according to manufacturer instructions, ensuring consistent sample handling, device calibration and operator training. Data were recorded systematically, allowing for paired comparison of POC and laboratory results.

Statistical analysis focused on evaluating agreement between POC and laboratory haemoglobin values. Methods included Bland-Altman plots to visualize bias and limits of agreement, intraclass correlation coefficients to assess reliability and linear regression to examine proportional differences. Subgroup analyses explored performance differences across sample type, surgical procedure, patient age and hemodynamic status. Additionally, the potential impact on transfusion practice was analyzed by comparing POC-based versus laboratory-based transfusion triggers, using institutional thresholds for haemoglobin concentration.

Transfusion decision analysis indicated that reliance solely on POC measurements could lead to minor variations in transfusion rates. In cases of borderline haemoglobin levels near institutional thresholds, some patients would have received transfusions based on POC readings that differed from laboratory results. However, the overall impact on transfusion practice was limited, as significant deviations were infrequent. Integrating POC measurement with clinical assessment and hemodynamic monitoring maintained safe and effective transfusion practices.

Several strategies can enhance the reliability of POC haemoglobin measurement in surgical practice. Standardized training for clinical staff ensures consistent sampling technique and device operation. Periodic device calibration and quality control checks maintain measurement fidelity. Understanding device-specific limitations, such as performance under low perfusion or extreme hemoglobin levels, allows clinicians to interpret results with appropriate caution. Implementing protocols that integrate POC readings with clinical assessment, vital signs and laboratory confirmation supports safe transfusion practices.

Emerging trends in POC haemoglobin monitoring include the integration of continuous or minimally invasive sensors, wireless data transmission and automated decision support. Continuous monitoring could allow real-time assessment of hemoglobin trends, enhancing detection of rapid blood loss and enabling dynamic transfusion management. Integration with electronic

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health record systems and clinical algorithms provides an opportunity for standardized reporting, audit and optimization of transfusion practices across surgical units.

In conclusion, point-of-care haemoglobin measurement offers a rapid and practical tool for perioperative blood management. The present prospective cohort study demonstrates moderate to strong agreement with laboratory-based measurements, with minor discrepancies observed under specific conditions.

Incorporating POC measurement into clinical practice can support timely decision-making, improve workflow efficiency and facilitate patient blood management strategies, while recognizing the limitations that necessitate complementary laboratory confirmation. Careful implementation, operator training and protocol integration ensure that POC haemoglobin devices contribute effectively to safe and efficient transfusion practices in surgical settings.