

The Utilization of Hematological Profiles in Decision Making of Acute Care Surgery: An Survey - Based Study

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ABSTRACT

Background: Laboratory tests are integral to surgical decision-making, yet unnecessary blood tests (BTs) contribute to increased healthcare costs, hospital-acquired anemia, and patient discomfort. Currently, no global guidelines exist for their appropriate use in emergency surgery. This study aimed to evaluate surgeons' attitudes, perceived clinical impact, cost awareness, and ordering practices regarding routine BTs in acute care settings.

Materials and Methods: A web-based survey, designed following the CHERRIES checklist, was distributed in July 2022 to surgeons involved in acute care surgery. The questionnaire assessed demographics, BT ordering triggers, perceived utility of specific tests, decision-making leadership, and cost awareness. Descriptive statistics and chi-square tests were used for subgroup comparisons.

Results: A total of 151 surgeons from 30 countries completed the survey, with a strong European predominance (84.1%). Most respondents (82.8%) were board-certified. Only 15.9% considered BTs "always essential," while 55.6% deemed them "sometimes non-essential." Residents ordered BTs in 74.2% of cases but participated in subsequent clinical decisions in only 37.1% ($p < 0.001$). Ordering was frequently driven by tradition (83% post-operative day protocols, 23.8% pre-discharge panels) rather than clinical changes (78.8%). Hemoglobin, white blood cell count, lactate, and C-reactive protein were perceived as most impactful, whereas liver function tests were often ordered but rarely influenced decisions. Only 43% routinely used clinical scoring systems (SOFA/APACHE II/NEWS). Crucially, 40% were unaware of BT-related costs and optimization strategies.

Conclusion: This survey reveals significant heterogeneity and a lack of standardization in BT ordering in emergency surgery globally, with low-cost awareness and persistent tradition-

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driven practices. These findings underscore the urgent need for evidence-based guidelines, structured education, and collaborative decision-making frameworks to optimize BT utilization and improve patient care.

Keywords: blood tests, emergency surgery, laboratory utilization, cost awareness, clinical decision-making, survey

INTRODUCTION

Surgical decision-making relies heavily on laboratory testing. Despite their importance, unnecessary blood tests (BTs) can lead to misdiagnoses, additional unwarranted investigations, and substantial healthcare expenditure (1). A UK National Health Service survey attributed 25% of laboratory waste to unnecessary BTs (2). Currently, no international standards exist for the appropriate use of BTs during surgical rounds in non-acute patient settings, except in cases of severe clinical deviation (e.g., bleeding, sepsis, acute coronary syndrome). Ordering practices are largely based on local customs rather than evidence.

Over the past two decades, numerous studies have highlighted the overuse of laboratory tests, and several local recommendations have been proposed to guide routine testing (1,5-7). Although individual tests may have low direct costs, their cumulative impact on clinical decisions can significantly influence healthcare spending. Moreover, indiscriminate phlebotomy can induce hospital-acquired anemia, leading to additional testing, prolonged hospital stays, unnecessary trans-fusions, increased mortality, and patient discomfort, particularly in those with cardiopulmonary diseases (1,3).

Despite growing awareness, surgeons' behaviors and attitudes toward BT ordering in emergency surgery remain poorly characterized. While elective surgery data suggest that routine postoperative day 1 tests often reflect tradition rather than utility (7,8), the persistence of such practices in acute care is unknown. Furthermore, the dynamics of who orders tests, who interprets results, and how decisions are made have not been comprehensively evaluated.

Thus, this survey aimed to (1) explore global attitudes toward routine BT ordering in emergency surgery, (2) assess the perceived impact of these tests on clinical decision making, (3) define the roles of different team members in ordering and interpretation, and (4) evaluate surgeons' awareness of costs and potential optimization strategies.

MATERIALS AND METHODS

Survey Design and Setting

An international online survey was conducted using the CHERRIES (Checklist for Reporting Results of Internet E-Surveys) methodology (21) to collect demographic, experiential, and practice-based data on BT utilization in emergency surgery. The survey was administered via Google Forms. The study was granted a formal waiver of Institutional Review Board (IRB) approval, as it involved anonymous survey data from healthcare professionals and did not include patient information.

Questionnaire Development

Following a comprehensive literature search across Medline, Scopus, Embase, and Google Scholar, the authors developed an electronic questionnaire using search terms including "blood tests," "laboratory testing," "routine testing," "postoperative testing," "emergency surgery," and "utilization review."

The questionnaire covered three domains: (1) perceived clinical value of specific tests, (2) triggers and justification for ordering BTs, and (3) cost and resource utilization awareness. Face validity, clarity, and comprehensibility were assessed by pilot-testing the survey on ten surgeons (five residents and five attendings). Minor wording adjustments were made based on their feedback. The full questionnaire is provided in *Supplementary File 1*.

Survey Administration and Data Collection

In July 2022, an email invitation with a Google Form link was sent to potential participants. Over three months, four reminder emails were dispatched at approximately three-week intervals. No incentives were offered.

Questions were not randomized, and respondents could navigate freely. All questions were mandatory to prevent incomplete submissions. Invitations were personalized by email address, but responses were anonymized. Data were stored securely in a password-protected online database.

Statistical Analysis

Following the closure of the survey, data were exported to Microsoft Excel for analysis. Descriptive statistics summarized respondent demographics and answers to the 25 main questions. Categorical variables were reported as numbers and percentages. Subgroup comparisons (e.g., residents vs. board-certified surgeons, European vs. non-European respondents) were performed using chi-square or Fisher's exact tests, with statistical significance set at $p < 0.05$. Given the exploratory nature and sample size, multivariate analyses were not performed. All analyses were conducted using SPSS version 26 (IBM Corp., Armonk, NY).

Explicit Compliance with the CHERRIES Checklist

The survey design, administration, and reporting adhered to the CHERRIES checklist for internet e-surveys. Key elements included: (1) a clear sampling frame (surgeons with an interest in acute care surgery); (2) a pilot-tested questionnaire; (3) mandatory answers to prevent incomplete data; (4) personalized email invitations with multiple reminders; (5) anonymous data collection with no IP address tracking; and (6) presentation of descriptive and subgroup analyses as recommended.

RESULTS

Sample Characteristics

The survey was completed by 151 doctors from 30 countries. The majority of respondents were from Europe (84.1%, $n=126$), followed by Asia (7.2%, $n=11$), Africa (5.2%, $n=8$), Latin America (1.2%, $n=2$), Oceania (1.2%, $n=2$), and other regions (1.2%, $n=2$). Most participants (82.8%, $n=125$) were board-certified surgeons (attending, senior consultants, or division chiefs), while 17.2% ($n=26$) were residents. General and emergency surgery was the most common specialty (83.4%, $n=126$), followed by trauma and acute care surgery (10.6%, $n=16$). Practice settings included university / academic hospitals (63.6%, $n=96$), community teaching hospitals (23.8%, $n=36$), community hospitals (11.9%, $n=18$), and private centers (0.7%, $n=1$). The majority (88.7%, $n=134$) worked in departments managing both elective and emergency surgeries. Full characteristics are presented in *table 1*.

Attitudes Toward Blood Test Utility

Only 15.9% ($n=24$) considered routine BTs "always essential," while 55.6% ($n=84$) stated they were "sometimes non-essential," 21.2% ($n=32$) "often non-essential," and 7.3% ($n=11$) "always non-essential" (*fig. 1*). No significant differences were observed between European and non-European respondents ($p=0.38$) or between attendings and residents ($p=0.42$).

Decision-Making Leadership

A significant discrepancy was observed between test orderers and clinical decision-makers. Residents ordered BTs in 74.2% ($n=112$) of cases, but attending surgeons made the final clinical decisions based on results in 77.5% ($n=117$) ($p < 0.001$). Attending surgeons were involved in the initial ordering decision in only 37.1% ($n=56$). Collegial team discussions guided decisions in just 43% ($n=65$) (*fig. 2*).

Triggers and Criteria for BT Ordering

Multiple factors influenced BT ordering, often simultaneously. The majority (83%, $n=125$) ordered tests based on postoperative day protocols. Nearly one-quarter (23.8%, $n=36$) routinely ordered pre-dis-

Table 1 - Sample features (N=151)

Characteristic	% (n)
Country	
Europe	84.1 (126)
Africa	5.2 (8)
Asia	7.2 (11)
Latin America	1.2 (2)
Oceania	1.2 (2)
Other	1.2 (2)
Position	
Resident	15.9 (24)
Board-certified surgeon	27.2 (41)
Senior consultant	39.1 (59)
Division Chief/Head	13.9 (21)
Other	3.9 (6)
Surgical specialty	
General surgery	83.4 (126)
Trauma and Acute Care surgery	10.6 (16)
Orthopaedics	2 (3)
Vascular surgery	2 (3)
Thoracic surgery	0.7 (1)
HPB & liver transplant	0.7 (1)
Emergency and Intensive care	0.7 (1)
Type of Hospital	
University/Academic	63.6 (96)
Community-teaching	23.8 (36)
Community	11.9 (18)
Private center	0.7 (1)

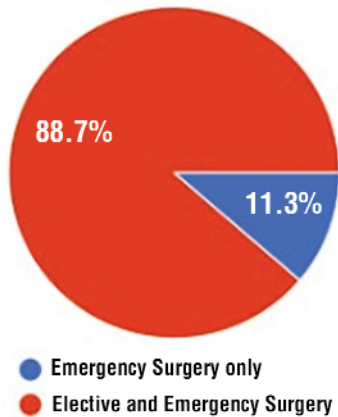
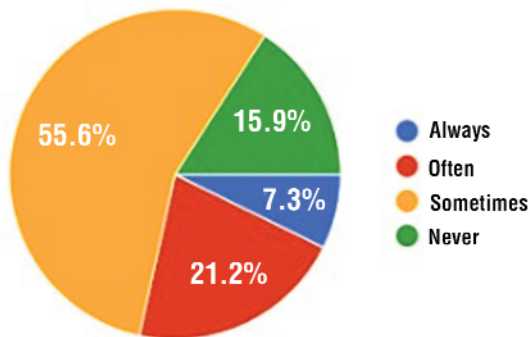
Do you work in Emergency Surgery?**In your daily practice, do you ever think that ordered blood test are not useful?**

Figure 1 - The usefulness of BTs' requests

charge panels regardless of clinical status. Over half (64.9%, n=98) ordered tests to re-check previously abnormal values. Notably, clinical improvements triggered tests in 78.8% (n=119). When prioritizing variables, 75.5% (n=114) considered clinical circumstance more important than the specific procedure. Vital signs and clinical examination were deemed more important than surgical drain output. Hemorrhage and sepsis were the most common pathological triggers.

Only 40% (n=60) of participants recognized the clinical concept of "failure-to-progress" as a criterion for identifying severely ill surgical patients not recovering normally.

Types of BT Ordered and Perceived Impact

Hemoglobin, white blood cell count, lactate, and C-reactive protein (CRP) were both the most frequently ordered and most clinically impactful tests. A notable disparity was observed for liver function tests (LFTs) and lactate dehydrogenase (LDH): though ordered with moderate frequency, less than 20% considered them useful for guiding clinical decisions. Among arterial blood gas (ABG) measures, lactate was deemed most clinically important, followed by pH and base excess (BE) (fig. 3).

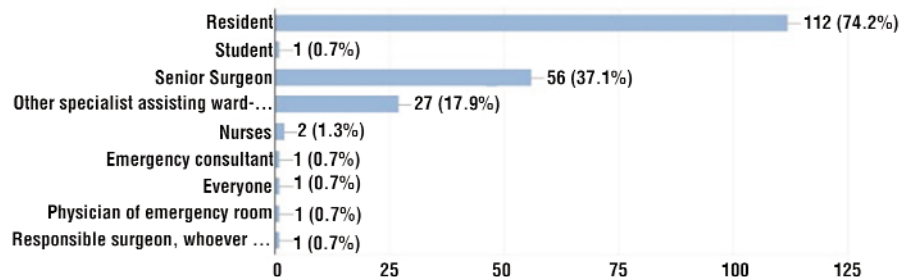
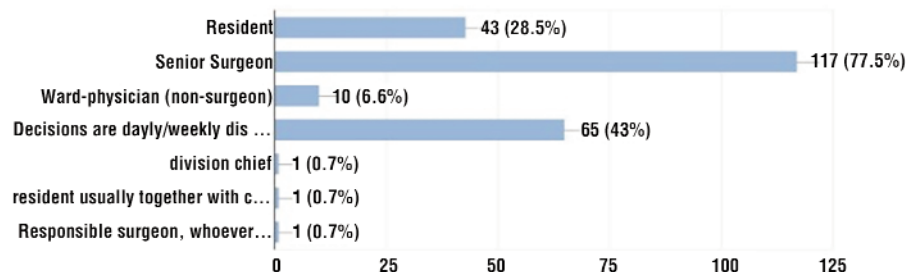
**Who usually orders blood tests during admission?
151 response****Who takes clinical decisions on the patient?
151 response**

Figure 2 - BT's leadership in making decisions

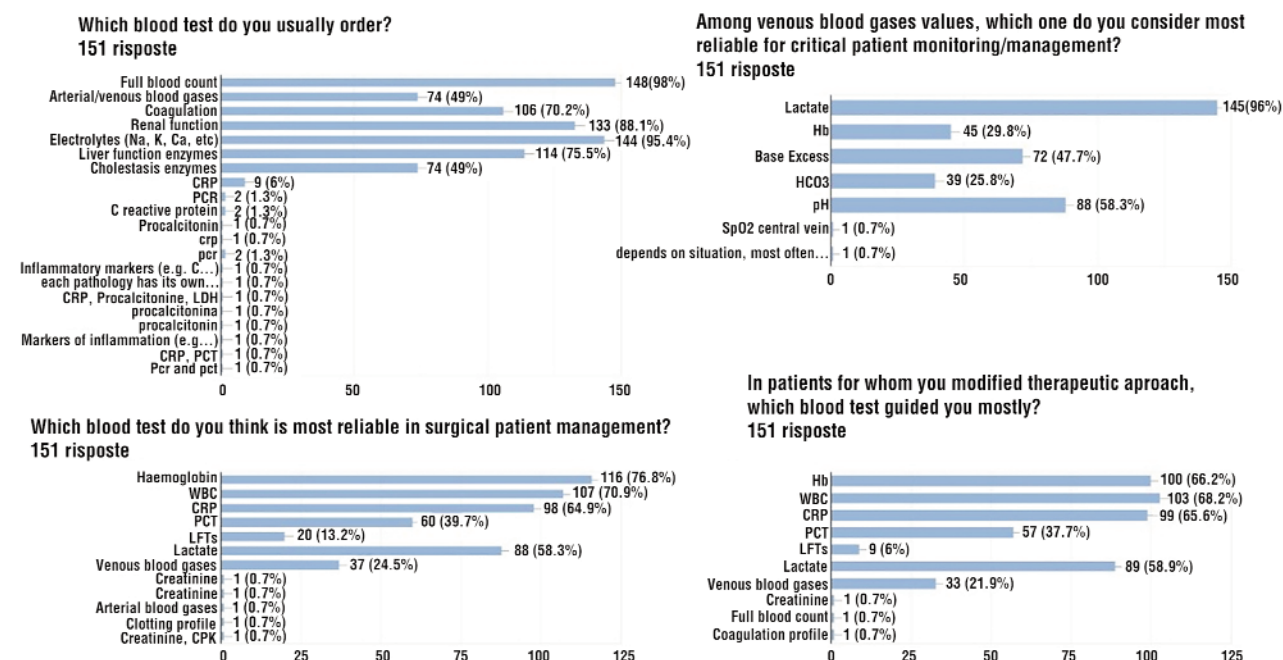


Figure 3 - Order frequencies and evaluations of BT's dependability

Use of Clinical Scoring Systems

Only 43% (n=65) of respondents reported regular use of validated risk stratification systems, including NEWS, APACHE II, or SOFA. Usage did not differ significantly between academic and community settings (45% vs. 38%, p=0.31).

Cost Awareness and Resource Optimization

Concerning findings emerged in the final domain. Forty percent (n=60) were unaware of the costs associated with the tests they ordered, and a similar proportion (40%, n=60) did not know how to optimize resource utilization. One-third (32%, n=48) were unsure who in their organization was responsible for cost control. Among those aware of cost-saving strategies, most learned through quality improvement projects or in-hospital educational programs (fig. 4).

DISCUSSION

This survey of 151 surgeons from 30 countries provides contemporary insights into attitudes and practices regarding routine BT ordering in emergency surgery. Our findings reveal significant heterogeneity, a persistent reliance on tradition, a marked disconnect

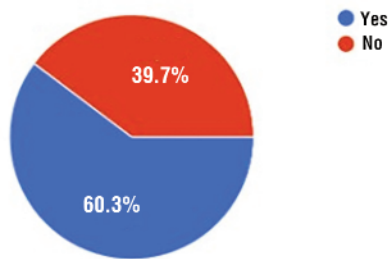
between test orders and decision-makers, and a remarkably low level of cost awareness. These results carry important implications for surgical education, healthcare costs, and patient care.

Heterogeneity and Lack of Standardization

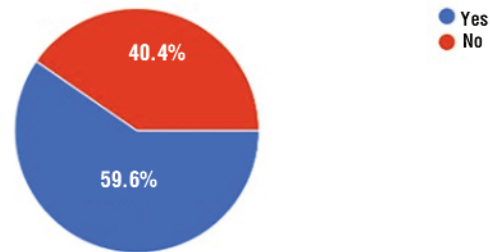
We observed non-standardized approaches to BT requests, with local protocols and therapeutic pathways predominating over evidence-based recommendations. Although only 15.9% deemed BTs "always essential," most ordered them based on postoperative day or before discharge. This paradox—acknowledging tests are often unnecessary yet ordering them—suggests practice is driven more by habit, custom, or medico-legal concerns than by clinical judgment.

Similar patterns have been reported in elective surgery, where routine postoperative day 1 tests following cholecystectomy (7) and bariatric surgery (8) appear to reflect tradition rather than utility. McKenna et al. (9) found abnormalities in only 4% of routine day 1 tests after colorectal resection, with just 1% requiring intervention. Comparable findings exist in joint arthroplasty, spine fusion, and pelvic reconstructive surgery (10-14). Our results confirm that this tendency persists in acute care settings despite limited evidence of benefit.

Are you conscious of blood tests' cost you order?
151 risposte



Have you ever been made aware about reducing unuseful blood tests?
151 risposte



Is there someone in your ward/hospital evaluating blood tests' expense?
151 risposte

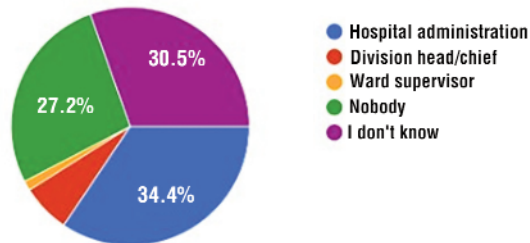


Figure 4 - BT's monitoring and cost awareness

The Resident-Senior Disconnect

A striking finding was the gap between those ordering BTs (residents in 74.2% of cases) and those making subsequent clinical decisions (senior surgeons in 77.5%). This represents a missed educational opportunity and a potential patient safety issue. Mughal et al. (2) demonstrated that shared decision-making between junior and senior doctors, involving discussion of the clinical need for tests, reduced BT demand by up to 33% and saved time and costs. Our study suggests such collaborative strategies are not yet widely adopted, potentially perpetuating a cycle where trainees learn to order tests without engaging in the clinical reasoning or decision-making processes.

Ordering Triggers

BT ordering was influenced by a combination of genuine clinical changes (hemorrhage, sepsis) and surgical dogmas (postoperative day protocols, pre-discharge panels). While 78.8% ordered tests in response to clinical changes, it is concerning that protocol-driven ordering persisted without clear indication. Nearly 25% routinely ordered pre-

discharge panels, and over 80% ordered tests based on postoperative day. This practice continues despite evidence questioning its utility (7,9).

Underutilization of Clinical Scoring Systems

Only 43% regularly used validated clinical scoring systems like SOFA, APACHE II, or NEWS. This is troubling, as these tools are specifically designed to identify patients at risk of deterioration and guide resource allocation. Several scores have been validated in surgical populations: APACHE II and SOFA are widely used in intensive care, while POSSUM and P-POSSUM predict mortality. The Emergency Surgery Score (ESS) has been shown to accurately predict mortality across surgical specialties (15). Modified early warning scores (MEWS, NEWS) may be superior for identifying early decompensation and ICU transfer needs (16). Hollis et al. (17) demonstrated that elevated early warning scores can signal impending life-threatening complications, enabling early intervention. The underuse of these objective tools represents a lost opportunity for standardized assessment that could reduce unnecessary testing by focusing resources on at-risk patients.

Cost Awareness and Educational Needs

Perhaps the most alarming finding is the significant lack of cost awareness: 40% did not know the costs of tests they ordered, and a similar proportion were unaware of optimization strategies. This aligns with prior studies showing that guideline implementation can dramatically reduce unnecessary testing without adverse events. For example, Faulkner et al. (19) reduced LFTs by 62.5%, coagulation screens by 31.6%, and CRP by 64.5% in an orthopedic setting. Fellow-driven quality improvement programs in medical ICUs have achieved similar results (20). The fact that most cost-aware respondents learned through in-hospital initiatives suggests that educational interventions can be effective, yet such programs remain uncommon, as evidenced by the 40% of surgeons including attendings and consultants who remain uninformed.

Implications for Practice and Education

These findings have several practical implications. First, there is an urgent need for evidence-based, internationally accepted guidelines for BT use in emergency surgery, covering indications, frequency, and interpretation. Such guidelines would help shift practice from tradition-based to need-based decision-making. Second, surgical training programs should incorporate test ordering as a clinical competency, ensuring trainees are involved in both ordering and the subsequent interpretation and management decisions. Third, institutions should implement clinical audits and structured educational initiatives to raise awareness of costs, clinical impact, and the value of laboratory testing. Displaying test prices within ordering systems, as some institutions have done, may also enhance cost consciousness.

Limitations

Several limitations must be acknowledged. First, the survey methodology inherently involves selection bias; participants may have a particular interest in emergency surgery and may not represent all surgeons globally. Second, the response rate cannot be accurately calculated, as it is unknown how many invitation emails were received and opened. Non-response bias may affect generalizability. Third, the geographic distribution was heavily skewed toward Europe (84.1%), which limits the "global" generalizability of our findings and may obscure

regional variations in practice. Fourth, social desirability bias is possible, as self-reported data reflect what surgeons claim to do rather than actual behavior. Fifth, the survey was conducted in 2022, and practices may have evolved. (Sixth, the sample size of 151, while adequate for descriptive analysis, limits the power for more complex statistical analyses and subgroup comparisons. Multivariate analyses to identify independent predictors of ordering practices were not feasible due to the sample size and exploratory nature of the study. Finally, the full questionnaire is included as supplementary material to enhance transparency.

Despite these limitations, this study offers valuable insights into a poorly understood aspect of surgical practice and identifies actionable targets for quality improvement.

CONCLUSION

This global survey reveals significant variation and a lack of consistency in BT ordering practices in emergency surgery. Ordering is frequently driven by tradition and delegated to trainees without their subsequent involvement in clinical decisions, while cost awareness remains low. The persistence of protocol-driven testing without clinical indication and the underutilization of validated scoring systems suggest that practice is still guided more by habit than by evidence. These findings highlight an urgent need for evidence-based guidelines, structured educational programs, shared decision-making frameworks, and institutional quality improvement initiatives to optimize BT use, reduce waste, improve patient outcomes, and control healthcare costs. Future research should focus on developing and validating evidence-based guidelines for BT ordering in specific emergency surgical scenarios and evaluating interventions aimed at reducing unnecessary testing.

Conflicts of Interest Statement: none

Ethics approval and consent to participate: not applicable as it is a survey and anonymous.

Consent for publication: not applicable.

Availability of data and materials: available.

Sources of funding for research: none.

Supplementary Material

Supplementary material associated with this article can be found, in the online version.

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