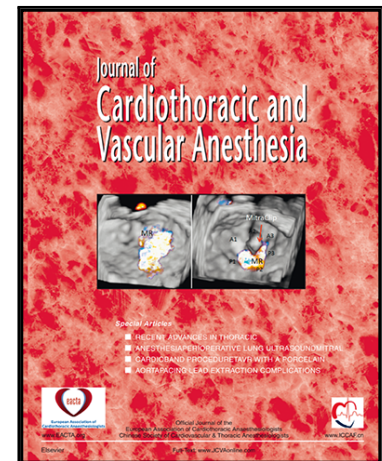


Perceptions, Definitions, and Preparedness Regarding
Low-Performing and Impaired Colleagues in Cardiothoracic and
Vascular Anesthesia: An International Survey



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Perceptions, Definitions, and Preparedness Regarding Low-Performing and Impaired Colleagues in Cardiothoracic and Vascular Anesthesia: An International Survey

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Abstract

Objective: To define low-performing colleagues in cardiothoracic and vascular anesthesia (LPC-CTVA), evaluate institutional preparedness to identify and manage such individuals, and identify predictors of recognition, reporting, and response behaviors.

Design: International cross-sectional survey.

Setting: Web-based data collection from June to September 2024.

Participants: Of 878 responses, 537 (61.2%) were complete and analyzed, representing 57 countries.

Interventions: None.

Measurements and Main Results: A 43-item questionnaire was developed by a multidisciplinary team and distributed via professional societies, social media, and email. It assessed definitions of LPC-CTVA, institutional protocols, and preparedness to address underperformance. Consensus was defined as $\geq 70\%$ agreement. Thirteen of 18 statements met consensus. Common indicators included non-compliance with infection control (80.0%), outdated knowledge (80.3%), repeated procedural failures (80.0%), and persistent negligence (79.1%). Institutional support was limited: among 464 respondents, 22.2% reported active supervision for underperformance, 15.3% reported the presence of identification mechanisms, and 11.7% indicated the existence of formal management processes. Although 39.9% of 434 had encountered a low-performing colleague, only 23.1% of 447 had reported one. Preparedness to manage impaired colleagues was reported by 46.2% of 418 respondents, and preparedness to manage underperforming colleagues by 44.1% of 416 respondents. Key barriers included the belief that others would act (33.7% of 265), perceived ineffectiveness (28.3%), and fear of retaliation (21.9%). Preparedness was more prevalent among older, more experienced clinicians, those in leadership roles, and those with prior experience in reporting.

Conclusions: A consensus-based definition of LPC-CTVA was established. However, institutional readiness and clinician confidence remain limited. Experience and structured systems enhance response capability.

Keywords: Anesthesiology, Cardiothoracic Anesthesia, Vascular Anesthesia, Professional Competence, Physician Performance, Physician Impairment, Ethics, Supervision, Performance Appraisal.

Highlights

This large international survey examined how anesthesiologists in cardiothoracic and vascular anesthesia define, perceive, and respond to underperformance and impairment among colleagues.

- The study analyzed 537 complete responses from across six continents.
- The results highlight wide variability in perceived prevalence, recognition strategies, and institutional readiness.

Most respondents emphasized the importance of ethical responsibility, psychological safety, and structured supervision.

Few centers reported having standardized pathways or support mechanisms in place for addressing performance concerns.

Introduction

Patient-centered safety in cardiothoracic and vascular anesthesia (CTVA) has gained widespread attention to ensure excellent, cost-effective surgical outcomes that meet the needs and desires of patients [1]. The joint International Standards for a Safe Practice of Anesthesia, developed by the World Federation of Societies of Anaesthesiologists and the World Health Organization, urge the continuous presence of trained and vigilant anesthesia providers [2]. European and American societies have developed structured training programs in CTVA [3–5]. However, these programs remain out of reach for many anesthesiologists worldwide. This highlights the importance of developing and evaluating core competencies, rather than relying solely on formal training programs. This calls for developing international standards to define the "competent physician performing CTVA" and to identify and cope with low-performing or non-competent ones in daily practice. Defining low performance is inherently challenging due to its diverse causes. These may include mental, physical, or professional limitations.

A large national U.S. survey [6] involving 2,938 practicing physicians across multiple specialties—including anesthesiology, cardiology, family practice, general surgery, internal medicine, pediatrics, and psychiatry—found that two-thirds of respondents perceived themselves as prepared to deal with ‘impaired’ colleagues. However, anesthesiologists represented only 11% of participants, which limits the generalizability of these findings to the specific context of CTVA. As such, structured approaches for recognizing and managing low performance in CTVA remain largely undescribed. While broader surveys have explored professional conduct and reporting behaviors in general practice and among anesthesiologists, they have not examined the unique demands and risks inherent to CTVA. This subspecialty involves high-risk procedures, advanced technologies, and critical multidisciplinary coordination settings in which lapses in individual performance may lead to immediate and

severe consequences. Although patient safety is often addressed at the system level, our study focuses specifically on how individual underperformance is recognized, defined, and managed within the CTVA community. These distinct clinical and organizational challenges underscore the need for a subspecialty-specific investigation to identify context-relevant indicators and assess institutional preparedness to respond effectively.

Importantly, our study did not aim to define a universal legal “standard of care,” which varies significantly across countries. Instead, we sought to capture the professional perceptions of underperformance in CTVA practice. This approach acknowledges jurisdictional differences while enabling cross-border reflection on what constitutes poor performance. We hypothesized that CTVA professionals would demonstrate consensus around a core set of behavioral and clinical indicators that define low performance. We further explored whether the presence of institutional approaches to identify and address such underperformance would be associated with higher self-reported rates of recognition and reporting. This international survey was developed to address the largely unexplored domain of low performance in CTVA and to capture global perspectives on definitions, preparedness, and institutional readiness. The results of this survey may serve as a foundation for developing actionable frameworks and guiding efforts by international societies to address low performance in CTVA.

Methods

The study was conducted and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies. A completed STROBE checklist is provided as Supplement C.

• Study Design and Objectives

This was an internet-based, global survey to quantify the perceived reporting of low performance in CTVA. The primary outcome was the perceived definition of low performance in practice. Secondary outcomes included (1) the reported availability of institutional approaches to identify and deal with impairment or low-performance in CTVA, (2) perceived ways to report those impaired or low-performing anesthesiologists, (3) recognizing the institutional approaches and actions needed to deal with low-performance in CTVA, and (4) the obstacles of reporting low-performance in CTVA.

• Ethical Approval

Ethical approval for the study was obtained from the Ethical Committee for Scientific Research at the institution of the Coordinating Investigator (University Hospital of Ioannina, Ioannina, Greece) on May 16, 2024, with reference number 410, before commencing the survey.

• Questionnaire Development

A 43-item questionnaire (Table 1) was written in English and included participants' characteristics (e.g., age, gender, race, years in CTVA practice, types of training and institution), their institutional infrastructure, including the number of cardiac, thoracic, and vascular surgical procedures performed every year and availability of skilled and experienced anesthesiologists, logistics, availability of institutional

approaches to identify and deal with low-performance in CTVA, and reported malpractice claims due to impaired or low-performance in CTVA during the last ten years. Respondents could select both fellowship training and current leadership role, as the options were not mutually exclusive. Additionally, having direct knowledge of whether or not to report low-performing anesthesiologists, including their characteristics and the reasons for failing to report an impaired or low-performing colleague during the last decade, was also reported. Lastly, the participants were asked about their views on the aspects of low performance in CTVA.

Questions and answers in the questionnaire were structured using the BRUSO approach (Brief, Relevant, Unambiguous, Specific, and Objective) [7]. The answer choices for the primary outcome question defining low-performing CTVA anesthesiologists (LPC-CTVA) were developed based on a structured review of published literature and collaborative expert discussion. We conducted comprehensive electronic searches through PubMed, Google Scholar, and open-access forums using keyword combinations such as: “incompetent physician,” “impaired physician,” “underperforming anesthesiologist,” “low-performing anesthesiologist,” “clinical incompetence,” “dealing with incompetent colleagues,” “reporting impaired colleagues,” “CTVA,” and “professional misconduct.”. The search spanned from database inception through March 2024.

Articles reviewed included DesRoches et al. [6, 8–9] and commentary sources from Medscape, the *British Medical Journal*, and other platforms [10–14] addressing impaired or underperforming practitioners. The included definitions aimed to reflect a broad spectrum of performance, ethical, and safety concerns in the CTVA context. All identified themes were synthesized into candidate statements to promote inclusivity and ensure relevance.

Respondents rated 18 predefined statements describing behavioral or clinical patterns potentially indicative of low performance. Items were phrased to emphasize patterns of concern, such as “repeated errors” or “frequent non-compliance,” rather than isolated incidents. These statements were designed to reflect perceived professional standards—not legal definitions—and to distinguish between repeated, patterned underperformance and isolated lapses or judgment errors. They aimed to capture peer-identified concerns, rather than meeting formal legal criteria for negligence or incompetence. The goal was to reach consensus on what practitioners themselves consider indicators of low performance, independent of jurisdictional definitions of negligence or standard of care. One item referencing impairment (substance use) was included for comparison, but the survey primarily focused on low performance related to conduct and competence.

To guide interpretation, participants were presented with a brief framing prompt before answering and were then asked to rate their agreement with the 18 predefined statements. No formal legal definitions were provided, as the survey aimed to capture peer-derived perceptions based on clinical experience rather than externally imposed criteria.

A free-text box was presented at the end of the questionnaire to allow respondents to elaborate on their views and offer comments beyond the structured items. Although this study did not include formal qualitative interviews, the free-text input provided valuable contextual insights into barriers such as fear of retaliation, hierarchical pressures, and the perceived ineffectiveness of reporting.

- **Instrument Validation and Pilot Testing**

The pilot phase included eight anesthesiologists with clinical expertise in cardiothoracic and vascular anesthesia (ES, MM, AK, AS, KK, PT, JH, and MRT). Nurse anesthetists were not included in the pilot testing phase due to limited availability within the collaborating networks at the time. However, they were eligible to participate in the main survey if they were directly involved in intraoperative CTVA care. Although only three responses were received (<1% of total participants), their inclusion was intended to reflect interdisciplinary team structures present in some healthcare systems worldwide. Their submitted comments were reviewed and considered during questionnaire finalization to ensure relevance and inclusivity. These responses were not analyzed separately or used to infer generalizable trends, and their statistical weight was minimal. A summary of the questionnaire development, pilot testing, revision, and dissemination process is illustrated in Figure 1.

- **Survey Administration and Dissemination**

Anesthesiologists and nurse anesthetists who provided perioperative care for patients undergoing cardiac, thoracic, or vascular surgery in operating rooms were eligible for participation. The survey was uploaded to the SurveyMonkey® internet platform. The URL links to the questionnaire were distributed to anesthesiologists and nurse anesthetists using both professional society channels and direct outreach via professional contacts, including email distribution lists and social media platforms (LinkedIn, Facebook, Twitter/X, WhatsApp), as well as a 'snowballing' sampling technique [15]. Due to the nature of this open distribution strategy, including social media, professional mailing lists, and respondent-driven sharing, it was not possible to determine the total number of individuals who received the survey invitation. Therefore, a conventional response rate could not be calculated. Nonetheless, the

approach enabled the collection of diverse perspectives across continents, which aligns with our goal of capturing a broad, global snapshot of CTVA professionals' perceptions, rather than targeting a fixed population denominator. Six reminders, including information about the aims and objectives of the survey, data handling and management, and privacy rights, were sent to the survey's investigators from June 10 until September 15, 2024, the predetermined completion date of the survey, encouraging them to send reminders to their networks. The initial survey was conducted from June 16 to 30. Based on participant feedback, the term 'low-performing' replaced 'non-competent'. This change aimed to avoid potential negative emotional responses without altering the structure, options, or logic of the questions.

Additionally, based on early feedback, we revised wording in several items to remove potentially stigmatizing terms such as 'drunk' or 'addict.' The final version adopted medically appropriate terminology, including 'substance use disorder' and 'impaired practitioner,' in line with ethical standards and contemporary clinical language [16]. Additionally, two Russian investigators translated the questionnaire into Russian because SurveyMonkey was not accessible in Russian territory. The translated version was programmed and tested on Google Forms to ensure accessibility for Russian-speaking participants. The Russian-language version was piloted and disseminated between August 26 and September 6, accompanied by three reminders.

- **Consent and Data Protection**

All participants were asked to voluntarily consent to participation and data analysis. Completion of the questionnaire was only possible after consent had been provided. Respondents were asked to complete all the questions in the questionnaire without omitting any answers, but with the option of responding 'I do not know' or 'I prefer not to answer' to all questions. A free text box was presented at the end of the

questionnaire to allow respondents to provide additional feedback. There were no identifiers that could link to the individual participant. All data collected will be encrypted, secured, and confidentially stored in the archiving system of the principal investigator's center (E.S., University Hospital of Ioannina, Ioannina, Greece) for five years, in accordance with the European Union's General Data Protection Regulation (GDPR) (accessible at <https://gdpr-info.eu/>). This study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional surveys [17], as recommended by the EQUATOR Network.

- **Definitions and Consensus Thresholds**

The agreement on the definition of impaired or otherwise incompetent CTVA was defined as the percentage of respondents who selected either “Agree” or “Strongly agree” in response to the definition statements (Supplement A), with a consensus threshold set at greater than 70% [18]. To avoid conceptual ambiguity, the survey addressed the terms 'impairment' and 'low performance' as distinct constructs. Impairment was defined to include physical, mental, or substance-related conditions that could compromise safe practice. Low performance, in contrast, referred to deficits in clinical knowledge, procedural competence, communication, or adherence to standards. This separation was maintained across survey items and analyses.

- **Sample Size Calculation**

The sample size was determined using Cochran's formula for sample size calculation with an unknown (non-finite) population. Given that the total number of anesthesiologists practicing cardiothoracic and vascular anesthesia is unknown, we assumed a population proportion of 50% ($p = 0.5$) to maximize variability and ensure a conservative estimate. To achieve a statistically representative sample for the primary survey's outcome (Q25), regarding the perceived definition of low

performance in practice, at least 385 responses were required, based on a 95% confidence level and a 5% margin of error. To accommodate responses from those who did not consent to participate in the survey or those not practicing CTVA, we aimed for a sample size of 733, with continued collecting responses until the predetermined completion date of the survey to compensate for incomplete responses.

- **Statistical Analysis**

The responses to the questionnaire—including those submitted through the translated Russian version—were verified, coded, and stored in English using Microsoft Excel (Microsoft Office 365 Business, Microsoft Corporation, USA). Statistical analysis and sample size calculations were performed by **(AK)**, a study investigator with a master's degree in Biostatistics.

Categorical variables were summarized as absolute and relative frequencies (%), while ordinal variables were reported as medians with interquartile ranges (IQR). Since most variables were categorical or ordinal, no normality testing was performed for descriptive analysis, and non-parametric methods were applied where appropriate. However, the normality of residuals in the regression models was evaluated using the Shapiro–Wilk test.

Likert scale responses were analyzed descriptively. Group comparisons were conducted using the chi-square or Fisher's exact test, where appropriate. A significance level of $p < 0.05$ was applied.

Questions 25, 30-A, 30-B, and 31 (see Table 1) were considered key analytic items, reflecting definitions of LPC-CTVA, perceived preparedness, and reporting history. For Q25, an “index score” was constructed to assess the relationship between respondent characteristics and agreement with defining indicators of low

performance. Univariate linear and logistic regression models were used to explore associations between the index score (dependent variable) and demographic or institutional covariates (independent variables).

All analyses were conducted using Stata™ Version 13.0 MP (StataCorp, College Station, TX, USA).

Results

Figure 2 presents the survey flowchart and the response and inclusion process. A total of 878 responses were gathered for the survey. Of 537 submitted responses, 465 met inclusion criteria and were included in the final analysis (Figure 2). The demographics of the respondents included 53.07% male, with a median age of 45 years (see Table 2). The highest proportions of respondents were from Spain (14.7%), Italy (9.1%), and Greece (7.8%) (Table 3). Respondents represented 57 countries across six continents, reflecting a broad international distribution (Table 2, Figure 3). Figure 3 summarizes this distribution by country and region. European countries were most represented, while participation from Africa and Latin America was limited. This uneven distribution may reflect regional variation in access to professional networks, survey dissemination reach, or interest in the topic.

Among those who completed the survey, the majority were anesthesiologists with cardiac, thoracic, and/or vascular fellowship training (40.78%), who primarily perform anesthesia for cardiothoracic and vascular procedures, as well as other types of surgeries (62.38%) (Table 2). Most participants worked at university hospitals (56.24%) and reported a median of 11 years of experience in CTVA practice (Table 2). Additionally, 74.67% of participants indicated that they received medical or anesthesia training in the same country where they currently practice (Table 2).

Details regarding institutional caseloads, operating room availability, and characteristics of the anesthesia workforce are presented in Table S1. Nurse anesthetists represented less than 1% of respondents ($n = 3$). Although their responses were accepted due to their clinical involvement in CTVA care, they were not separately analyzed or used to infer generalizable trends.

Out of the eighteen original statements presented (Tables 4 and 5 and Figure 4), thirteen achieved at least a 70% consensus, with respondents indicating either “Agree” or “Strongly Agree” regarding the definition of impaired or otherwise incompetent cardiac, thoracic, and vascular anesthesiologists (CTVA). Specifically, over 75% of 465 respondents agreed that issues such as inadequate or outdated knowledge compromising optimal patient care, non-compliance with standard infection control protocols, and a lack of understanding or failure to adhere to procedural steps, including monitoring and controlling anesthetic depth, hemodynamics, temperature, coagulation, and ventilation, were prevalent. Response counts for individual items ranged from 450 to 465. Additional concerns included negligence in practice—defined as failing to act with the appropriate level of care—non-compliance with the standard of care, ineffective communication with anesthesia, perfusion, and surgical teams, and recurring medication errors. Further details on the Likert-scale responses defining low-performing CTVA (ranging from “strongly agree” to “strongly disagree”) and thematically categorized free-text responses ($n = 23$). Avoidance of work, inadequate training, deficient continuing education, institutional obstacles, psychological distress, and reluctance to seek help are presented in Table 5.

Consensus-Based Definition of Low-Performing Colleagues

Based on the 13 indicators meeting the $\geq 70\%$ agreement threshold (Table 5), we formulated a consensus definition of an LPC-CTVA:

A low-performing colleague in cardiothoracic and vascular anesthesia is one who demonstrates recurrent or persistent unsafe or substandard behaviors across procedural, cognitive, communicative, and professional domains — including repeated procedural failures, persistent outdated knowledge, recurrent non-compliance with infection control, consistent failure to follow institutional protocols, frequent poor communication or teamwork, recurrent medication errors, habitual neglect of monitoring or patient safety checks, repeated breaches in sterile technique, recurrent failure to prepare or check equipment, persistent inability to perform essential procedures, repeated breaches of professional conduct, recurrent negligence, and consistent inability to recognize or respond appropriately to intraoperative complications. This definition reflects peer-perceived patterns of unsafe practice, not isolated incidents, and is intended for professional—not legal—contextual use.

As presented in Table 6, a limited proportion of respondents indicated that their institutions have formal processes to address issues related to impaired or incompetent cardiac, thoracic, or vascular anesthesiologists. Specifically, among the 464 respondents, only 22.16% reported that their centers provide structured supervision for such practitioners. Institutional mechanisms for identifying impairment or incompetency were confirmed by 15.27% of the 464 respondents, while only 11.73% of these respondents indicated that their institutions actively manage these cases through defined procedures.

Table 7 illustrates the varying levels of preparedness among CTVA professionals to address impairment and incompetence. Among 418 respondents, 46.2% reported feeling either very or somewhat prepared to manage cases involving

impaired colleagues. Similarly, 44.1% of 416 respondents expressed personal confidence in dealing with incompetence. Notably, this individual's preparedness contrasts with the limited institutional support: only 11.7% of the 464 respondents indicated that their institutions had formal procedures in place to manage such cases. By contrast, a substantial minority of respondents reported feeling unprepared, 29.4% regarding impairment and 31.5% concerning incompetence.

Despite moderate levels of perceived preparedness, actual reporting remained low (Table 8). Only 23.1% of 447 respondents reported notifying the appropriate authority about a suspected impaired or incompetent CTVA colleague within the past decade. In contrast, 39.9% of 434 respondents reported personal knowledge of such colleagues, and 19.0% of 429 were aware of malpractice claims involving impaired or incompetent CTVA professionals during the same time frame. These referred to self-reported awareness of claims, not legally adjudicated malpractice judgments.

Table S2 presents the most frequently cited reasons for not reporting impaired or incompetent colleagues in CTVA. Among 265 respondents, the leading justifications included the belief that someone else was already addressing the issue (33.7% agreed, 6.8% strongly agreed). Another common reason, reported by 246 respondents, was the perception that reporting would have no impact (28.3% agreed, 11.5% strongly agreed). Additionally, 26.5% of 265 respondents agreed that they did not know how to report such concerns, while 21.9% agreed and 5.4% strongly agreed (n = 265) that they feared retaliation. Notably, a substantial proportion also indicated that they felt it was not their responsibility or were concerned they might be similarly scrutinized in the future.

Regression analyses identified several significant predictors of understanding, preparedness, and reporting practices related to low-performing CTVA

anesthesiologists (Tables S3–S6). The mean index score for understanding the definition of a low-performing CTVA—calculated from Question 25, which included 18 Likert-scale sub-items (range: 0–90)—was 68.8 (SD = 17.78), with higher scores reflecting greater understanding. Greater understanding was significantly associated with being a Head of Department ($\beta = 10.22$; $p = 0.033$). Conversely, lower scores were observed among female respondents ($p = 0.013$), individuals trained exclusively in one country ($p = 0.046$), and those uncertain about their institution's ability to identify or manage low-performing practitioners. Notably, prior experience in reporting a colleague was linked to higher levels of understanding ($p = 0.015$) (Table S3).

Preparedness to manage impaired colleagues was associated with age (OR = 1.03, $p = 0.013$), experience (OR = 1.03, $p = 0.019$), and holding a leadership position (OR = 2.11, $p = 0.028$). Institutional readiness, indicated by systems for supervision (OR = 1.93, $p = 0.008$), identification (OR = 2.63, $p = 0.002$), and management (OR = 1.91, $p = 0.041$), also significantly contributed to preparedness. Respondents who had previously reported a colleague felt more prepared (OR = 2.52, $p < 0.001$) (Table S4).

Among respondents whose institutions had defined procedures for managing low-performing colleagues ($n = 51$), 68.6% reported having recognized such a colleague in the past decade, and 54.9% reported having formally reported them. In contrast, among those without such institutional procedures ($n = 383$), recognition and reporting rates were 37.1% and 21.4%, respectively. While these findings suggest a positive association between institutional systems and both recognition and reporting, the survey was not powered for formal statistical testing of this relationship.

Preparedness in managing low-performing peers was correlated with age (OR = 1.04, $p < 0.001$), years of experience (OR = 1.04, $p = 0.012$), and leadership role (OR = 1.93, $p = 0.047$). Previous reporting of a colleague (OR = 1.78, $p = 0.013$) and institutional systems (all $p < 0.05$) further predicted higher preparedness (Table S5).

Respondents who reported a low-performing colleague in the past decade were significantly more likely to have years of experience (OR = 1.04, $p = 0.002$), hold a leadership position (OR = 2.58, $p = 0.004$), and feel prepared to handle mental impairment (OR = 2.52, $p < 0.001$) or low performance (OR = 1.78, $p = 0.013$) (Table S6).

Discussion

This study's findings allowed us to propose a consensus-based definition of LPC-CTVA, summarizing 13 indicators identified by $\geq 70\%$ of respondents. This definition emphasizes recurrent or persistent unsafe behaviors across procedural, cognitive, communicative, and professional domains, rather than isolated lapses, and is intended to inform professional awareness and institutional policy development. Our findings confirm the initial hypothesis that CTVA professionals share consensus on a core set of indicators defining low performance and impairment. Thirteen of eighteen statements surpassed the predefined threshold, forming a profession-informed basis for identifying underperformance and related impairments. These indicators reflect perceived risks—not direct predictors of harm—and must be interpreted within broader institutional contexts. Factors such as culture, infrastructure, and leadership significantly influence how both performance and impairment issues translate into safety concerns. Recent reports have also noted growing strain on the CTVA workforce, including burnout, mental health challenges,

and staffing gaps, which may contribute to or hinder recognition and response to underperformance and impairment [19–22].

The consensus indicators captured the multifactorial nature of underperformance and impairment, including outdated knowledge, protocol nonadherence, repeated procedural errors, poor communication, and ethical breaches. Impairment—whether physical, mental, or substance-related—was conceptually distinct but professionally relevant. These definitions reflect peer consensus, not legal determinations.

The survey framed “a reasonable person” as a reasonably competent practitioner, aligning with clinical—not legal—standards. Indicators of underperformance and impairment were defined as sustained or recurring concerns, not isolated errors or jurisdiction-specific legal violations. Deviations were assessed through peer perception across diverse practice settings.

This consensus-based definition supports early recognition of underperformance and impairment, offering a structured, non-legal framework for institutional response in high-acuity settings. Given the growing awareness of burnout and mental health strain—particularly in cardiac anesthesia—it is plausible that recurrent issues may arise from psychosocial stressors rather than clinical deficits alone. This underscores the need to integrate wellness strategies with existing quality assurance efforts [21–22].

While our sample size was comparable to the U.S. survey by DesRoches et al. [6], this study offers a subspecialty-focused lens on low performance and impairment in CTVA. By applying consensus thresholds to responses from 57 countries, we captured context-specific insights absent from broader workforce research. However,

cross-national variation in institutional readiness, reporting norms, and professional hierarchies may have influenced responses. These differences enrich interpretation but limit generalizability to underrepresented regions, reinforcing the need for context-sensitive strategies when applying global data locally [19–20].

The item on substance use did not reach consensus, likely reflecting recognition that substance use disorder is a distinct form of impairment requiring specialized, rehabilitative—not punitive—approaches. This conceptual separation from underperformance was preserved throughout the survey. Stigma, legal concerns, or institutional gaps may explain reluctance to endorse this item, despite known safety implications [23]. Free-text responses further highlighted issues such as professional disengagement, institutional barriers, training gaps, and mental health strain, broadening the understanding of low performance and impairment in CTVA.

Despite broad international input and a high proportion of fellowship-trained respondents, fewer than 25% reported institutional systems to identify or manage low-performing or impaired colleagues. Only 11.7% confirmed structured mechanisms, falling short of ethical expectations to protect patients regardless of legal constraints [24]. Preparedness was limited: under half felt equipped to intervene, and only 23% had submitted a report, despite nearly 40% witnessing underperformance or impairment in the past decade. As in the DesRoches study [6], common barriers included deflected responsibility, doubts about impact, fear of retaliation, and unclear institutional processes.

Subgroup analysis showed that department heads, senior clinicians, and those with prior reporting experience were more likely to feel prepared and to report impaired or low-performing colleagues. Those in public hospitals or institutions with formal systems reported greater readiness. Yet, only 11.7% of respondents had access

to structured pathways, while 44.1% felt confident intervening, suggesting individual preparedness may exceed system support. Female respondents and those trained and practicing in the same country were less likely to recognize underperformance, possibly due to structural limitations or fewer comparative perspectives [25]. These findings underscore the importance of both personal and institutional readiness. Despite widespread recognition, addressing underperformance and impairment remains sensitive, often linked to age-related decline, cognitive or mental health issues, or substance misuse [26]. Structured evaluation, early support, and institutional accountability are essential to protect patients and uphold professional standards [8,9].

Limitations

This study used non-targeted, open-access distribution methods, precluding calculation of a conventional response rate and limiting assessments of representativeness. However, this approach supported broad international participation and thematic exploration.

Non-response bias is possible, as respondents may have been more experienced or engaged in managing underperformance. The predominance of university-based clinicians with substantial CTVA experience may limit applicability to less experienced or non-academic settings.

Although nurse anesthetists comprised fewer than 1% of respondents ($n = 3$), their inclusion reflected interdisciplinary care models in some health systems and their direct involvement in intraoperative CTVA practice. Given their minimal number and lack of subgroup analysis, their impact on the overall findings is likely

negligible. However, we acknowledge that their participation may introduce some heterogeneity.

The primary outcome items were developed through expert consensus rather than a validated psychometric tool, which may introduce subjectivity. In addition, low participation from some high-population countries and variation in cultural norms or reporting practices may limit cross-national comparability.

Participants were not provided with formal legal definitions of low performance or impairment, and interpretation likely varied based on individual experience, institutional norms, and regional expectations. This perceptual variability may limit the transferability of findings. While structured reporting barriers were explored quantitatively, the absence of qualitative interviews limited insight into emotional and institutional dynamics, particularly around impairment-related concerns. Early versions of the survey included colloquial terms for substance use that may have been perceived as pejorative; these were revised during data collection following participant feedback. Finally, as this was a self-reported and anonymous survey, social desirability or self-protective bias may have influenced responses, especially given the sensitivity surrounding both underperformance and impairment.

Conclusion

This international survey established a consensus-based definition of low-performing anesthesiologists in cardiothoracic and vascular anesthesia, grounded in professional conduct, clinical competence, and procedural adherence. However, readiness to recognize and manage such cases remains limited, particularly in institutions lacking structured oversight. Seniority, leadership roles, and prior reporting experience were associated with greater preparedness. These findings

underscore the importance of establishing clear policies, fostering inclusive leadership development, and providing targeted training. Despite consensus on definitions, persistent institutional and cultural gaps underscore the need for system-level solutions and proactive support frameworks.

Acknowledgment

In preparing the Discussion section of this manuscript, we utilized artificial intelligence (AI) assistance (ChatGPT, OpenAI) to help generate initial thematic structures and enhance narrative clarity. The authors thoroughly reviewed, edited, and approved all AI-generated content, taking full responsibility for the scientific accuracy and interpretation of the material.

Tables:

Table 1. Full LPC-CTVA Survey Instrument

Section 1: Participants' Characteristics and Hospital Facilities

- 2. Are you practicing cardiac, thoracic, and/or vascular anesthesia or involved in perioperative care for such procedures?
 - 3. In what country do you work?
 - 4. What is your age in years?
 - 5. How can you describe your gender?
 - 6. How would you rate your race or ethnicity?
 - 7. Type of hospital
 - 8. Years of experience in cardiac, thoracic, and/or vascular anesthesiology
 - 9. What is your primary job description?
 - 10. What is your profession?
 - 11. Did you receive medical/anesthesia training in the country where you practice?
 - 12–24. Caseload and staffing levels for cardiac, thoracic, and vascular anesthesia (annual procedures, weekly OR availability, and number of consultants/registrars)
12. What is the approximate **annual number of cardiac surgical procedures** performed at your hospital?
 13. What is the approximate **annual number of thoracic surgical procedures** performed at your hospital?
 14. What is the approximate **annual number of vascular surgical procedures** performed at your hospital?
 15. How many **dedicated cardiac operating rooms** are typically available each week?
 16. How many **dedicated thoracic operating rooms** are generally available each week?
 17. How many **dedicated vascular operating rooms** are usually available each week?
 18. How many **consultant/attending anesthesiologists** regularly cover cardiac anesthesia cases?
 19. How many **resident, registrar, or fellow anesthesiologists** are typically assigned to cardiac anesthesia?
 20. How many **consultant/attending anesthesiologists** regularly cover thoracic anesthesia cases?
 21. How many **resident, registrar, or fellow anesthesiologists** are usually assigned to thoracic anesthesia?
 22. How many **consultant/attending anesthesiologists** regularly cover vascular anesthesia cases?
 23. How many **resident, registrar, or fellow anesthesiologists** are typically assigned to vascular anesthesia?
 24. Is **CTVA anesthesia** covered by the same team or separate subspecialized teams in your institution?

Section 2: Definition of Low-Performing CTVA Anesthesiologist

- 25. Please rate your agreement with the following statements (18 predefined items on behaviors and indicators of low performance).

- 25.1 Frequently fails to follow infection control precautions (e.g., hand hygiene, sterile technique).
- 25.2 Regularly displays outdated clinical knowledge inconsistent with current practice standards.
- 25.3 Makes repeated procedural errors during standard anesthetic care.
- 25.4 Demonstrates a lack of familiarity with essential monitoring or resuscitation equipment.
- 25.5 Fails to follow institutional or international guidelines in daily clinical decisions.
- 25.6 Has inadequate or poor communication with surgical and ICU colleagues.
- 25.7 Consistently exhibits poor preoperative patient assessment or preparation.
- 25.8 Repeatedly mismanages intraoperative hemodynamics.
- 25.9 Administers inappropriate or unsafe drug dosages.
- 25.10 Displays signs of cognitive or psychomotor decline impacting clinical performance.
- 25.11 Fails to recognize or respond appropriately to intraoperative complications.
- 25.12 Has multiple episodes of falling asleep or inattentiveness during cases.
- 25.13 Regularly omits documentation or falsifies clinical records.
- 25.14 Shows reluctance to seek help when needed during difficult cases.
- 25.15 Avoids participation in multidisciplinary team discussions or debriefings.
- 25.16 Arrives late or unprepared for assigned operating room duties.
- 25.17 Has repeated conflicts with coworkers or staff due to unprofessional behavior.
- 25.18 Appears intoxicated, impaired, or under the influence of substances while on duty.

Section 3: Institutional Approaches

- 26. Does your center supervise CTVA professionals for low performance?
- 27. Does your center have institutional approaches to identify low-performing CTVA anesthesiologists?
- 28. Does your center have institutional approaches to deal with low-performing CTVA anesthesiologists?
- 29. If yes, please elaborate on your center's approach.

Section 4: Reporting Low-Performing Colleagues

- 30. Please rate the extent to which you feel prepared to deal with impaired or low-performing colleagues.
- 31. In the last 10 years, did you report a low-performing CTVA colleague?
- 32. If yes, how did you report that?
- 33. If no, please rate your agreement with reasons for not reporting.

Section 5: Prevalence and Consequences

- 34. In the last 10 years, have you had personal knowledge of a low-performing CTVA colleague?
- 35. Have you had personal knowledge of malpractice claims related to low-performing CTVA colleagues?
- 36. Do you have any further comments?

Table 2. Respondents' characteristics

	Frequencies (%) of responses
Demographics	
Age (yrs) (n (%) and median [interquartile range])	489 (91.06%) 45 [38 – 52]
Sex	
<i>Males (n, %)</i>	285 (53.07%)
<i>Females (n, %)</i>	241 (44.88%)
<i>I don't prefer to say (n, %)</i>	11 (2.05%)
Race/ethnicity	
<i>White / Caucasian</i>	345 (64.25%)
<i>Asian / Pacific Islander</i>	66 (12.29%)
<i>Middle Eastern</i>	43 (8.01%)
<i>Hispanic</i>	33 (6.15%)
<i>I prefer not to answer</i>	32 (5.96%)
<i>Multiple ethnicity</i>	12 (2.23%)
<i>African, Black, or African American</i>	4 (0.74%)
<i>American Indian or Alaskan Native</i>	2 (0.37%)
Professional background	
Profession	
<i>An anesthesiologist with cardiac, thoracic, and/or vascular fellowship training</i>	219 (40.78%)
<i>An anesthesiologist without cardiac, thoracic, and/or vascular fellowship training</i>	136 (25.33%)
<i>Head of the department of anesthesia or</i>	93 (17.32%)

<i>cardiac, thoracic, and/or vascular anesthesia</i>	
<i>Resident or trainee in anesthesia</i>	20 (3.72%)
<i>Intensivist</i>	18 (3.35%)
<i>Retired general anesthesiologist</i>	16 (2.98%)
<i>Fellow in anesthesia</i>	12 (2.23%)
<i>Retired cardiothoracic and vascular anesthesiologist</i>	6 (1.12%)
<i>I prefer not to answer</i>	6 (1.12%)
<i>Anesthesia technician</i>	4 (0.74%)
<i>Nurse anesthetist</i>	3 (0.56%)
<i>Cardiothoracic and vascular surgeon</i>	2 (0.37%)
<i>Performing cardiovascular surgery without stating relevant fellowship training</i>	2 (0.37%)
Primary job description	
<i>Performing anesthesia for cardiothoracic and vascular procedures, but also for other surgeries</i>	335 (62.38%)
<i>Performing cardiac anesthesia</i>	131 (24.39%)
<i>Performing cardiothoracic and vascular anesthesia</i>	113 (21.04%)
<i>Performing thoracic anesthesia</i>	62 (11.55%)
<i>Performing vascular anesthesia</i>	47 (8.75%)
<i>Performing vascular and thoracic anesthesia</i>	48 (8.94%)
<i>Certified nurse anesthetist</i>	24 (4.47%)
Type of hospital	

<i>University Hospital</i>	302 (56.24%)
<i>Public, non-university Hospitals</i>	82 (15.27%)
<i>Specialized cardiac, thoracic, and/or vascular surgery</i>	60 (11.17%)
<i>Private hospital</i>	53 (9.87%)
<i>Tertiary care hospital (neither university hospital nor specialized center)</i>	31 (5.77%)
<i>Secondary care hospital</i>	6 (1.12%)
Years of experience in cardiac, thoracic, and/or vascular anesthesiology practice in years	504 (93.85%)
(respondents n (%) and median [interquartile range])	11 [5 – 20]

Frequencies indicate the number of participants providing an answer. When applicable, results are presented as absolute and relative frequencies, along with the median [IQR].

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Table 3. Distribution of the participants' countries.

Country	Sample's physician anesthesia providers		Population's physician anesthesia providers *	
	(Freq.)	(%)	(Freq.)	(%)
Spain	79	14.71	7500	1.05
Italy	49	9.12	15500	0.32
Greece	42	7.82	1300	3.23
Russian Federation	40	7.45	30000	0.13
Serbia	37	6.89	950	3.89
Saudi Arabia	29	5.4	1500	1.93
United States of America	27	5.03	67000	0.04
Ukraine	26	4.84	6800	0.38
India	19	3.54	16500	0.11
Brazil	15	2.79	24000	0.06
China	13	2.42	71698	0.02
Japan	13	2.42	12208	0.11
Turkey	13	2.42	7000	0.19
United Kingdom of Great Britain	12	2.23	9645	0.12
Belgium	11	2.05	2217	0.50
Germany	11	2.05	25000	0.04
Israel	9	1.68	800	1.12
Switzerland	9	1.68	2594	0.35
Canada	7	1.3	4464	0.16
Cyprus	7	1.3	162	4.32

Egypt	7	1.3	5500	0.13
Bosnia and Herzegovina	5	0.93	230	2.17
Australia	5	0.93	5535	0.09
Colombia	4	0.74	3600	0.11
Romania	4	0.74	1400	0.29
Argentina	3	0.56	4760	0.06
Montenegro	3	0.56	81	3.70
Albania	2	0.37	260	0.77
Croatia	2	0.37	870	0.23
Hungary	2	0.37	900	0.22
Mexico	2	0.37	8157	0.02
Netherlands	2	0.37	2316	0.09
Portugal	2	0.37	1855	0.11
Slovenia	2	0.37	400	0.50
State of Palestine	2	0.37	-	-
The former Yugoslav Republic of Macedonia	1	0.19	182	0.55
Austria	1	0.19	3362	0.03
Belorussia	1	0.19	-	-
Bolivia (Plurinational State of Bolivia)	1	0.19	720	0.14
Bulgaria	1	0.19	1386	0.07
Denmark	1	0.19	1925	0.05

Finland	1	0.19	1100	0.09
France	1	0.19	9700	0.01
Indonesia	1	0.19	2891	0.03
Iraq	1	0.19	488	0.20
Jamaica	1	0.19	-	-
Lithuania	1	0.19	-	-
Malta	1	0.19	86	1.16
Nepal	1	0.19	235	0.42
Nigeria	1	0.19	1050	0.09
Oman	1	0.19	290	0.34
Philippines	1	0.19	3510	0.03
Republic of Moldova	1	0.19	470	0.21
Sri Lanka	1	0.19	410	0.24
Sudan	1	0.19	190	0.53
United Arab Emirates	1	0.19	-	-
Zimbabwe	1	0.19	87	1.15
Total	537	100%	-	-

* Data obtained from: <https://wfsahq.org/member-focus/about-our-members/member-societies/>

Table 4 Participant agreement with 18 candidate indicators describing low performance in CTVA practice. This table presents the full set of predefined statements evaluated by respondents. Items that reached $\geq 70\%$ agreement were used to construct the final definition of LPC-CTVA (see Table 5). Statements are listed in descending order of agreement.

Statement	**Total number of participants who responded to the statement	*Agree & Strongly Agree
Inadequate or outdated knowledge to ensure optimum patient care	463	372 (80.34%)
Non-compliance with the standard infection control precautions	465	372 (80%)
Non-understanding, unawareness, or non-following the procedures' steps (e.g., sequence and steps of anesthetic and surgical procedures regarding anesthetic depth, vigilant hemodynamic, temperature, coagulation, and ventilation monitoring, and control)	460	368 (80%)

Negligence in practice is defined as the failure to behave with the level of care that a reasonable person would have exercised under the same circumstances [https://www.law.cornell.edu/wex/negligence].	464	367 (79.09%)
Non-compliance with the standard of care	465	366 (78.71%)
Having ineffective communication with the anesthesia, perfusion, and surgery teams	463	360 (77.75%)
Repeated drug errors	462	352 (76.19%)
Having inter-professional ethical issues (e.g., troublemaking, harassment, discrimination, bullying)	460	337 (73.26%)
Making medical errors (e.g., wrong approach, procedure, or technique)	463	333 (71.92%)
Direct patient damage or death secondary to a wrong anesthetic intervention or procedure performed	460	330 (71.74%)

Non-compliance with the institutional standardized protocols	465	333 (71.61%)
Leaving the operating room with “the patient unattended” midway through operations	464	327 (70.47%)
Non-compliance with the institutional policy and procedures	463	325 (70.19%)

Results are presented as absolute and relative frequencies. * Percentages are calculated based on the total number of participants who responded; missing values are excluded from the analysis. **"I prefer not to answer" is excluded from the percentage calculations.

Table 5. Consensus-based definition of low-performing cardiothoracic and vascular anesthesiologists (CTVA).

This table presents the 13 predefined statements that met the $\geq 70\%$ agreement threshold among respondents and constitute the final consensus-derived definition of LPC-CTVA. These items are derived from the full set presented in Table 2 and ordered by level of agreement.

Regarding the definition of impaired or otherwise incompetent cardiac, thoracic, and /or vascular anesthesiologist (CTVA) in practice, please rate the extent to which you	*Strongly Disagree & Disagree	*Undecided	*Agree & Strongly Agree	I prefer not to answer
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agree with the following statements.				
Drunk, addict, or drug-abusing	122 (26.99%)	29 (6.42%)	301 (66.59%)	20 (3.72%)
Leaving the operating room with “the patient unattended” midway through operations	108 (23.28%)	29 (6.25%)	327 (70.47%)	8 (1.49%)
Negligence in practice is defined as the failure to behave with the level of care that a reasonable person would have exercised under the same circumstances [https://www.law.cornell.edu/wex/negligence].	77 (16.59%)	20 (4.31%)	367 (79.09%)	8 (1.49%)
Inadequate or outdated knowledge to ensure optimum patient care	60 (12.96%)	31 (6.7%)	372 (80.34%)	8 (1.49%)
Making wrong decisions	76 (16.34%)	67 (14.41%)	322 (69.25%)	7 (1.3%)
Making medical errors (e.g., wrong approach, procedure, or technique)	79 (17.06%)	51 (11.02%)	333 (71.92%)	9 (1.68%)
Repeated drug errors	83 (17.97%)	27 (5.84%)	352 (76.19%)	10 (1.86%)
Non-compliance with the institutional standardized protocols	82 (17.63%)	50 (10.75%)	333 (71.61%)	7 (1.3%)

Non-compliance with the standard of care	64 (13.76%)	35 (7.53%)	366 (78.71%)	7 (1.3%)
Non-compliance with the institutional policy and procedures	80 (17.28%)	58 (12.53%)	325 (70.19%)	9 (1.68%)
Non-compliance with the standard infection control precautions	66 (14.19%)	27 (5.81%)	372 (80%)	7 (1.3%)
Having ineffective communication with the anesthesia, perfusion, and surgery teams	67 (14.47%)	36 (7.78%)	360 (77.75%)	9 (1.68%)
Direct patient damage or death secondary to a wrong anesthetic intervention or procedure performed	79 (17.17%)	51 (11.09%)	330 (71.74%)	12 (2.23%)
Having inter-professional ethical issues (e.g., troublemaking, harassment, discrimination, bullying)	76 (16.52%)	47 (10.22%)	337 (73.26%)	12 (2.23%)
Personal physical or health issues or disabilities preclude optimum and safe patient care.	97 (21%)	100 (21.65%)	265 (57.36%)	10 (1.86%)
Repeated sudden physical collapse or nervous breakdown during direct patient care.	83 (18%)	62 (13.45%)	316 (68.55%)	11 (2.05%)

Personal age limit (too old or too young) precluding the provision of optimum and safe patient care	185 (40.39%)	105 (22.93%)	168 (36.68%)	14 (2.61%)
Non-understanding, unawareness, or non- following the procedures' steps (e.g., sequence and steps of anesthetic and surgical procedures regarding anesthetic depth, vigilant hemodynamic, temperature, coagulation, and ventilation monitoring, and control)	62 (13.48%)	30 (6.52%)	368 (80%)	12 (2.23%)
Others *				
<i>Avoiding Work / Excuses</i>	3 / 23 (13%)			
<i>Lack of continuing professional development (CPD) / Medical Knowledge</i>	3 / 23 (13%)			
<i>Inability to Manage Blood / Errors</i>	3 / 23 (13%)			
<i>Structural/Institutional Barriers</i>	3 / 23 (13%)			
<i>Disinterest / Complaining</i>	2 / 23 (8.7%)			
<i>Insufficient Training in Topics</i>	2 / 23 (8.7%)			
<i>Lack of Cardiac Anesthesia Training</i>	2 / 23 (8.7%)			
<i>Mental Health / Personal Issues</i>	2 / 23 (8.7%)			

<i>Corruption / Disrupting Teamwork</i>	1 / 23 (4.3%)
<i>Not Asking for Help</i>	1 / 23 (4.3%)
<i>Refusal to Train Residents</i>	1 / 23 (4.3%)

Results are presented as absolute numbers and corresponding percentages. Percentages represent the proportion of respondents who answered the Likert-scale items ("strongly disagree" to "strongly agree"). * Percentages are calculated relative to the 23 "other" responses, not the full respondent. Missing values are excluded from the analysis.

Table 6. Supervision and management of CTVA for impairment or incompetence.

Survey question	Category	Yes, %	No, %	I don't know. %	I prefer not to say, %
Does your center "supervise" the cardiac, thoracic, and/or vascular anesthesiologists (CTVA) for impairment or incompetence to practice?	Supervision of CTVA	119 (22.16%)	272 (50.65%)	62 (11.55%)	11 (2.05%)
Does your center "identify" the cardiac, thoracic, and/or vascular anesthesiologists (CTVA) for	Identification of CTVA	82 (15.27%)	304 (56.61%)	71 (13.22%)	7 (1.3%)

impairment or incompetence to practice?

Does your center “deal with” the cardiac, thoracic, and/or vascular anesthesiologists (CTVA) for impairment or incompetency to practice?	Management of CTVA Impairment/Incompetency	63 (11.73%)	298 (55.49%)	90 (16.76%)	13 (2.42%)
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Results are presented as absolute and relative frequencies

Table 7. Preparedness to deal with impaired or incompetent cardiothoracic and vascular anesthesiologists (CTVA)

Please rate the extent to which “you feel prepared.”	Very prepared	Somewhat prepared	Very unprepared	Somewhat unprepared	I prefer not to say	I do not know
To deal with colleagues who practice cardiothoracic and vascular anesthesiologists (CTVA) while impaired.”	49 (9.12%)	199 (37.06%)	77 (14.34%)	81 (15.08%)	12 (2.23%)	30 (5.59%)
To deal with colleagues who are	57 (10.61%)	180 (33.52%)	104 (19.37%)	65 (12.1%)	10 (1.86%)	32 (5.96%)

incompetent in their
cardiothoracic and vascular
anesthesiologists (CTVA)
practice.”

Results are presented as absolute and relative frequencies

Table 8. Reporting and awareness of impairment, incompetency, and malpractice in cardiothoracic and vascular anesthesia (CTVA) practice.

Survey question	Yes, %	No, %	I don't know. %	I prefer not to say, %
In the last ten years, did you report that a cardiac, thoracic, and/or vascular anesthesiologist (CTVA) was impaired or incompetent to your supervisor, head of unit/department, hospital clinic, professional society, or other relevant authority?	124 (23.09%)	279 (51.96%)	21 (3.91%)	23 (4.28%)
In the last ten years, have you had direct, personal	219 (39.85%)	165 (30.73%)	31 (5.77%)	19 (3.54%)

knowledge of a cardiac, thoracic, and/or vascular anesthesiologist (CTVA) who was impaired or incompetent to practice in your hospital, group, or practice?

In the last ten years, have you had direct, personal knowledge of malpractice claims related to an impaired or incompetent cardiac, thoracic, and/or vascular anesthesiologist (CTVA)?	102 (18.99%)	268 (49.91%)	46 (8.57%)	13 (2.42%)
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Results are presented as absolute and relative frequencies

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Author contributions: CRediT

The corresponding authors acknowledge co-author contributions using CRediT (Contributor Roles Taxonomy) roles as follows:

Authors 1 to 7: Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft

Author 3: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft

Authors 8 to 29: Validation, survey's dissemination, and Writing – review and editing

Author 30: Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft

Appendices

Supplement B: Tables S1 to S7

Table S1. Distribution of the participants' countries.

* Data obtained from: <https://wfsahq.org/member-focus/about-our-members/member-societies/>

Table S2: Caseload, Facilities, and Workforce of Respondents' Centers. Frequencies indicate the number of respondents providing an answer. When applicable, results are presented as absolute and relative frequencies, along with the median [IQR].

Table S3. Reasons for not reporting an impaired or incompetent cardiothoracic and vascular anesthesiologist (CTVA). Results are shown as both absolute and relative frequencies.

Table S4. Univariate linear regression models for the definition of low-performing cardiothoracic and vascular anesthesiologists (CTVA). Statistical significance was defined as $p < 0.05$

Table S5. Univariate logistic regression models for the preparedness to deal with colleagues who practice cardiothoracic and vascular anesthesia (CTVA) while physically or mentally impaired. Statistical significance was defined as $p < 0.05$

Table S6. Univariate logistic regression models for the preparedness to deal with low-performing colleagues in their cardiothoracic and vascular anesthesia (CTVA) practice. Statistical significance was defined as $p < 0.05$

Table S7. Univariate logistic regression models for reporting low-performing cardiothoracic and vascular anesthesiologists (CTVA) in the past 10 years. Statistical significance was defined as $p < 0.05$

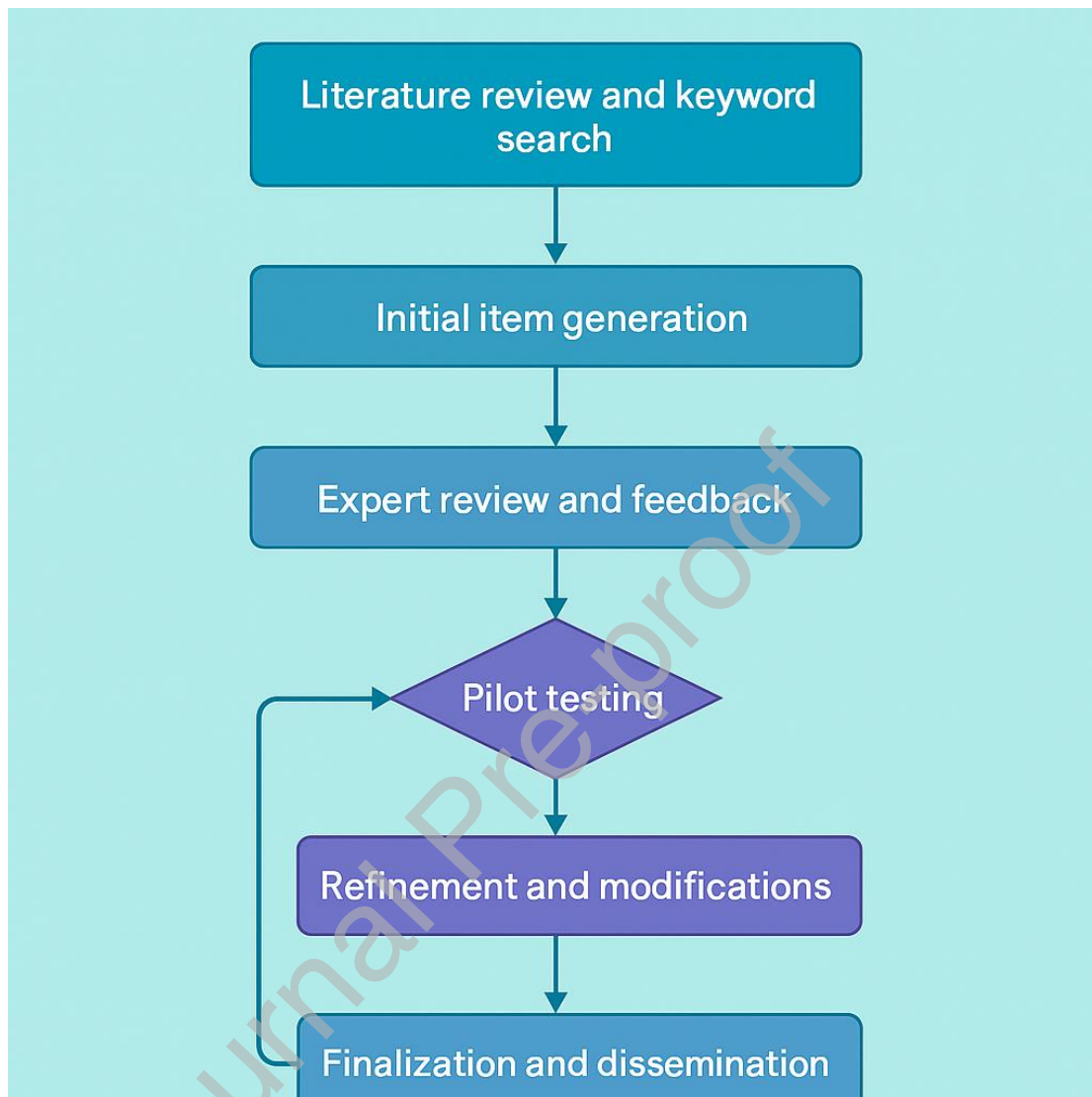
Figures legends

Figure 1. Flowchart summarizing the development, piloting, revision, and dissemination process of the final 43-item questionnaire used in this international survey.

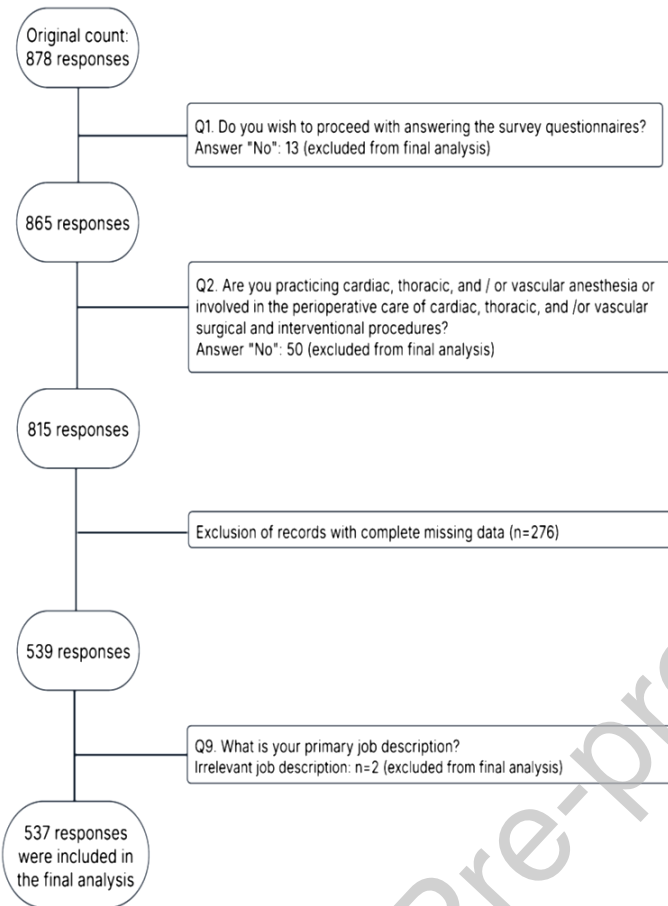


Figure 2. Flowchart depicting the process for selecting and including survey responses.

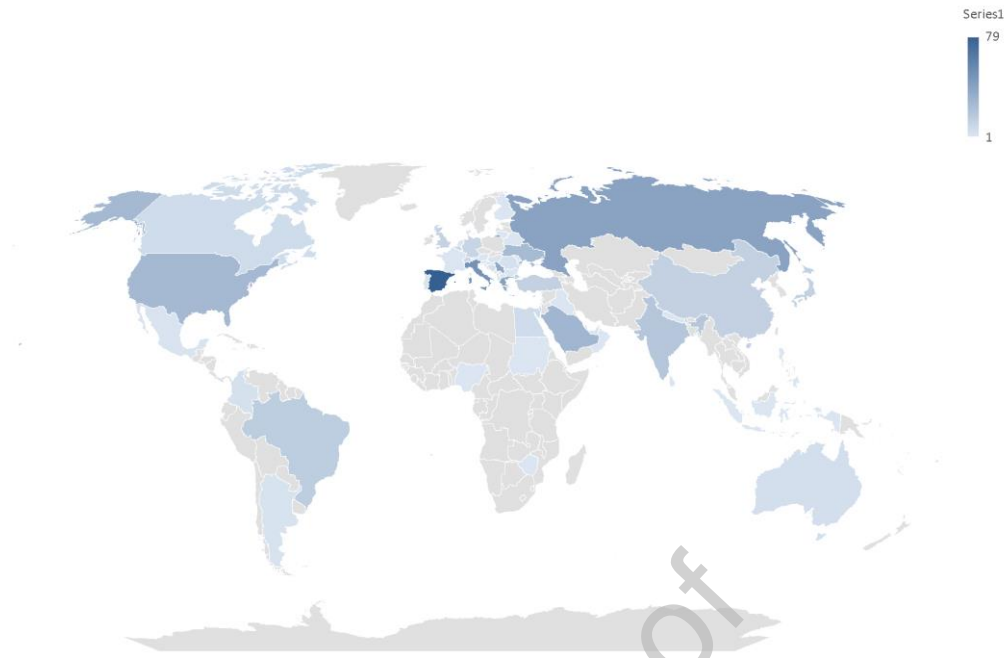


Figure 3. Geographic distribution of LPC-CTVA survey respondents by country and continent.

This map-based representation illustrates the global participation in the LPC-CTVA survey (N = 418), with countries labeled by the number of respondents and color-coded by continent. The highest response counts were observed from Italy (n = 52), India (n = 33), Egypt (n = 31), the United States (n = 29), and Spain (n = 28), reflecting a substantial contribution from Europe, Asia, and the Middle East.

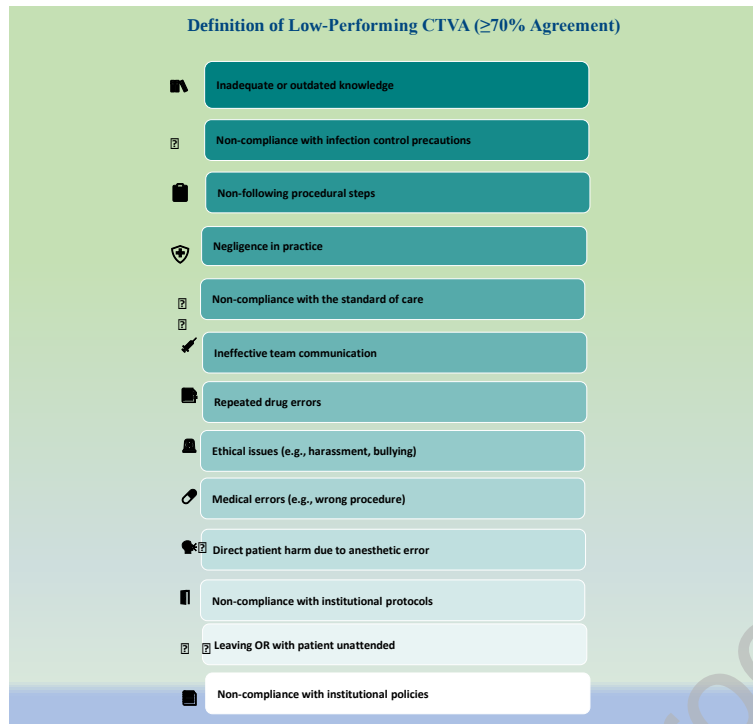


Figure 4. Consensus-Based Definition of Low-Performing cardiothoracic and vascular anesthesiologists (CTVA) Anesthesiologists

Graphical Abstract

