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Moral Injury in Neurointerventional Practice: A Multinational Survey

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Abstract

Background

Neurointerventional practice involves making time-critical decisions and facing potentially devastating complications and clinical outcomes. Clinician distress in this field has traditionally been framed through the call burden, burnout or the “second victim” phenomenon, but these constructs may not fully capture ethical and identity-based distress. Moral injury offers a complementary framework, yet remains largely unexplored among neurointerventionalists.

Methods

We conducted an anonymous, multinational, cross-sectional survey of practicing neurointerventionalists and trainees. The survey assessed exposure to ethically distressing situations, organizational culture, institutional support, and professional consequences consistent with moral injury constructs. Analyses were descriptive, with exploratory comparisons evaluating associations between moral injury–related experiences and consideration of reducing or transitioning away from neurointerventional practice.

Results

A total of 212 neurointerventionalists completed the survey. Moral injury was considered relevant or highly relevant to INR by 88% of respondents. Frequent emotional exhaustion was reported by 46%. Recurrent exposure to ethically distressing situations, including pressure to treat patients with low expected benefit, was common. Lack of structured institutional support after major complications was reported by 64%, and 58% described an absence of psychological safety within their departments. Overall, 51% reported negative impacts on professional

functioning, and 42% had considered reducing or transitioning away from neurointerventional duties; 18% had already modified their clinical practice. The probability of professional disengagement increased progressively with cumulative moral injury burden. Domain-specific differences were observed across emotional, ethical, and organizational stressors.

Conclusions

Moral injury is prevalent among neurointerventionalists and is closely linked to organizational and systemic factors. It provides a clinically relevant framework to understand professional disengagement and workforce vulnerability in neurointerventional practice, underscoring the need for institution-level accountability, peer-support programs, and structural interventions and cultural change.

Key messages

What is already known on this topic

Burnout and the second victim phenomenon have been documented among neurointerventionalists, with prior work demonstrating high rates of emotional exhaustion, post-traumatic stress symptoms after major complications, and insufficient institutional support. However, these frameworks do not fully capture the ethical and identity-based distress increasingly reported by clinicians practicing in high-stakes procedural environments.

What this study adds

In this multinational survey of 212 neurointerventionalists, 88% considered moral injury relevant to their field, 64% reported no structured institutional support after adverse events, and 58% described an absence of psychological safety. Over half reported negative effects on professional functioning, 42% had considered reducing or leaving neurointerventional practice, and 18% had already modified their clinical activity. Professional disengagement increased progressively with cumulative moral injury burden.

How this study might affect research, practice or policy

These findings reframe clinician distress in neurointervention as a systemic and ethical problem rather than an individual vulnerability, supporting the need for institution-level accountability, structured peer-support programs, transparent ethical deliberation processes, and cultural change to protect both clinician wellbeing and workforce sustainability.

Introduction

Neurointervention is a high-risk procedural specialty characterized by time-critical decision-making, technical complexity, and the potential for devastating neurological outcomes. Neurointerventionalists routinely manage acute ischemic stroke, ruptured and unruptured aneurysms, arteriovenous malformations, and other cerebrovascular emergencies under conditions of uncertainty and limited margins for error. These clinical realities expose practitioners to intense cognitive, emotional, and moral demands (1,2).

Physician distress in such environments has historically been conceptualized through burnout, defined by emotional exhaustion, depersonalization, and reduced personal accomplishment (3). Burnout is common among physicians working in high-acuity procedural specialties and has been associated with increased medical errors, reduced job satisfaction, and impaired quality of care (4,5). However, burnout primarily reflects workload and resource depletion and does not fully capture ethical and identity-based distress increasingly described by clinicians (6).

More recently, the “second victim” phenomenon has been used to describe the acute psychological impact of complications on physicians (7). Rai and colleagues demonstrated high rates of post-traumatic stress symptoms among neurointerventionalists after major complications, highlighting the importance of institutional and peer support (8). While this framework is highly relevant, it focuses on discrete adverse events rather than the cumulative effects of practicing within ethically constraining systems.

Moral injury provides a complementary framework. Originally described in military contexts (9), moral injury refers to the lasting psychological and professional harm resulting from actions, omissions, or systemic constraints that violate deeply held moral values. In healthcare, moral

injury has been linked to repeated exposure to ethically compromising situations, perceived institutional betrayal, and misalignment between professional values and organizational priorities (6,10–12). Importantly, moral injury is conceptually distinct from burnout: it reflects ethical transgression rather than exhaustion (6,13).

Neurointerventional practice may represent a “perfect storm” for moral injury. Practitioners face high-stakes decisions, limited resources, time constraints, room availability constraints, external pressures, and intense scrutiny, often with insufficient institutional support (8). Despite this, moral injury has not been systematically studied in INR. This study aims to characterize the prevalence, drivers, and perceived consequences of moral injury among neurointerventionalists and to position moral injury as a clinically relevant construct beyond burnout and second victim frameworks.

Methods

Study design and reporting standards

We conducted an anonymous, multinational, cross-sectional survey designed to explore moral injury and related ethical distress among neurointerventionalists and trainees. The study was conceived as an exploratory, hypothesis-generating investigation aimed at characterizing the prevalence, drivers, and perceived consequences of moral injury within contemporary neurointerventional practice.

The study design and reporting were informed by the Checklist for Reporting of Survey Studies (CROSS) (14). Given the exploratory nature of the study and the absence of a validated diagnostic instrument for moral injury in healthcare, the emphasis was placed on transparency, descriptive rigor, and conceptual coherence rather than causal inference.

Ethical considerations

Participation was voluntary and anonymous. No personally identifiable information, including names, institutions, IP addresses, or geolocation data, was collected or stored. The survey addressed professional experiences and perceptions without involving patient-level data or interventions. In accordance with institutional policies and prevailing ethical guidelines for minimal-risk research involving healthcare professionals, formal institutional review board approval was not required. Completion of the survey implied informed consent.

Participants and eligibility criteria

Eligible participants were practicing neurointerventionalists and trainees actively involved in endovascular procedures, including but not limited to acute ischemic stroke thrombectomy, intracranial aneurysm treatment, arteriovenous malformation or fistula embolization, and other cerebrovascular interventions.

No restrictions were imposed based on geographic location, primary specialty background (neuroradiology, neurosurgery, or neurology), practice environment, or years of experience. Respondents who were not currently engaged in neurointerventional clinical practice were excluded.

Survey development and conceptual framework

Survey development was guided by established theoretical frameworks of moral injury and potentially morally injurious events (PMIEs) as described in military and healthcare literature. Moral injury was conceptualized as a form of ethical and identity-based distress arising from

repeated exposure to situations in which clinicians feel unable to act in accordance with their professional values due to systemic, organizational, or institutional constraints.

Importantly, moral injury was explicitly distinguished from burnout. While burnout reflects emotional exhaustion and depersonalization associated with workload and resource depletion, moral injury reflects ethical transgression, perceived betrayal, and erosion of professional meaning. This conceptual distinction informed item selection and domain structure.

Item generation and domain structure

Survey items were developed by interventional neuroradiologists with experience in high-risk neurovascular care and familiarity with clinician wellbeing literature. Items were adapted to reflect scenarios specific to neurointerventionalists, including emergency decision-making, high-stakes procedural risk, complications with severe neurological consequences, and institutional responses to adverse events.

The survey was structured into the following domains:

1. Demographic and professional characteristics, including years in practice, practice environment, proportion of time devoted to neurointervention practice, and leadership roles.
2. Quality of life and emotional exhaustion, capturing global wellbeing and frequency of emotional exhaustion over the preceding six months.
3. Exposure to ethically distressing clinical situations, including pressure to treat patients with low expected benefit, procedures driven by external (institutional, organizational, or medicolegal) pressure, and expectations to provide care under medically or ethically inappropriate conditions.

4. Organizational culture and institutional support, including availability of structured support after complications, presence of psychological safety, and access to confidential reporting mechanisms for unethical or abusive behavior.
5. Professional impact and behavioral consequences, including effects on professional functioning, emotional engagement, and intentions to reduce or modify neurointerventional practice.
6. Ethical distress in academic and research practice, addressing perceptions of fairness, mentorship, and integrity in research-related activities.

Most items were rated on a 5-point Likert scale ranging from strong disagreement to strong agreement or from never to almost always, as appropriate to the item content. Optional free-text fields allowed respondents to provide qualitative context.

Pilot testing

Prior to dissemination, the survey was reviewed internally by a small group of neurointerventionalists to ensure clarity, relevance, and face validity. Minor wording adjustments were made to improve interpretability and to avoid ambiguity. Formal psychometric validation was not pursued, as the primary aim was descriptive characterization rather than scale development.

Survey administration

The survey was administered electronically using Google Forms and disseminated internationally over a predefined study period. Distribution occurred through professional neurointerventional networks, specialty mailing lists, and academic communication channels commonly used within the neurointerventional community. The survey consisted of 34 items,

including demographic and professional characteristics, exposure to ethically distressing situations, organizational culture, and professional impact. Based on pilot testing, the estimated time to complete the survey was approximately 10–12 minutes. To maximize participation while preserving anonymity, the survey was accessible via a single open link. No incentives were provided. Respondents were able to complete the survey in a single session, and all core questions were mandatory to minimize missing data.

Outcomes and operational definitions

Because moral injury is not a formally codified diagnosis and no validated healthcare-specific diagnostic instrument exists, outcomes were defined descriptively based on response patterns consistent with established moral injury constructs. The absence of a validated healthcare-specific moral injury instrument does not represent a methodological flaw of this study, but rather reflects the current conceptual gap in the field, which this work aims to help define.

Moral injury–consistent experiences were operationally defined as recurrent ethical conflict, perceived institutional betrayal, and erosion of professional meaning, as reflected by responses to items addressing ethical pressure, organizational support, and professional impact.

Burnout-related constructs such as workload or fatigue were intentionally not used as primary outcomes, to avoid conflation between moral injury and emotional exhaustion.

Statistical analysis

All analyses were primarily descriptive and aimed at characterizing the prevalence and perceived impact of moral injury–consistent experiences among neurointerventionalists. Categorical

variables were summarized using frequencies and percentages, and continuous variables were reported as medians with interquartile ranges due to non-normal distributions.

In addition, a limited set of exploratory inferential analyses was performed for hypothesis-generating purposes only. These analyses were pre-specified conceptually, rather than data-driven, and were restricted to clinically and theoretically coherent exposure–outcome pairs linking moral injury–related experiences (e.g., emotional exhaustion, ethical pressure, organizational culture) to a single downstream professional outcome: consideration of stepping away from or reducing neurointerventional duties.

Two-by-two comparisons were conducted using Fisher's exact test, and results were expressed as odds ratios (ORs) with 95% confidence intervals (CIs). Comparisons across more than two categorical levels were assessed using χ^2 tests, where appropriate. No multivariable modeling was performed, given the exploratory nature of the study, the absence of a validated diagnostic instrument for moral injury in healthcare, and the high conceptual and statistical collinearity among survey domains.

No adjustment for multiple comparisons was applied. Accordingly, p-values are reported as exploratory signals rather than confirmatory evidence and should be interpreted with caution. The purpose of these analyses was not to establish causality, but to support signal detection and to inform the design of future hypothesis-driven studies. These analyses are not intended to quantify effect sizes, but to demonstrate internal coherence between moral injury constructs and downstream professional behaviors.

Analyses were performed using R software (version 4.5.2).

Results

Survey distribution and respondent characteristics

A total of 212 neurointerventionalists completed the survey. All respondents provided complete answers to mandatory items. Participants represented a broad range of seniority levels, practice environments, and geographic regions, reflecting the heterogeneity of contemporary neurointerventional practice. Among respondents, 18% identified as women and 82% as men. Most respondents reported substantial professional experience: 130 (61%) had more than 10 years in practice, 42 (20%) had between 5 and 10 years, and 40 (19%) had 5 years or less. Practice environments included academic centers (117, 55%), hybrid academic–private settings (57, 27%), and predominantly private practice (38, 18%). The majority of respondents (149, 70%) devoted more than 70% of their professional activity to INR, and 78 (37%) reported holding a formal leadership role. Annual procedural volume was high, with most respondents reporting ≥100 INR procedures per year (74.5%).

Respondent characteristics, clinical workload, and leadership roles are summarized in Table 1.

Geographical distribution

Respondents reported practicing primarily in Europe (47.2%), North America (27.4%), Asia (18.9%), and South America (4.7%), with limited representation from other regions (Middle East, Africa, and Oceania combined: <2%).

The most represented countries were the United States (21.2%), United Kingdom (11.8%), France (10.8%), India (7.5%), and Italy (7.1%). This distribution indicates a predominantly European and North American cohort, with substantial representation from Asia.

Awareness and perceived relevance of moral injury

Awareness of moral injury as a professional construct was high. Overall, 187 respondents (88%) considered moral injury to be relevant or extremely relevant to neurointerventional practice. Frequent emotional exhaustion, lack of institutional support, and absence of psychological safety were commonly reported (Figure 1). Only a small minority perceived moral injury as marginally relevant or not relevant to their clinical field, suggesting that the concept strongly resonates with lived professional experience.

Quality of life and emotional exhaustion

Self-rated overall quality of life showed wide interindividual variability, with a median score of approximately 65 on a 0–100 scale (interquartile range approximately 55–75).

Emotional exhaustion after work during the preceding six months was common: 98 (46%) reported emotional exhaustion frequently or almost always, 81 (38%) reported exhaustion occasionally, and 33 (16%) reported exhaustion rarely or never.

These findings indicate that nearly half of respondents experience persistent emotional depletion.

Exposure to ethically distressing clinical situations

Recurrent exposure to ethically challenging situations was frequently reported. Feeling pressured to treat patients with a low likelihood of meaningful benefit was reported as frequent or very frequent by 44 respondents (20.8%), with an additional proportion reporting such pressure occasionally.

Similarly, 66 respondents (31.1%) reported having performed neurointerventional procedures primarily due to external pressure, including institutional, organizational, or medicolegal factors, rather than their own clinical judgment. Expectations to provide care under conditions perceived

as medically or ethically inappropriate were reported by 87 respondents (41%), indicating that ethical incongruence represents a recurrent aspect of INR practice rather than an isolated occurrence. Exposure to ethically distressing clinical situations and potential morally injurious events is detailed in Supplementary Table S1.

Organizational culture and institutional support

Perceived institutional support following adverse events was limited. Only 76 respondents (36%) reported access to structured psychological or institutional support after major complications, whereas 136 (64%) reported no such support.

Beyond post-complication support, broader organizational culture issues were evident. An absence of a culture of psychological safety within the department was reported by 123 respondents (58%), suggesting that many neurointerventionalists do not feel able to openly discuss emotional or ethical difficulties related to their work without fear of negative professional consequences. Access to safe and confidential channels to report unethical or abusive behavior was reported by 62 respondents (29%), while the remainder reported uncertainty or lack of such mechanisms.

Organizational culture, psychological safety, and access to institutional support mechanisms are summarized in Supplementary Table S2.

Professional impact of moral injury–consistent experiences

Moral and ethical distress had a substantial impact on professional functioning. Overall, 109 respondents (51%) reported that moral injury– or burnout-related symptoms had negatively affected their work performance, including concentration, emotional engagement, or professional

satisfaction. Importantly, many respondents explicitly distinguished this distress from workload or fatigue alone, describing experiences more consistent with ethical conflict and erosion of professional meaning. These effects were reported not only by early-career clinicians but also by respondents with more than a decade of practice and by those holding leadership positions, suggesting that moral injury in neurointerventionalists is not a transient or junior phenomenon, but a persistent issue affecting the full professional lifespan.

The professional impact of moral injury–consistent experiences and associated behavioral consequences are reported in Supplementary Table S3.

Behavioral consequences and career intentions

Ethical and emotional distress translated into tangible behavioral consequences. Overall, 89 respondents (42%) reported having considered stepping away from or reducing their INR duties because of emotional fatigue or ethical distress. Among these, 38 respondents (18% of the total cohort) reported having already taken concrete steps to modify their clinical practice.

Reported behavioral adaptations included intention to reduce exposure to the highest-risk procedures (83 respondents, 39%), reduction in on-call or emergency activity, and reassessment of long-term career sustainability within neurointerventional practice.

In addition, 93 respondents (44%) reported that professional responsibilities had a significant negative impact on their personal or family life.

Notably, these intentions and actions were reported despite high procedural volumes and strong professional engagement, reinforcing the interpretation that disengagement reflects ethical and organizational strain rather than lack of commitment or technical involvement.

Ethical distress in academic and research practice

Ethical distress extended beyond direct patient care. Seventy respondents (33%) reported experiencing moral distress related to unethical research practices, including authorship disputes, data handling concerns, or institutional reporting. Only 87 respondents (41%) felt that their academic or research contributions were recognized fairly within their institution or department, and fewer than half reported feeling adequately mentored or supported in their academic career trajectory (Supplementary Table S4).

Exploratory inferential analyses

In exploratory two-by-two analyses, frequent emotional exhaustion (OR, 3.72; 95% CI, 1.96–7.06), frequent ethical pressure to treat low-benefit patients (OR, 2.44; 95% CI, 1.19–4.99), and research-related moral distress (OR, 3.37; 95% CI, 1.81–6.27) were associated with consideration of stepping away from neurointerventional duties (Figure 2). Similarly, frequent pressure to treat patients with a low likelihood of meaningful benefit was associated with professional disengagement (odds ratio approximately 2.0–2.5, $p<0.05$). Moral distress related to unethical research practices was also associated with consideration of reducing clinical activity (odds ratio approximately 1.8–2.2, $p<0.05$).

Lack of a psychological safety culture showed a consistent direction of association with professional disengagement, although this did not reach conventional statistical significance in exploratory testing. All inferential analyses were exploratory, unadjusted for multiple comparisons, and intended for hypothesis generation rather than confirmatory inference.

When moral injury domains were aggregated into a cumulative burden score, the probability of considering or acting upon stepping away increased in a stepwise fashion across burden levels

(Figure 3). The observed stepwise pattern suggests a cumulative, dose–response–like relationship between moral injury burden and professional disengagement. Domain-specific differences in disengagement probability were observed across emotional, ethical, and organizational domains (Supplementary Figure S1).

Discussion

In this multinational survey of neurointerventionalists, we found that moral injury–consistent experiences are common, pervasive, and deeply embedded within the organizational and systemic context of contemporary neurointerventional practice. Beyond emotional exhaustion and the acute psychological sequelae of complications, respondents described recurrent ethical conflicts, perceived institutional betrayal, and progressive erosion of professional meaning—hallmark features of moral injury. Importantly, these experiences were associated with impaired professional functioning, intentions to modify clinical activity, and concerns regarding long-term career sustainability, underscoring their relevance not only to individual wellbeing but also to workforce resilience.

Recent work by Rai and colleagues highlighted the profound psychological toll of major complications on neurointerventionalists, demonstrating high rates of post-traumatic stress symptoms and a strong association with insufficient institutional support (8). Our findings complement and extend this literature by suggesting that clinician distress in neurointerventional practice cannot be fully explained by isolated adverse events. Rather, many respondents reported chronic exposure to ethically compromising situations that accumulate over time, creating a background of persistent moral tension that may predispose clinicians to more severe psychological harm when complications occur. In this framework, adverse events may function less as isolated triggers and more as amplifiers of pre-existing ethical strain.

Although moral injury, burnout, and the second victim phenomenon share overlapping downstream consequences—including emotional exhaustion, reduced professional satisfaction, and consideration of career change—they differ fundamentally in their triggers, mechanisms, and

implications for intervention. Burnout arises primarily from chronic workload imbalance and resource depletion, and its core dimensions (emotional exhaustion, depersonalization, reduced accomplishment) are well captured by validated instruments such as the Maslach Burnout Inventory (3). The second victim phenomenon describes the acute psychological impact of a specific adverse event on the clinician directly involved, with distress typically time-limited and event-linked (7,8). Moral injury, by contrast, reflects cumulative ethical transgression and perceived value incongruence between the clinician and the healthcare system, producing identity-level distress that may persist independently of workload or discrete complications (6,10,13). In practice, these constructs frequently coexist: a neurointerventionalist experiencing burnout from chronic on-call demands may simultaneously carry moral injury from repeated institutional failures to support ethical decision-making. Recognizing where these frameworks converge and diverge is essential for designing targeted interventions—workload redistribution may alleviate burnout but will not resolve distress rooted in ethical conflict, just as debriefing after a complication may address second victim distress without modifying the systemic conditions that produce moral injury.

Burnout remains prevalent in neurointerventional practice, consistent with reports from other high-acuity procedural specialties (3–5). However, many respondents explicitly distinguished their distress from fatigue or workload alone. Unlike burnout, moral injury is rooted in ethical transgression, value incongruence, and perceived betrayal (6,13)—a distinction particularly salient in neurointerventional practice, a field characterized by high technical engagement, strong professional identity, and deep personal investment in patient outcomes. Clinicians may continue to perform at a high technical level while simultaneously experiencing profound erosion of professional meaning—a pattern poorly captured by burnout constructs alone.

Framing clinician distress exclusively through the lens of burnout risks individualizing what are fundamentally systemic ethical failures. Our findings suggest that moral injury provides a more precise explanatory framework for distress driven by repeated exposure to ethically misaligned conditions, including pressure to treat patients with limited expected benefit, externally driven procedural decisions, and lack of institutional containment following adverse events. These pressures reflect structural features of healthcare delivery rather than individual vulnerability.

A central and concerning finding of this study is the high prevalence of perceived organizational failure. The high rates of inadequate institutional support and absent psychological safety reported in our cohort mirror observations in other high-risk procedural specialties but are particularly troubling in neurointerventional practice, where adverse outcomes may be catastrophic and emotionally destabilizing for clinicians. The absence of visible, non-punitive support structures may compound distress and contribute to feelings of abandonment at precisely the moments when clinicians are most vulnerable.

Perceived institutional betrayal—i.e., when clinicians believe that organizations prioritize reputation, productivity, or legal risk over professional integrity and clinician wellbeing—is a core component of moral injury (6,10,11). Without transparent mechanisms for ethical deliberation, open discussion of complications, and meaningful support, clinicians may internalize blame, disengage emotionally, or withdraw from high-risk aspects of practice. Over time, such dynamics threaten not only physician wellbeing but also patient safety and institutional trust (10–12).

Crucially, moral injury in this cohort was associated with tangible behavioral consequences. A substantial proportion of respondents reported considering or already enacting withdrawal from

neurointerventional duties, with commonly reported adaptations including avoidance of the highest-risk procedures, reduction in emergency exposure, and reassessment of long-term career viability. In a highly specialized field with limited workforce redundancy, such patterns raise significant concerns regarding access to care, procedural coverage, and the sustainability of training programs. While these adaptations may represent protective strategies for individual clinicians, they may carry unintended downstream consequences for healthcare systems and patients.

Ethical distress was not confined to direct patient care but extended into academic and research practice (11,12,15). The prevalence of research-related moral distress and perceived inequity in academic recognition suggest that moral injury among neurointerventionalists may arise across multiple professional roles, reinforcing its systemic and multidimensional nature. Addressing moral injury therefore requires interventions that extend beyond the catheterization laboratory to encompass research culture, leadership practices, and career development pathways.

Collectively, these findings challenge approaches that focus primarily on individual resilience, mindfulness, or coping strategies. While such interventions may offer symptomatic relief, they are unlikely to resolve distress rooted in systemic ethical conflict. When moral injury arises from organizational structures and institutional priorities, responsibility for remediation must also reside at the system level. Potential strategies include structured, non-punitive support mechanisms following complications; peer-level support; transparent processes for ethical deliberation and decision-making; leadership accountability for fostering psychological safety; and alignment of productivity metrics with patient-centered and professional values.

Recognizing moral injury as an occupational hazard of neurointerventional practice represents a critical step toward meaningful reform. By shifting the focus from individual vulnerability to

systemic responsibility, healthcare organizations may better protect clinician wellbeing, preserve professional meaning, and ensure the long-term sustainability of this high-risk, high-impact specialty.

Beyond burnout and the "second victim" framework, our findings suggest that moral injury in neurointerventional practice represents a collective phenomenon embedded within organizational structures and team-based care. Importantly, members of the angiography suite team—trainees, nurses, technologists, and anesthesiologists—who witness adverse events without the agency to intervene may experience a distinct form of moral distress rooted in powerlessness rather than direct responsibility (16). The experiences of these "third victims" are rarely acknowledged or formally addressed, representing a systemic gap that may silently amplify moral injury across the neurointerventional workforce.

Although not designed to identify protective factors, our study suggests that clinical autonomy, supportive team dynamics, and accessible peer support may buffer against moral injury. These elements may actively preserve professional meaning when ethical pressures arise. Professional motivation likely plays a dual role: while purpose-driven commitment may initially buffer distress, it may increase vulnerability when institutional constraints conflict with core values. Moral injury may thus reflect not lack of resilience, but erosion of professional ideals.

Several strategies were employed to maximize survey participation. The survey was disseminated through multiple complementary channels, including international professional societies, specialty mailing lists, academic department networks, and social media platforms commonly used within the neurointerventional community. Survey design prioritized brevity (34 items, approximately 10–12 minutes) and full anonymity to reduce barriers to participation. As

the survey was distributed through open professional networks rather than a defined institutional roster, a formal response rate could not be calculated—a limitation shared with other large-scale surveys of neurointerventionalists (1,8). Nevertheless, the cohort of 212 respondents compares favorably with prior survey-based studies in this field and encompasses a diverse range of geographic regions, seniority levels, and practice settings.

Survivorship bias warrants consideration. This survey excludes clinicians who have left the field, potentially underestimating moral injury's true prevalence and severity. Understanding why some clinicians adapt, remain, or exit represents an important research direction. Addressing moral injury requires system-level interventions encompassing team-based support, protection of clinical autonomy, and preservation of professional meaning across the neurointerventional workforce.

Limitations

This study has limitations. Its cross-sectional design precludes causal inference, and self-reported data may be subject to recall or response bias. Physicians experiencing greater distress may have been more likely to participate. Additionally, the absence of a validated diagnostic instrument for moral injury necessitated a descriptive approach. Nonetheless, the consistency of findings across seniority levels, practice settings, and domains supports their robustness and relevance.

Conclusions

Moral injury is a prevalent and clinically meaningful form of distress among neurointerventionalists, driven largely by systemic ethical conflicts and organizational failures. Extending beyond burnout and the second victim framework, moral injury offers a valuable lens to understand professional disengagement and workforce vulnerability in neurointerventional

practice. Addressing moral injury will require institutional accountability, cultural change, and system-level interventions to safeguard clinician wellbeing, patient safety, and the sustainability of the specialty.

References

1. Fargen KM, Arthur AS, Leslie-Mazwi T, et al. A survey of burnout and professional satisfaction among United States neurointerventionalists. J Neurointerv Surg. 2019;11(11):1100-1104.

2. Abdalla RN, Ansari SA, Hurley MC, et al. Correlation of Call Burden and Sleep Deprivation with Physician Burnout, Driving Crashes, and Medical Errors among US Neurointerventionalists. AJNR Am J Neuroradiol. 2022;43(9):1286-1291.

3. Maslach C, Schaufeli WB, Leiter MP. Job burnout. Annu Rev Psychol. 2001;52:397-422.

4. Shanafelt TD, Boone S, Tan L, et al. Burnout and satisfaction with work-life balance among US physicians relative to the general US population. Arch Intern Med. 2012;172(18):1377-85.

5. West CP, Dyrbye LN, Erwin PJ, Shanafelt TD. Interventions to prevent and reduce physician burnout: a systematic review and meta-analysis. Lancet. 2016;388(10057):2272-2281.

6. Dean W, Talbot S, Dean A. Reframing Clinician Distress: Moral Injury Not Burnout. Fed Pract. 2019;36(9):400-402.

7. Wu AW. Medical error: the second victim. The doctor who makes the mistake needs help too. BMJ. 2000;320(7237):726-7.

8. Rai AT, Orru E, Fargen KM, et al. Unseen wounds: a multinational investigation of neurointerventionalists on the psychological toll of complications. J Neurointerv Surg. 2025:jnis-2025-024288.

9. Litz BT, Stein N, Delaney E, et al. Moral injury and moral repair in war veterans: a preliminary model and intervention strategy. Clin Psychol Rev. 2009;29(8):695-706.

10. Dean W, Morris D, Manzur MK, Talbot S. Moral Injury in Health Care: A Unified Definition and its Relationship to Burnout. Fed Pract. 2024;41(4):104-107.

11. Linzer M, Poplau S. Eliminating burnout and moral injury: Bolder steps required. EClinicalMedicine. 2021;39:101090.

12. Norman SB, Feingold JH, Kaye-Kauderer H, et al. Moral distress in frontline healthcare workers in the initial epicenter of the COVID-19 pandemic in the United States. Depress Anxiety. 2021;38(10):1007-1017.

13. Guille C, Sen S. Burnout, Depression, and Diminished Well-Being among Physicians. N Engl J Med. 2024;391(16):1519-1527.

14. Sharma A, Minh Duc NT, Luu Lam Thang T, et al. A Consensus-Based Checklist for Reporting of Survey Studies (CROSS). J Gen Intern Med. 2021;36(10):3179-3187.

15. Berger JT. Moral distress in medical education and training. J Gen Intern Med. 2014;29(2):395-8.

16. Russ MJ. Correlates of the Third Victim Phenomenon. Psychiatr Q. 2017;88(4):917-920.

Table 1. Respondent characteristics, clinical workload, and leadership (N = 212)

Characteristic	n (%)
Geographical region	
Europe	100 (47.2)
North America	58 (27.4)
Asia	40 (18.9)
South America	10 (4.7)
Other regions	4 (1.8)
Male sex	174 (82.1)
Years in practice	
≤5 years	40 (18.9)
5–10 years	42 (19.8)
>10 years	130 (61.3)
Practice environment	
Academic	117 (55.2)
Hybrid academic–private	57 (26.9)
Predominantly private	38 (17.9)
Clinical workload	
≥70% of professional activity devoted to INR	149 (70.3)
≥100 INR procedures per year	158 (74.5)
Formal leadership position	78 (36.8)

Figure Legends

Figure 1.

Prevalence of Moral Injury–Consistent Experiences. Bars represent the percentage of respondents endorsing selected high-burden experiences, including perceived relevance of moral injury, frequent emotional exhaustion, lack of institutional support, absence of psychological safety culture, and consideration or action toward reducing/stepping away from INR duties.

Figure 2.

Exploratory Associations With Professional Disengagement. Odds ratios (ORs) with 95% confidence intervals (CIs) represent exploratory, hypothesis-generating analyses.

Figure 3.

Moral Injury Burden and Professional Disengagement. The burden score reflects the number of prespecified high-risk domains present (range, 0–5). The y-axis indicates the unadjusted probability of considering or acting upon stepping away from neurointerventional practice.

Disclosures:

The authors are all in active neurointerventional practice. The authors have no additional pertinent disclosures to make with reference to this work..