





REVIEW

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# Beyond the operating room: addressing the “second-victim” phenomenon in surgical practice

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## Abstract

Complications are plausible events during surgical operations. Surgical complications profoundly impact surgeons, often called “second victims” of adverse events. These complications trigger a range of emotional and psychological responses, including guilt, anxiety, heightened empathy, and the looming threat of burnout. Moreover, the toll extends to physical health, with chronic stress and sleep disturbances taking their toll. Surgeons’ social lives are not immune to the fallout, and their career satisfaction may wane, pushing some towards defensive medicine practices. While mentorship, counselling, and peer support are crucial support mechanisms, they encounter barriers such as time constraints and the fear of negative perceptions. This paper suggests practical recommendations, including comprehensive wellness programmes, a streamlined badge card system for easy access to resources, and mindfulness training to mitigate stress and burnout. Recognising and proactively addressing these multifaceted impacts is imperative for cultivating a resilient medical community capable of providing optimal patient care.

**Keywords** Second victim, Surgical complications, Surgeon’s well-being

## Introduction

In the context of academic pursuits, particularly within the realm of medicine, errors are met with minimal tolerance due to their potential ramifications [1]. Within this sphere, surgery emerges as a discipline where errors carry profound consequences. Surgery demands a delicate balance of skill, knowledge, and dexterity due to the intricate complexities of human anatomy and physiology.

Mistakes during surgery, whether in judgement, oversight, or technical aspects, can result in severe patient harm, increased healthcare costs, and, in extreme cases, even death [2]. Especially noteworthy is the observation that in cases where errors have arisen during medical care, patients experience a substantial 18% increase in adverse events compared to those without such errors. These adverse events encompass a broad spectrum of systemic effects, spanning cardiorespiratory,

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gastrointestinal, neurological, and musculoskeletal complications, among others [2].

Surgical complications refer to unfavourable issues that arise after surgery, ranging from minor problems like infections to more serious events like organ damage or patient death [3]. The occurrence and nature of these complications depend on factors such as the specific surgical procedure, the surgeon's experience, the surgical environment, the patient's health conditions, and the quality of healthcare facilities [4, 5]. It is crucial to recognise that these complications are an inherent part of surgical practice and cannot be entirely avoided.

Globally, surgical complications manifest approximately 16.8% of the time, with mortality rates standing at 0.5% [6]. These complication rates exhibit significant international variation, with figures of 12.5% recorded in the US [7], 18.5% in Nigeria [8], and 28% in India [9]. Such disparities underscore the diverse and widespread prevalence of surgical complications across different healthcare systems.

Surgeons facing adverse events often undergo a difficult journey, starting with immediate crisis management and evolving into personal and professional challenges. This journey includes phases of self-doubt, replaying the incident, coping with judgement from peers and authorities, and seeking emotional support, ultimately leading to varied long-term outcomes of either withdrawal, resilience, or personal growth [10]. The repercussions of surgical complications are profound, affecting both patients and surgeons. For patients, this may mean extended recovery times, chronic pain, or enduring disabilities [11]. Surgeons, on the other hand, often confront professional self-doubt, burnout, increased anxiety, sleep disturbances, depression, and a decline in job satisfaction over time [12, 13].

The ramifications for surgeons confronting adverse events are complex and can be influenced by a multitude of factors extending beyond the initial emotional and occupational hurdles they encounter [14]. These factors encompass the preventability of the complications, the individual surgeon's personality and level of experience, the outcomes of patients affected, responses from both patients and colleagues, and the institutional culture within which the surgeon operates [15].

Recognising the substantial and complex impact of surgical complications, it is imperative for the medical community and governing authorities to embrace a comprehensive and multifaceted approach [16]. Recommendations aimed at aiding surgeons in managing the personal aftermath of complications include enhancing mentoring programs, adopting collaborative teamwork strategies, providing environments conducive to open dialogue devoid of blame, and establishing frameworks

specifically designed to address the human dimension of such complications [15]. Combining rigorous technical training with robust psychological support is essential. Such an initiative aims to cultivate a medical community that is not only technically adept but also resilient and better prepared to navigate the intricacies and inevitable challenges of surgical care. This paper proposes practical measures, including comprehensive wellness programmes, a streamlined badge card system for easy access to resources, and mindfulness training to mitigate stress and burnout.

### Methodology

The review methodology involved a comprehensive search of published studies reporting the emotional and physical impacts of surgical complications on surgeons. The study inclusion criteria encompassed various study designs, including descriptive, case-control, cohort, observational, and randomised controlled trials. Eligible studies were required to report on the emotional distress, psychological effects, physical health consequences, and social implications experienced by surgeons following surgical complications. Only full-text articles in English, published from the twenty-first century reflecting contemporary surgical practices, were considered.

Databases such as PubMed, EMBASE, Google Scholar, the Cochrane Library, and Scopus were searched using various iterations of a search string which was custom fashioned to include a broad set of studies. The search string is as follows:

("surgical complications" OR "surgical errors" OR "adverse events" OR "postoperative outcomes" OR "surgeons' well-being" OR "second victim syndrome" OR "psychological impact" OR "surgeon stress" OR "surgical performance" OR ("peer support programs" AND "surgeon") OR ("post-traumatic stress" AND "surgeons")) AND ("complications" OR "errors" OR "outcomes" OR "well-being" OR "emotional impact" OR "psychosocial effects" OR "mental health" OR "resilience") AND ("surgery" OR "surgeons" OR "surgical")

Moreover, a manual search of reference lists from relevant articles and recent reviews was conducted to identify additional studies meeting the inclusion criteria. Abstracts and unpublished studies were excluded from the review to ensure the inclusion of high-quality, peer-reviewed literature.

The review did not impose a strict sample size requirement to capture a diverse range of experiences and perspectives from surgeons practising in different settings. Studies providing qualitative insights, as well as those presenting quantitative data, were included to offer a comprehensive understanding of the emotional and physical impacts of surgical complications on surgeons.

In addition, studies reporting on interventions or support mechanisms aimed at mitigating the negative effects of surgical complications on surgeon well-being were also considered for inclusion.

With those criteria decided upon collectively, a team of 3 reviewers (N.A, J.P, H.R.B) working independently screened the articles on the title, abstract, and full-text level. Any inconsistencies or disputes were resolved on discussion with a fourth reviewer (W.A.A.). Upon conclusion of this process, 67,400 records were excluded on the title and abstract level with no full-text retrieval. 795 full-texts were retrieved, of which 30 studies were of high quality and thus passed our threshold to inclusion.

This review aims to provide a nuanced understanding of the challenges faced by surgeons following surgical complications, with a focus on the emotional, psychological, physical, and social dimensions of their experiences. A summary of the refined methodology is presented in Table 1, outlining the systematic approach employed to identify and synthesise relevant literature on this important topic.

### Impacts of surgical complications on operating surgeons

#### Emotional and psychological effects

The realisation of surgical complications often elicits profound psychological distress among surgeons [13], manifesting in feelings of guilt, anxiety, and self-doubt [17]. While these feelings commonly manifest, surgeons may also experience a range of other emotions, such as frustration, anger, or grief, depending on the specific circumstances and their individual coping mechanisms. These coping mechanisms include discussing complications, deconstructing the incidents,

and rationalising [15]. A significant portion of surgeons (87.8%) cope with the emotional ramifications of their work by engaging in discussions with a surgical colleague. However, research indicates a concerning trend, with 6.5% of surgeons resorting to alcohol and other substances to manage the emotional burden. Moreover, a majority (58.5%) express difficulty in navigating the emotional fallout of surgical complications throughout their careers, with little improvement observed with increasing experience [17].

This emotional response triggers a period of reflection, where surgeons question their professional abilities and experience an erosion in self-confidence [13]. During this period, surgeons could also engage in introspection regarding systemic factors, communication breakdowns, or ethical dilemmas inherent in complex medical decision-making. In addition, witnessing patients suffer due to complications can evoke strong feelings of empathy and sadness, particularly in surgeons who have formed deep connections with their patients over time [18]. Furthermore, surgical complications can affect not only the surgeon’s individual well-being but also interpersonal relationships within healthcare teams. Conflicts, blame, or breakdowns in communication among team members may exacerbate the emotional burden faced by surgeons.

These adversities can disrupt a surgeon’s ability to maintain focus in challenging situations, potentially impeding critical decision-making processes. The cognitive burden of navigating these emotional challenges may lead to long-term self-doubt, depersonalisation, and a diminished sense of professional accomplishment and fulfilment [19]. This multifaceted impact underscores the complexity behind the technical and emotional dimensions of surgical practice.

**Table 1** Summary of the methodology

Methodology steps	Description
Literature search	PubMed, EMBASE, Google Scholar, the Cochrane Library, and Scopus
Inclusion criteria	Full-text articles published in English in the 21st century Various study designs include descriptive, case-control, cohort, observational, and randomised controlled trials Studies involving comorbidity and previous pharmacological or surgical treatments Studies providing raw data
Exclusion criteria	Studies that do not report outcomes Case reports are excluded Stand-alone abstracts and unpublished studies Studies with estimated or modelled numerator or denominator values
Search terms	("surgical complications" OR "surgical errors" OR "adverse events" OR "postoperative outcomes" OR "surgeons' well-being" OR "second victim syndrome" OR "psychological impact" OR "surgeon stress" OR "surgical performance" OR ("peer support programs" AND "surgeon") OR ("post-traumatic stress" AND "surgeons")) AND ("complications" OR "errors" OR "outcomes" OR "well-being" OR "emotional impact" OR "psychosocial effects" OR "mental health" OR "resilience") AND ("surgery" OR "surgeons" OR "surgical")
Additional search	A manual search was conducted to include references from recently published procedure-specific reviews
Sample size requirement	No strict sample size requirement

### Physical health effects

The negative repercussions of surgical complications on surgeons extend well beyond their emotional impact, encroaching upon their physical health. The chronic stress associated with managing these complications has been linked to significant health issues, including cardiovascular concerns like hypertension [15, 20]. Sustained exposure to stress hormones can further deteriorate overall physical well-being. In addition, surgeons frequently encounter sleep disturbances stemming from the emotional and psychological toll of surgical complications [21]. Insomnia and disrupted sleep patterns, prevalent in these circumstances, exacerbate physical health issues and may fuel a vicious cycle of impaired well-being. Moreover, the relentless stress and emotional burden significantly contribute to surgeon burnout [18], posing a grave threat to their overall physical and mental well-being [22].

It is essential to consider that individual surgeons may exhibit varied responses to the physical consequences of stress and sleep disruptions. Factors such as genetic predisposition, lifestyle choices, and pre-existing health conditions play significant roles in determining susceptibility to health issues and resilience in the face of stress [23]. Notably, with 6.5% of surgeons resorting to alcohol and other substances to cope with emotional burdens, this behaviour can exacerbate physical health problems and perpetuate a cycle of stress and diminished well-being [17]. Moreover, recurrent exposure to stressors and inadequate sleep can precipitate chronic conditions such as metabolic syndrome, immune dysfunction, and heightened susceptibility to infections [24–26].

### Effects on social lives

Surgical complications have the potential to blur the boundaries between a surgeon's personal and professional identities, affecting not only their confidence in their professional abilities but also their sense of self-worth and identity within their social circles [27]. Surgeons facing these challenges often encounter difficulties in effectively communicating and sharing the significant emotional burdens they carry. The distress stemming from managing complications can lead to heightened irritability, mood swings, and emotional detachment, further complicating their interpersonal relationships [28]. Surgeons have described internal processes such as feelings of personal responsibility, self-doubt, and perceived failure, which contribute to their emotional turmoil [29]. While some surgeons may seek solace in their social networks, many experience a withdrawal from social activities and engagements due to these emotional challenges, resulting in a diminished capacity to nurture meaningful social connections [30]. This withdrawal and detachment

from social life, directly attributable to the pressures and emotional strain of surgical complications, negatively impact the overall well-being of surgeons, eroding their support networks and exacerbating feelings of isolation and loneliness.

In addition, cultural and institutional factors play a significant role in shaping how surgeons interact socially. Institutional support systems and cultural norms surrounding discussions of emotional challenges can heavily influence surgeons' willingness to seek support from their social networks. Institutional frameworks, such as time pressure, fatigue, and cultural expectations to embody the ideal image of a surgeon, greatly impact surgeons' responses to surgical complications [20]. Furthermore, external pressures such as potential damage to reputation and medicolegal concerns are significant factors influencing surgeons' social responses to complications [29].

### Long-term impacts on surgeons' clinical practice

Various factors, including personality traits, coping mechanisms, and resilience levels, can shape how surgeons experience career satisfaction amidst challenges [29]. Nevertheless, a consistent encounter with surgical complications can diminish a surgeon's overall satisfaction with their career [27]. Confronted with these challenges on a regular basis, surgeons may begin to question their career choices, leading to a decline in job satisfaction and a sense of fulfilment [31]. This dissatisfaction can have adverse effects on the quality of care provided. Surgeons grappling with emotional exhaustion and burnout, stemming from frequent complications, encounter significant hurdles in maintaining the high standards of care essential in surgical practice [32].

To mitigate the risks associated with complications and malpractice claims, some surgeons resort to defensive medicine, with this approach often involving ordering unnecessary tests or procedures as a legal safeguard [20]. While these practices may offer legal protection, they inadvertently contribute to increased healthcare costs and operational inefficiencies. This not only exacerbates the overall stress and complexity faced by surgeons in their clinical practice but also impacts the efficiency and cost-effectiveness of the healthcare system at large [20]. Moreover, the emotional toll of managing complications can influence surgeons' decision-making processes in clinical practice. Surgeons may become more risk-averse or adopt overly cautious approaches to avoid potential complications, potentially impacting the timeliness and appropriateness of interventions [33, 34].

However, there is potential for surgeons to use their experiences with complications as opportunities for professional growth and skill development. Despite facing

adversity, some surgeons may develop enhanced problem-solving abilities, refined clinical judgement, and a deeper understanding of patients’ care, positively impacting their clinical practice [35]. Institutional support is crucial in preserving job satisfaction and maintaining high standards of care [15]. The impacts of surgical complications on operating surgeons have been summarised in Table 2.

**Discussion and future prospects**

**Immediate access to specialised psychological counselling services for surgeons**

It is crucial to ensure immediate access to specialised psychological counselling services tailored to enhance the psychological well-being of surgeons [36]. Hospitals or surgical institutions could create dedicated support programmes specifically tailored to the needs of surgeons facing emotional challenges related to surgical complications. These services should be proficient and adequately equipped to assist surgeons in navigating

the multifaceted emotional challenges they inevitably encounter during practice [37]. The implementation of a well-being support service has been shown to decrease burnout levels, improve enjoyment and work satisfaction, and reduce work-related stress [38].

Fostering an open and non-judgmental environment where surgeons can express themselves without hesitation is fundamental [36]. Encouraging an open exchange of experiences, challenges, and lessons learned nurtures a sense of camaraderie among surgical teams [37], providing an outlet for emotional expression and cultivating a perpetual learning and improvement culture. This positively impacts patient safety, as insights from complications become invaluable in refining surgical techniques and protocols [39].

**Integration of telemedicine and telepsychiatry in surgical practice**

The integration of telemedicine and telepsychiatry into surgical practice represents a significant advancement in

**Table 2** The impacts of surgical complications on operating surgeons

Impact	Description
Emotional and psychological effects [13, 15, 17–19]	<ul style="list-style-type: none"> <li>- Intense guilt, anxiety, self-doubt, frustration, anger and grief</li> <li>- Reflection on professional abilities, and erosion of self-confidence</li> <li>- Discussing, deconstructing, rationalising incidents</li> <li>- Concerning trend: 6.5% resort to alcohol/substances for emotional management</li> <li>- Witnessing patient suffering evokes empathy and sadness, especially in surgeons with deep patient connections</li> <li>- Surgical complications affect interpersonal relationships within healthcare teams</li> <li>- Conflicts, blame, communication breakdowns exacerbate emotional burden</li> <li>- Depersonalisation and diminished sense of accomplishment</li> </ul>
Physical health effects [15, 17, 18, 20–26]	<ul style="list-style-type: none"> <li>- Chronic stress leading to health issues such as hypertension, sleep disturbances, insomnia, and disrupted sleep patterns</li> <li>- Sustained stress hormone exposure deteriorates overall physical well-being</li> <li>- Prolonged stress exposure could precipitate metabolic syndrome, immune dysfunction, heightened susceptibility to infections</li> <li>- Insomnia and disrupted sleep patterns exacerbate physical health issues</li> <li>- Factors such as genetic predisposition, lifestyle choices, and pre-existing conditions contribute to variation in individual responses to physical effects</li> <li>- Alcohol/substance use as coping mechanism exacerbates physical health problems, perpetuates stress cycle</li> </ul>
Effects on social lives [20, 27–30]	<ul style="list-style-type: none"> <li>- Strained relationships with family and friends</li> <li>- Difficulty in communicating emotional burdens</li> <li>- Increased irritability and emotional detachment</li> <li>- Diminished capacity to nurture meaningful social connections</li> <li>- Institutional support systems and cultural norms affect willingness to seek social support</li> <li>- Time pressure, fatigue, cultural expectations shape responses to complications</li> <li>- External pressures like potential damage to reputation, medicolegal concerns impact social responses.</li> </ul>
Long-term impacts on clinical practice [20, 27, 31–35]	<ul style="list-style-type: none"> <li>- Gradual diminishment of career satisfaction</li> <li>- Reduced job satisfaction and questioning of career choices</li> <li>- Diminished sense of professional fulfilment and enthusiasm</li> <li>- Compromised quality of care due to emotional exhaustion and burnout</li> <li>- Adoption of defensive medicine practices, leading to unnecessary tests and procedures, increased healthcare costs, and operational inefficiencies</li> <li>- Surgeons becoming more risk-averse, adopting overly cautious approaches</li> <li>- Some surgeons develop enhanced problem-solving abilities, refined clinical judgement, deeper understanding of patient care</li> </ul>

addressing the critical issue of the “second-victim” phenomenon among surgeons. A study on a computer-based intervention aimed at promoting well-being among surgeons revealed a disparity between subjective perceptions and objective assessments of well-being [40]. Many surgeons perceived their well-being as above average, while objective evaluations suggested otherwise. However, personalised feedback resulting from the intervention increased their willingness to implement changes to improve their well-being [40]. Therefore, promoting such well-being interventions within healthcare institutions is crucial to encouraging surgeons to prioritise their mental health, especially considering their demanding schedules [41].

Customised telepsychiatry programmes, tailored to address the unique challenges faced by surgeons, play a significant role in reducing the stigma associated with seeking mental healthcare [42]. For instance, a 3-week online self-training intervention focussing on mindfulness as a cognitive-emotional segmentation strategy demonstrated positive effects on psychological detachment, psychological work–family conflict, and work–life balance satisfaction [43]. In addition, segmentation preferences moderated the intervention’s effect on psychological detachment, with participants exhibiting low segmentation preferences experiencing stronger effects [43]. Moreover, all participants experienced an improvement in their emotional well-being. Furthermore, integrating virtual consultations into surgical discussions can provide immediate mental health support to surgical teams following adverse events or complications [44]. These innovative approaches offer practical and accessible means for surgeons to seek mental health support, effectively aligning with their demanding professional schedules.

#### **Holistic approach in surgical education and training**

In the field of surgical education and training, there is a recognised need for a skill set that goes beyond mere technical proficiency, adequately preparing surgeons to navigate the multifaceted challenges inherent in their practice [45, 46]. This comprehensive training should encompass not only surgical skills but also resilience and adaptive coping mechanisms [45, 47]. An integral aspect of this approach involves the implementation of support toolkits tailored to offer immediate and structured assistance following adverse clinical outcomes, addressing the emotional, ethical, and legal dimensions of surgical practice [30]. For instance, a well-being and resilience programme that addressed mental, physical, and social aspects of well-being through monthly sessions held during protected educational time demonstrated significant benefits for residents [47]. Reports indicated

improvements in culture, community, communication, emotional intelligence, and work–life integration skills among participants. This success was facilitated by committed leadership, a supportive department culture, protected time for sessions, and interactive learning, with ongoing feedback to customise the programme to residents’ specific needs [47].

Using constructivist grounded theory, an analysis of mental three-dimensional (3D) visualisation focussed on resilience as positive adaptation, considering both protective and vulnerability factors [46]. Findings highlighted the critical role of mental 3D visualisation in pre-operative planning, managing intraoperative challenges, and regulating emotions during high-risk surgery, thus promoting long-term surgical resilience [46]. Through the integration of such toolkits and surgical curricula, future surgeons can be equipped not only with technical proficiency but also with resilience, fostering intraoperative environments conducive to risk adaptation [41, 45, 46]. Furthermore, by normalising discussions around mental health and providing tools for self-care, training programmes can empower surgeons to prioritise their well-being.

#### **Collaborative research, encouragement of peer support, and mentoring amongst surgeons**

Facilitating peer support networks among surgeons can foster a sense of community and solidarity within the profession. Surgeons who have encountered similar challenges, such as surgical complications, can offer valuable support and empathy to their peers. The successful implementation of collaborative initiatives and support networks, exemplified by programmes such as Nationwide Children’s Hospital’s “YOU Matter” and the University of Missouri Health Care’s “for YOU” initiative, underscores the significant impact of collaborative research and peer support in addressing the ‘second victim’ phenomenon among healthcare professionals [48]. These programmes, providing structured peer support and mentoring, can greatly assist staff in coping with the psychological distress arising from medical errors and adverse patient outcomes, particularly in high-risk work environments [48]. The incorporation of electronic peer support reporting and documentation of numerous supportive encounters further highlights the effectiveness of such programmes in improving emotional well-being and work-related metrics.

Furthermore, peer mentoring and collaborative initiatives play a crucial role in exchanging experiences and strategies. For instance, the American Paediatric Surgical Association’s (APSA) peer support programme has demonstrated the feasibility of establishing and sustaining a national initiative by a professional society to offer

**Table 3** The prospects of managing the well-being of surgeons after adverse situations and events

Prospect	Description
Immediate access to specialised psychological counselling services [36–39]	<ul style="list-style-type: none"> <li>- Provision of specialised psychological counselling services tailored for surgeons</li> <li>- Creating a non-judgmental environment for open expression</li> <li>- Encouraging sharing of experiences to foster camaraderie and continuous learning</li> <li>- Implementation of well-being support service shown to decrease burnout, improve satisfaction, and reduce work-related stress</li> <li>- Positive impact on patient safety through insights from complication</li> </ul>
Integration of telemedicine and telepsychiatry [40–44]	<ul style="list-style-type: none"> <li>- Utilisation of telemedicine and telepsychiatry for mental health support</li> <li>- Accessibility and alignment with professional schedules</li> <li>- Customised telepsychiatry programs to reduce stigma in seeking mental health care</li> <li>- Three-week online self-training intervention focussing on mindfulness demonstrated positive effects on psychological detachment, work–life balance satisfaction, and affective well-being</li> <li>- Provision of immediate mental health support through virtual consultations post-complications</li> </ul>
Holistic approach in surgical education and training [41, 45, 46]	<ul style="list-style-type: none"> <li>- Comprehensive training should include surgical skills, resilience, and adaptive coping mechanisms</li> <li>- Well-being and resiliency programme addressing mental, physical, and social aspects showed significant benefits for residents</li> <li>- Improvements observed in culture, community, communication, emotional intelligence, and work–life integration skills</li> <li>- Success facilitated by committed leadership, supportive department culture, protected time, interactive learning, and ongoing feedback</li> <li>- Integration of toolkits and curricula equips future surgeons with resilience, fostering adaptive environments</li> <li>- Normalising discussions around mental health and providing self-care tools empower surgeons to prioritise well-being</li> </ul>
Collaborative research, peer support and mentoring [13, 48, 49]	<ul style="list-style-type: none"> <li>- Implementation of collaborative initiatives and support networks</li> <li>- Structured peer support and mentoring to cope with psychological distress</li> <li>- Electronic peer support reporting to document support encounters</li> <li>- Encouragement of mutual assistance and collective responsibility for enhanced patient safety and care quality</li> </ul>
Promoting self-care practices amongst surgeons [50–55]	<ul style="list-style-type: none"> <li>- Incorporation of physical activities into surgical training programs</li> <li>- Integrating stress-reducing benefits of exercises such as jogging, swimming, and yoga</li> <li>- Encouraging regular exercise, healthy eating, and good sleep hygiene is crucial for physical and mental well-being [50]</li> <li>- Importance of designating time for self-care</li> <li>- Adopting team sports to foster community and supportive environment</li> <li>- Surgeons who prioritise finding meaning in their work, maintaining a positive outlook, and achieving work–life balance are less likely to experience burnout</li> <li>- Knitting has shown to induce relaxation, decrease anxiety, and enhance emotional regulation and mindfulness</li> </ul>

emotional first aid, thereby extending support to surgeons in need [49]. While only a quarter of trained supporters formally utilised the APSA programme to provide support, over 80% reported using the skills acquired to assist colleagues and trainees within their own institutions [49]. These interactions not only enhance the resilience of the surgical workforce but also contribute to a culture of mutual assistance and collective responsibility [13]. Therefore, fostering such a supportive environment through collaborative efforts and peer mentorship is essential for enhancing patient safety and overall care quality, providing a model that can be replicated across diverse healthcare settings.

#### **Promoting self-care practices amongst surgeons**

Hospitals and surgical institutions can advance the well-being of their surgical staff by promoting self-care practices as part of comprehensive wellness initiatives. This includes encouraging regular exercise, healthy eating habits, and maintaining good sleep hygiene. Furthermore, allocating designated time for self-care is essential for maintaining both physical and mental well-being [50]. For instance, research indicates that surgeons who have had recent visits to their primary care providers are more likely to be up-to-date with all age-appropriate health screenings and exhibit superior overall and physical quality of life scores [51]. In addition, surgeons who

prioritise finding meaning in their work, focus on important aspects of life, maintain a positive outlook, and emphasise work–life balance are less likely to experience burnout [51]. While many factors associated with a lower risk of burnout are also linked to achieving a high overall quality of life, significant differences exist, underscoring the need for surgeons to adopt a diverse range of wellness promotion practices to attain optimal well-being [51]. Encouraging surgeons to prioritise their mental health can contribute to fostering a healthier and more resilient surgical workforce.

Incorporating physical activities and sports into surgical training programmes presents a strategic approach to mitigating the effects of the “second-victim” phenomenon, which is of particular concern in the demanding and high-stress environment of surgical work [52]. Engaging in activities such as jogging, swimming, or yoga has been shown to reduce stress, providing surgeons with a natural means to balance the emotional challenges associated with their profession [53]. Participating in team sports, in particular, adds a social dimension to physical activity, fostering a sense of community among surgical teams and creating a supportive environment where surgeons feel comfortable discussing and addressing emotional concerns [54].

One intervention that has proven successful is knitting, which has been shown to induce a relaxation response, decrease anxiety, and enhance emotional regulation and mindfulness [55]. In addition, it improves dexterity and manual skills, potentially benefiting surgical performance. Implementing knitting as a wellness intervention for surgeons is feasible due to its accessibility, portability, and low cost [55]. Programme directors can provide materials and instructional resources to facilitate learning. Table 3 summarises the prospects of managing surgeons’ well-being after adverse situations and events.

## Conclusion

Surgeons, like all humans, are susceptible to the impacts of surgical complications in their day-to-day lives. This review underscores that many surgeons experience emotional, physical, and psychological stress when faced with postoperative complications. Recognising and proactively addressing these multifaceted impacts is crucial for the well-being of surgeons and fostering a resilient medical community capable of consistently delivering high-quality patient care. Only through these concerted efforts can we sustain a healthcare system that thrives on excellence and compassion, even in the face of inevitable surgical complications.

## Author contributions

The study was conceptualised and supervised by W.A.A. Material preparation, data collection, and analysis were performed by all authors. The first and final draft of the manuscript was written by all authors. All authors read and approved the final manuscript.

## Data availability statement

Data availability is not applicable to this article as no new data were created or analysed in this study.

## Declarations

### Competing interests

The authors declare no competing interests.

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## References

1. Wolf ZR, Hughes RG. Error reporting and disclosure. In: Hughes RG, editor. Patient safety and quality: an evidence-based handbook for nurses. Agency for Healthcare Research and Quality (US): Rockville; 2008.
2. Turrentine FE, Schenk WG, McMurry TL, Tache-Leon CA, Jones RS. Surgical errors and the relationships of disease, risks, and adverse events. *Am J Surg*. 2020;220:1572–8.
3. Palmerola R, Hartman C, Theckumparampil N, Mukkamala A, Fishbein J, Schwartz M, et al. Surgical complications and their repercussions. *J Endourol*. 2016;30:52–7.
4. Pearse RM, Moreno RP, Bauer P, Pelosi P, Metnitz P, Spies C, et al. Mortality after surgery in Europe: a 7 day cohort study. *Lancet*. 2012;380:1059–65.
5. Dindo D, Demartines N, Clavien P-A. Classification of surgical complications. *Ann Surg*. 2004;240:205–13.
6. International Surgical Outcomes Study Group. Global patient outcomes after elective surgery: prospective cohort study in 27 low-, middle- and high-income countries [published correction appears in *Br J Anaesth*. 2017 Sep 1;119(3):553]. *Br J Anaesth*. 2016;117(5):601–9. <https://doi.org/10.1093/bja/aew316>.
7. Dencker EE, Bonde A, Troelsen A, Varadarajan KM, Sillesen M. Postoperative complications: an observational study of trends in the United States from 2012 to 2018. *BMC Surg*. 2021;21(1):393.
8. Osinaik B, Ayandipo O, Onyeka T, Alagbe-Briggs O, Mohammed AD, Oyedepo OO, et al. Nigerian surgical outcomes – Report of a 7-day prospective cohort study and external validation of the African surgical outcomes study surgical risk calculator. *Int J Surg*. 2019;68:148–56.
9. Agarwal V, Kulkarni AP, Muthuchellappan R, Shah BA, Rane PP. Postoperative outcomes following elective surgery in India. *Indian J Crit Care Med*. 2021;25:528–34.
10. Scott SD, Hirschinger LE, Cox KR, McCoig M, Brandt J, Hall LW. The natural history of recovery for the healthcare provider “second victim” after adverse patient events. *Qual Saf Health Care*. 2009;18:325–30.
11. Archer S, Pinto A, Vuik S, et al. Surgery, complications, and quality of life: a longitudinal cohort study exploring the role of psychosocial factors. *Ann Surg*. 2019;270(1):95–101. <https://doi.org/10.1097/SLA.00000000000002745>.
12. Siddaiah-Subramanya M, To H, Haigh C. The psychosocial impact of surgical complications on the operating surgeon: a scoping review. *Ann Med Surg*. 2021;67: 102530.
13. Turner K, Bolderston H, Thomas K, Greville-Harris M, Withers C, McDougall S. Impact of adverse events on surgeons. *Br J Surg*. 2022;109:308–10.
14. Greenberg AL, Cevallos JR, Ojute FM, Davis DL, Greene WR, Lebares CC. The General Surgery Residency Experience: a multicenter study of differences in wellbeing by race/ethnicity. *Ann Surg Open*. 2022;3(3):e187. <https://doi.org/10.1097/AS9.0000000000000187>.
15. Pinto A, Faiz O, Bicknell C, Vincent C. Surgical complications and their implications for surgeons’ well-being. *Br J Surg*. 2013;100:1748–55.
16. Santos G, Jones MW. Prevention of surgical errors. Treasure Island (FL): StatPearls Publishing; 2023.



17. Patel AM, Ingalls NK, Mansour MA, Sherman S, Davis AT, Chung MH. Collateral damage: The effect of patient complications on the surgeon's psyche. *Surgery*. 2010;148:824–30.
18. Han K, Bohnen JD, Peponis T, Martinez M, Nandan A, Yeh DD, et al. The surgeon as the second victim? Results of the Boston Intraoperative Adverse Events Surgeons' Attitude (BISA) Study. *J Am Coll Surg*. 2017;224:1048–56.
19. Le HD, Wolinska JM, Baertschiger RM, Himidan SA. Complication is inevitable, but suffering is optional-psychological aspects of dealing with complications in surgery. *Eur J Pediatr Surg*. 2023;33:181–90.
20. Orri M, Revah-Lévy A, Farges O. Surgeons' emotional experience of their everyday practice - a qualitative study. *PLOS ONE*. 2015;10: e0143763.
21. Luu S, Patel P, St-Martin L, Leung AS, Regehr G, Murnaghan ML, et al. Waking up the next morning: surgeons' emotional reactions to adverse events. *Med Educ*. 2012;46:1179–88.
22. Pinto A, Faiz O, Bicknell C, Vincent C. Acute traumatic stress among surgeons after major surgical complications. *Am J Surg*. 2014;208:642–7.
23. Alegria-Torres JA, Baccarelli A, Bollati V. Epigenetics and lifestyle. *Epigenomics*. 2011;3(3):267–77. <https://doi.org/10.2217/epi.11.22>.
24. Ragnoli B, Pochetti P, Pignatti P, et al. Sleep deprivation, immune suppression and SARS-CoV-2 infection. *Int J Environ Res Public Health*. 2022;19(2):904. <https://doi.org/10.3390/ijerph19020904>.
25. Kivimäki M, Bartolomucci A, Kawachi I. The multiple roles of life stress in metabolic disorders. *Nat Rev Endocrinol*. 2023;19(1):10–27. <https://doi.org/10.1038/s41574-022-00746-8>.
26. Besedovsky L, Lange T, Haack M. The sleep-immune crosstalk in health and disease. *Physiol Rev*. 2019;99(3):1325–80. <https://doi.org/10.1152/physrev.00010.2018>.
27. Biggs S, Waggett HB, Shabbir J. Impact of surgical complications on the operating surgeon. *Colorectal Dis*. 2020;22:1169–74.
28. Akyol C, Celik SU, Koc MA, Bayindir DS, Gocer MA, Karakurt B, et al. The impact of patient deaths on general surgeons' psychosocial well-being and surgical practices. *Front Surg*. 2022;9: 898274.
29. Vitous CA, Byrnes ME, De Roo A, Jafri SM, Suwanabol PA. Exploring emotional responses after postoperative complications: a qualitative study of practicing surgeons. *Ann Surg*. 2022;275(1):e124–31. <https://doi.org/10.1097/SLA.0000000000004041>.
30. O'Meara S, D'Arcy F, Dowling C, Walsh K. The psychological impact of adverse events on urology trainees. *Irish J Med Sci*. 2022;192(4):1819–24.
31. Chauvet P, Figuier C, Lambert C, Michel C. Surgical complications and their impact for gynecological surgeons. *Int J Gynecol Obstet*. 2022;160:1001–6.
32. Mallon C, Goberman-Hill R, Blom A, Whitehouse M, Moore A. Surgeons are deeply affected when patients are diagnosed with prosthetic joint infection. *PLOS One*. 2018;13: e0207260.
33. Westaby S, Baig K, Pepper J. Publishing SSMD: the risks outweigh the benefits. *Bull R Coll Surg Engl*. 2015;97(4):155–9. <https://doi.org/10.1308/147363515X14134529302542>.
34. Sacks GD, Dawes AJ, Tsugawa Y, et al. The association between risk aversion of surgeons and their clinical decision-making. *J Surg Res*. 2021;268:232–43. <https://doi.org/10.1016/j.jss.2021.06.056>.
35. Anton NE, Lebares CC, Karipidis T, Stefanidis D. Mastering stress: mental skills and emotional regulation for surgical performance and life. *J Surg Res*. 2021;263:A1–12. <https://doi.org/10.1016/j.jss.2021.01.009>.
36. Drudi LM, D'Oria M, Bath J, van Nispen J, Smeds MR. Postoperative complications and their association with post-traumatic stress disorder in academic vascular surgeons. *J Vasc Surg*. 2023;77:899-905.e1.
37. Helo S, Moulton CAE. Complications: acknowledging, managing, and coping with human error. *Transl Androl Urol*. 2017;6:773–82.
38. Hendrix RJ, Beqari J, Winton M, Davids JS, Torres U, Larkin AC, LaFemina J. Wellbeing program demonstrates early improvement in general surgery residency. *J Am Coll Surg*. 2018;227(4):S234–5. <https://doi.org/10.1016/j.jamcollsurg.2018.07.513>.
39. Choi SHJ, Yan TD, Misskey J, Chen JC. The emotional impact and coping mechanisms following adverse patient events among Canadian Vascular Surgeons and Trainees. *Vasc Endovasc Surg*. 2023;58(3):294–301.
40. Shanafelt TD, Kaups KL, Nelson H, et al. An interactive individualized intervention to promote behavioral change to increase personal well-being in US surgeons. *Ann Surg*. 2014;259(1):82–8. <https://doi.org/10.1097/SLA.0b013e3182a58fa4>.
41. Eidt JF, Mannoia K. A toolkit for individualizing interventions to mitigate second-victim syndrome in a diverse surgery community. *J Vasc Surg Venous Lymphat Disord*. 2023;12(2): 101680.
42. El Hechi MW, Bohnen JD, Westfal M, Han K, Cauley C, Wright C, et al. Design and impact of a novel surgery-specific second victim peer support program. *J Am Coll Surg*. 2020;230:926–33.
43. Althammer SE, Reis D, van der Beek S, et al. A mindfulness intervention promoting work-life balance: How segmentation preference affects changes in detachment, well-being, and work-life balance. *J Occup Organ Psychol*. 2021;92(4):282–308. <https://doi.org/10.1111/joop.12346>.
44. Finney RE, Jacob AK. Peer support and second victim programs for anesthesia professionals involved in stressful or traumatic clinical events. *Adv Anesth*. 2023;41:39–52.
45. Harrison R, Lawton R, Perlo J, Gardner P, Armitage G, Shapiro J. Emotion and coping in the aftermath of medical error: a cross-country exploration. *J Patient Saf*. 2015;11:28–35.
46. Mueller F, Brommelsiek M, Sutkin G. Mental 3D visualization: building surgical resilience for performing high-risk procedures. *J Surg Educ*. 2022;79(3):809–17. <https://doi.org/10.1016/j.jsurg.2022.01.007>.
47. Price ET, Coverley CR, Arrington AK, Nfonsam VN, Morris-Wiseman L, Riall TS. Are we making an impact? a qualitative program assessment of the resident leadership, well-being, and resiliency program for general surgery residents. *J Surg Educ*. 2020;77(3):508–19. <https://doi.org/10.1016/j.jsurg.2019.12.003>.
48. Merandi J, Liao N, Lewe D, Morvay S, Stewart B, Catt C, et al. Deployment of a second victim peer support program. *Pediatric Qual Saf*. 2017;2: e031.
49. Fall F, Hu YY, Walker S, et al. Peer support to promote surgeon well-being: The APSA Program Experience. *J Pediatr Surg*. 2024;59(9):1665–71. <https://doi.org/10.1016/j.jpedsurg.2023.12.022>.
50. Dairywala MI, Gupta S, Salna M, Nguyen TC. Surgeon strength: ergonomics and strength training in cardiothoracic surgery. *Semin Thorac Cardiovasc Surg*. 2021;34:1220–9.
51. Shanafelt TD, Oreskovich MR, Dyrbye LN, et al. Avoiding burnout: the personal health habits and wellness practices of US surgeons. *Ann Surg*. 2012;255(4):625–33. <https://doi.org/10.1097/SLA.0b013e31824b2fa0>.
52. Zenati MA, Leissner KB, Zorca S, Kennedy-Metz L, Yule SJ, Dias RD. First reported use of team cognitive workload for root cause analysis in cardiac surgery. *Semin Thorac Cardiovasc Surg*. 2019;31:394–6.
53. Congsheng L, Kayani S, Khalid A. An empirical study of physical activity and sports affecting mental health of university students. *Front Psychol*. 2022;13: 917503.
54. Marqués-Sánchez P, Benítez-Andrades JA, Calvo D, Ramos NA. The socialisation of the adolescent who carries out team sports: a transversal study of centrality with a social network analysis. *BMJ Open*. 2021;11: e042773.
55. Zhang RS, Gast KM. Knitting: A simple and effective intervention for surgeon wellbeing. *Am J Surg*. 2023;226(3):400–1. <https://doi.org/10.1016/j.amjsurg.2023.04.018>.

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