Beyond Burnout: Cognitive Workload, Psychological Wellbeing and Patient Safety in Australian Anaesthesia Practice

Paper 1

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Abstract

Background: Anaesthesia requires sustained vigilance, rapid decision-making, effective teamwork, and the capacity to adapt to changing clinical demands. Burnout, fatigue, and cognitive workload are increasingly recognised as workforce concerns; however, their interrelationships with organisational conditions, situational awareness, and patient safety remain underexplored across multidisciplinary anaesthesia teams.

Aim: To examine relationships among psychological wellbeing, fatigue, cognitive workload, situational awareness, organisational support, and patient safety incident exposure within Australian anaesthesia practice.

Methods: A cross-sectional anonymous online survey was completed by 80 Australian anaesthesia professionals and students. Measures included the Copenhagen Burnout Inventory, a modified Fatigue Assessment Scale, an adapted NASA Task Load Index, investigator-developed Situational Awareness and Organisational Support measures, an eight-category Patient Safety Incident Exposure checklist, and optional qualitative questions. Data were analysed using descriptive statistics, reliability analysis, Pearson correlations, professional-group and on-call comparisons, exploratory multiple linear regression, and descriptive content analysis.

Results: All retained composite measures demonstrated acceptable-to-excellent internal consistency ($\alpha = .774$–$.938$). Burnout, fatigue, and cognitive workload were strongly interrelated; Work-related Burnout showed the strongest association with Fatigue ($r = .881$, $p < .001$). Greater burnout, fatigue, and cognitive workload were associated with poorer perceived Situational Awareness, while more favourable Organisational Support was associated with better psychological and cognitive outcomes. Anaesthetic nurses reported the highest burnout, fatigue, and cognitive workload across professional groups. Patient Safety Incident Exposure was not significantly correlated with any study scale, and the exploratory regression model was not significant, $F(7, 72) = 0.894$, $p = .516$, $R^2 = .080$. Qualitative responses primarily identified staffing, workload, production pressure, leadership, recognition, and recovery opportunities as contributors to workplace strain.

Conclusions: Burnout, fatigue, cognitive workload, situational awareness, and organisational support were closely interconnected within this multidisciplinary sample. Although these variables did not explain patient safety incident exposure, the findings indicate that clinician wellbeing and cognitive capacity are important indicators of the conditions under which anaesthesia care is delivered. Sustainable improvement should therefore address organisational design and workforce conditions alongside individual wellbeing support.

Keywords: Anaesthesia; burnout; cognitive workload; fatigue; human factors; organisational support; patient safety; situational awareness.

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1. Introduction

1.1 The Cognitive Demands of Modern Anaesthesia

Anaesthesia is a cognitively demanding area of healthcare requiring sustained vigilance, rapid information processing, anticipation of clinical change, and effective multidisciplinary coordination. Anaesthesia professionals must continuously integrate physiological monitoring, surgical progress, medication effects, equipment performance, and communication from multiple team members while remaining prepared to respond immediately to unexpected deterioration. This combination of high information load, time-sensitive decision-making, and responsibility for maintaining physiological stability places considerable demands on finite cognitive resources[1].

Advances in monitoring, pharmacology, equipment, and perioperative medicine have substantially improved anaesthesia safety, but they have also increased the complexity of contemporary practice. Clinicians now manage increasingly sophisticated technologies and documentation systems alongside more complex patients and procedures. Safe performance therefore depends not only on technical competence, but also on the ability to maintain situational awareness and prioritise competing demands within dynamic clinical environments[2].

These demands can be considered through Cognitive Load Theory, which proposes that working memory has a limited capacity for processing information[3]. When task demands approach or exceed available cognitive resources, additional interruptions, competing priorities, inefficient processes, or unexpected events may become more difficult to manage. Experienced clinicians can reduce some of this burden through pattern recognition, established mental models, and automaticity, but expertise does not remove the fundamental limitations of human cognition.

This is particularly relevant in anaesthesia because periods of apparent stability may rapidly transition to high-acuity events. Clinicians must retain sufficient cognitive capacity to recognise deterioration, interpret evolving information, communicate effectively, and respond appropriately while maintaining awareness of the broader clinical situation. Situational awareness—the perception of relevant information, comprehension of its meaning, and anticipation of future developments—is therefore central to performance in complex dynamic systems[4].

A Human Factors perspective extends this analysis beyond the individual clinician. Human Factors and Ergonomics considers performance to arise from interactions among people, tasks, technologies, teams, and organisational systems. Anaesthesia has been a prominent adopter of this systems-based approach, with developments such as standardised monitoring, equipment checks, simulation, crisis resource management, structured communication, and cognitive aids contributing to improvements in safety[5].

However, contemporary workload is influenced by more than the inherent complexity of clinical care. Staffing limitations, interruptions, production pressure, extended working hours, documentation requirements, inadequate recovery opportunities, and competing organisational priorities may introduce additional cognitive demands[6]. These conditions are important because safe clinical performance requires not merely that clinicians possess the necessary knowledge and skills, but that the surrounding work system enables those capabilities to be used effectively.

Understanding cognitive workload in anaesthesia therefore requires consideration of the conditions under which clinicians work. Burnout, fatigue, organisational support, and situational awareness may interact with workload in ways that influence both clinician wellbeing and the effort required to maintain performance. Examining these relationships across the multidisciplinary anaesthesia workforce provides an opportunity to move beyond explanations centred solely on individual resilience and towards a broader understanding of how work systems support—or constrain—safe and sustainable clinical practice.

[1] Gaba, 2000; Kelly et al., 2023; Schulz et al., 2013
[2] Gaba, 2000; Kelly et al., 2023
[3] Sweller, 1988; Sweller et al., 2011
[4] Endsley, 1995; Schulz et al., 2013
[5] Fletcher et al., 2003; Gaba, 2000; Kelly et al., 2023
[6] Carayon et al., 2006; Holden et al., 2013; Kelly et al., 2023

1.2 Psychological Wellbeing in Anaesthesia

Psychological wellbeing has become an important workforce issue across healthcare, with burnout and fatigue increasingly recognised as consequences of sustained occupational demand rather than simply deficiencies in individual resilience. Within anaesthesia, these concerns are particularly relevant because clinicians must maintain prolonged vigilance, manage high-acuity situations, respond rapidly to unexpected deterioration, and coordinate care within multidisciplinary teams while frequently working under time and resource constraints.

Burnout is commonly conceptualised as a response to chronic occupational stress. Although the Maslach model describes burnout through emotional exhaustion, depersonalisation, and reduced personal accomplishment[7], the Copenhagen Burnout Inventory (CBI) conceptualises the construct in terms of exhaustion across personal, work-related, and patient-related domains[8]. This distinction is useful in anaesthesia because psychological strain may arise from general exhaustion, workplace conditions, or the demands of direct patient care, and these sources may not affect clinicians equally.

Burnout within anaesthesia has been associated with workload, prolonged working hours, professional pressure, limited recovery, organisational culture, and workforce constraints[9]. Its consequences extend beyond individual distress. Burnout has been linked with reduced job satisfaction, absenteeism, intention to leave, workforce turnover, and poorer professional engagement, all of which may affect the sustainability of specialist clinical teams.

Fatigue represents a related but distinct concern. Whereas burnout generally reflects longer-term occupational exhaustion, fatigue may arise acutely through insufficient sleep, prolonged shifts, circadian disruption, on-call work, or sustained physical and cognitive effort. Fatigue can adversely affect vigilance, reaction time, working memory, attention, and decision-making, making it particularly relevant to anaesthesia practice where subtle changes in patient condition may require rapid interpretation and response[10].

Burnout and fatigue should not, however, be considered in isolation from the work environment. The Job Demands–Resources model proposes that wellbeing is influenced by the balance between occupational demands and the resources available to manage them[11]. Within anaesthesia, demands may include clinical complexity, interruptions, production pressure, workload, staffing constraints, documentation, and extended hours. Resources may include adequate staffing and skill mix, supportive leadership, professional recognition, effective teamwork, reliable equipment, protected breaks, education, and access to assistance when workload escalates.

This distinction is important because interventions directed solely at individual coping may have limited effect when the principal source of strain lies within the organisation of work. Counselling, peer support, and resilience-based initiatives may be valuable, but they cannot substitute for adequate staffing, manageable workload, recovery opportunities, psychologically safe communication, and effective leadership[12].

Psychological wellbeing may also interact with cognitive performance. Burnout and fatigue have been associated with impaired attention, executive functioning, communication, and situational awareness, although clinicians may continue to maintain effective performance through expertise, teamwork, structured routines, and adaptive behaviours[13]. This creates an important Human Factors question: clinicians may remain clinically functional while the cognitive and psychological effort required to sustain that performance progressively increases.

The relationship between wellbeing and patient safety is therefore complex. Systematic reviews have identified associations between healthcare staff wellbeing, burnout, and aspects of patient safety and quality of care[14]. However, patient safety outcomes are influenced by multiple interacting factors, including clinical exposure, teamwork, reporting culture, supervision, technology, staffing, workload, and organisational safeguards. A simple assumption that burnout directly produces patient harm is therefore unlikely to capture the complexity of anaesthesia systems.

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[7] Maslach et al., 2001
[8] Kristensen et al., 2005
[9] Sanfilippo et al., 2017; West et al., 2018
[10] Gregory & Edsell, 2014
[11] Demerouti et al., 2001; Bakker & Demerouti, 2007
[12] Bakker & Demerouti, 2007; Demerouti et al., 2001; West et al., 2018
[13] Gregory & Edsell, 2014; Hall et al., 2016; Schulz et al., 2013
[14] Hall et al., 2016; Tawfik et al., 2019

Most anaesthesia wellbeing research has also concentrated on physicians, despite contemporary anaesthesia being delivered by multidisciplinary teams[15]. Anaesthetic nurses, anaesthesia technicians or anaesthetic healthcare practitioners, anaesthesia registrars, consultant anaesthetists, and students may work within the same clinical environment while experiencing different levels of autonomy, workload, role demand, recognition, and organisational support. Examining these professional groups together may therefore provide a more complete understanding of how psychological wellbeing operates within the anaesthesia work system.

For this reason, the present study examines burnout and fatigue alongside cognitive workload, situational awareness, organisational support, and patient safety incident exposure. This approach treats psychological wellbeing not as an isolated individual outcome, but as one component of the broader system through which safe and sustainable anaesthesia care is delivered.

1.3 Human Factors, Organisational Systems and Patient Safety

Patient safety in anaesthesia has progressively moved away from explanations centred solely on individual error towards a systems-based understanding of clinical performance. Contemporary Human Factors and Ergonomics recognises that outcomes emerge from interactions among clinicians, tasks, technologies, teams, organisational structures, and the broader environment in which care is delivered. This perspective is particularly relevant to anaesthesia, where safe care depends upon multiple layers of monitoring, communication, equipment, checking processes, professional expertise, and organisational support.

Reason's Swiss Cheese Model illustrates this systems approach by proposing that adverse events rarely result from a single isolated failure. Instead, harm may occur when weaknesses across several layers of defence align. In anaesthesia, these defences may include equipment design, physiological monitoring, medication checks, clinical protocols, supervision, teamwork, communication, and professional judgement[16]. The model therefore shifts attention from asking who made an error towards understanding the conditions that allowed an error or hazard to progress through the system.

The Systems Engineering Initiative for Patient Safety (SEIPS) extends this approach by conceptualising healthcare as a work system in which people, tasks, tools and technologies, the physical environment, and organisational factors interact to shape both clinician and patient outcomes[17]. From this perspective, clinician wellbeing is not separate from system performance. Staffing, workload, workflow, leadership, technology, and opportunities for recovery may influence the cognitive resources available to clinicians while simultaneously affecting how effectively teams respond to clinical demands.

Contemporary safety science has also distinguished between Safety-I and Safety-II. Safety-I focuses on understanding why things go wrong and preventing recurrence through incident analysis, standardisation, and stronger defences. This remains essential. However, Safety-II also asks why clinical work succeeds so frequently despite complexity, uncertainty, interruptions, and fluctuating resources[18].

This distinction is highly relevant to anaesthesia. Clinicians continually adapt to changing patient physiology, surgical developments, equipment issues, staffing constraints, competing priorities, and unexpected events. They may redistribute tasks, increase monitoring, seek assistance, clarify communication, or alter the sequence of work to maintain safe care. Many of these adaptations are never recorded because they successfully prevent problems from progressing[19].

Resilience Engineering describes this capacity to anticipate, monitor, respond, and learn under variable conditions[20]. Importantly, resilience should not be interpreted simply as the personal ability of clinicians to tolerate increasing pressure. A resilient clinical system provides adequate staffing, effective teamwork, reliable equipment, supportive leadership, flexible processes, and sufficient capacity for recovery.

This distinction matters because safe outcomes can conceal the amount of adaptation required to achieve them. Clinicians may continue to provide high-quality care while experiencing substantial fatigue, cognitive workload, or psychological strain. The absence of an adverse event therefore does not necessarily indicate that the

[15] Sanfilippo et al., 2017; West et al., 2018
[16] Reason, 2000
[17] Carayon et al., 2006; Holden et al., 2013
[18] Hollnagel, 2014
[19] Hollnagel, 2014; Hollnagel et al., 2006; Kelly et al., 2023
[20] Hollnagel et al., 2006

underlying work system is sustainable[21]. A system may appear successful precisely because clinicians are compensating for staffing shortages, inefficient processes, workload pressure, interruptions, or inadequate organisational support.

This concept also helps explain why clinician wellbeing and patient safety should be examined as related but distinct outcomes. Burnout or fatigue should not automatically be assumed to cause patient harm, nor should the absence of measurable harm be interpreted as evidence that workforce strain is unimportant. Instead, Human Factors approaches encourage examination of the conditions under which clinicians are required to maintain performance and the resources available to support that performance.

The present study therefore draws on Human Factors, SEIPS, Safety-II, and Resilience Engineering to examine burnout, fatigue, cognitive workload, situational awareness, organisational support, and patient safety incident exposure within the same multidisciplinary anaesthesia workforce. This systems perspective provides the foundation for investigating whether psychological and cognitive demands cluster together, how they relate to organisational conditions, and whether they are associated with reported exposure to patient safety events.

1.4 Knowledge Gap, Study Aim and Objectives

Despite growing interest in burnout, fatigue, cognitive workload, and clinician wellbeing, several gaps remain within the anaesthesia literature. Much of the existing research has examined these constructs individually or has focused predominantly on physician anaesthetists[22]. Comparatively less attention has been directed towards the multidisciplinary workforce through which anaesthesia care is actually delivered, including anaesthetic nurses and anaesthesia technicians or anaesthetic healthcare practitioners.

A further limitation is that psychological wellbeing is often studied separately from the cognitive and organisational conditions in which clinical work occurs[23].

Burnout, fatigue, cognitive workload, situational awareness, staffing, organisational support, and patient safety are likely to reflect interacting aspects of a complex work system rather than independent problems. However, the concurrent examination of these factors within multidisciplinary Australian anaesthesia practice remains comparatively limited.

The relationship between clinician wellbeing and patient safety also requires careful investigation. Although impaired wellbeing has been associated with aspects of healthcare quality and safety, patient safety events arise from multiple interacting influences and cannot be attributed to psychological strain alone[24]. Examining patient safety incident exposure alongside psychological, cognitive, and organisational variables may therefore provide a more nuanced understanding of whether these outcomes are associated within multidisciplinary anaesthesia practice.

The present study addresses these gaps using a systems-based approach. Rather than treating burnout as an isolated occupational health outcome, it examines psychological wellbeing alongside fatigue, cognitive workload, perceived situational awareness, organisational support, and patient safety incident exposure within a multidisciplinary Australian cohort.

Aim:

The primary aim was to examine the relationships among psychological wellbeing, fatigue, cognitive workload, situational awareness, organisational support, and patient safety incident exposure among Australian anaesthesia professionals and students undertaking supervised anaesthesia training.

Objectives:

The study sought to:

[21] Hollnagel, 2014; Carayon et al., 2006; Holden et al., 2013
[22] Sanfilippo et al., 2017; Hall et al., 2016; Tawfik et al., 2019; West et al., 2018
[23] Bakker & Demerouti, 2007; Carayon et al., 2006; Holden et al., 2013
[24] Hall et al., 2016; Tawfik et al., 2019; Reason, 2000

1. describe levels of personal, work-related, and patient-related burnout, fatigue, cognitive workload, situational awareness, organisational support, and patient safety incident exposure;
2. examine relationships among the principal psychological, cognitive, organisational, and patient safety variables;
3. compare burnout, fatigue, cognitive workload, and patient safety incident exposure across professional groups;
4. compare burnout, fatigue, cognitive workload, and patient safety incident exposure between participants who did and did not undertake on-call duties;
5. explore whether burnout, fatigue, cognitive workload, situational awareness, and organisational support were independently associated with patient safety incident exposure; and
6. describe participants' perceptions of workplace factors contributing to burnout and opportunities for improving staff wellbeing and patient safety.

Hypotheses:

Four quantitative hypotheses were specified:

H1: Higher burnout would be associated with greater fatigue and greater perceived cognitive workload.

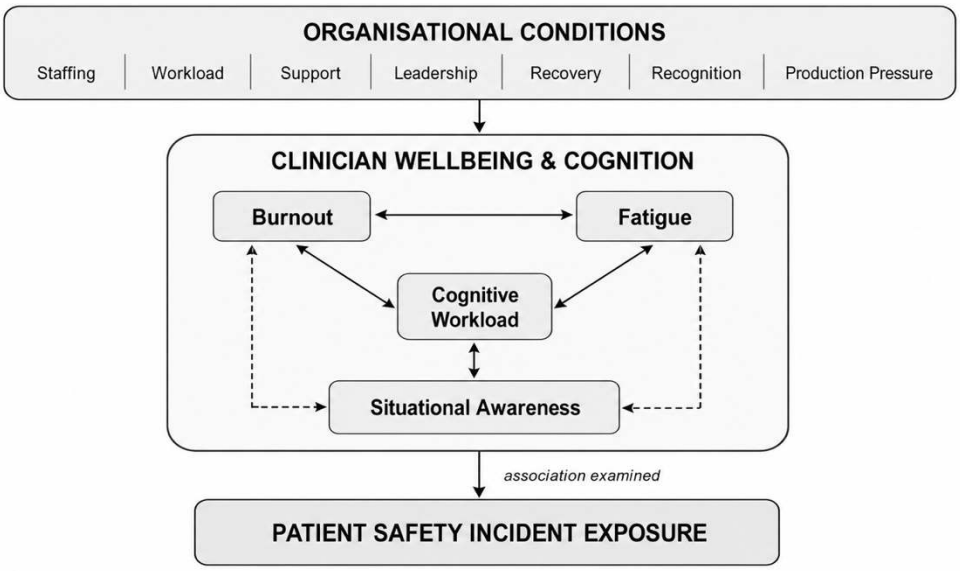
H2: More favourable organisational support would be associated with lower burnout, lower fatigue, lower cognitive workload, and better perceived situational awareness.

H3: Burnout, fatigue, and cognitive workload would differ across professional groups within the multidisciplinary anaesthesia workforce.

H4: Burnout, fatigue, cognitive workload, situational awareness, and organisational support would be significantly associated with patient safety incident exposure.

The qualitative component was exploratory rather than hypothesis-driven. It examined how participants described contributors to workplace stress and burnout, potential improvements to staff wellbeing, and the perceived relationship between clinician wellbeing and patient safety.

Figure 1. *Conceptual Framework for the Study*



Note. The framework represents hypothesised associations among study constructs and does not imply causal pathways.

2. Methods

2.1 Study Design

This study used a cross-sectional mixed-methods survey design to examine relationships among psychological wellbeing, fatigue, cognitive workload, situational awareness, organisational support, and patient safety incident exposure within Australian anaesthesia practice. Quantitative measures were combined with optional open-ended questions to provide both statistical assessment of the principal study variables and contextual information concerning participants' workplace experiences.

The study was informed by the Human Factors and systems-based perspectives outlined in the Introduction, particularly the SEIPS framework, Safety-II, and Resilience Engineering[25]. These frameworks guided interpretation of clinician wellbeing and cognitive workload as outcomes arising within broader work systems rather than solely as individual characteristics.

Quantitative analyses included descriptive statistics, internal-consistency testing, Pearson correlations, professional-group and on-call comparisons, and exploratory multiple linear regression. Qualitative responses were analysed using descriptive content analysis[26].

Because the study was observational and cross-sectional, it was designed to identify associations rather than causal relationships. Findings are therefore interpreted as relationships within the participating cohort and not as evidence that burnout, fatigue, workload, organisational conditions, or situational awareness directly caused patient safety events.

Reporting was informed by the STROBE recommendations for observational research[27] and, for the qualitative component, the Standards for Reporting Qualitative Research[28].

2.2 Study Population and Recruitment

Participants were recruited using a voluntary convenience sampling strategy. Recruitment commenced on 30 May 2026, when the survey invitation was first distributed, and continued until the survey closed on 1 August 2026. Completed survey responses were recorded from 31 May to 1 August 2026.

Eligible participants were adults currently working, or undertaking recognised supervised clinical training, in an anaesthesia-related role within Australia. The multidisciplinary recruitment strategy was intended to reflect the team-based nature of contemporary anaesthesia practice and included consultant anaesthetists, anaesthesia registrars, anaesthetic nurses, anaesthesia technicians or anaesthetic healthcare practitioners, and anaesthesia students.

Participants were eligible if they:

- were aged 18 years or older;
- were currently employed, or undertaking recognised supervised clinical training, in an anaesthesia-related role within Australia; and
- provided consent by proceeding with and submitting the anonymous questionnaire.

The survey invitation was distributed electronically through professional organisations, workplace and professional networks, email distribution lists, social media, and participant sharing within relevant anaesthesia networks. No financial or material incentives were offered for participation.

A total of 80 completed survey submissions were received. Following data screening, no submissions were excluded on the basis of eligibility, duplication, or incomplete completion of the primary survey components; all 80 were retained in the final quantitative dataset. The sample included participants from public and private

[25] Carayon et al., 2006; Holden et al., 2013; Hollnagel, 2014; Hollnagel et al., 2006
[26] Elo & Kyngäs, 2008
[27] von Elm et al., 2007
[28] O'Brien et al., 2014

hospitals, day-procedure services, and regional settings, with variation in professional role and clinical experience.

Because recruitment relied on convenience and network-based sampling, the number of eligible individuals who viewed or received the invitation could not be determined and a formal response rate could not be calculated. The sample should therefore be regarded as an exploratory multidisciplinary cohort rather than a nationally representative sample of the Australian anaesthesia workforce.

2.3 Survey Development

The questionnaire was developed to examine psychological wellbeing, fatigue, cognitive workload, situational awareness, organisational conditions, and patient safety incident exposure within multidisciplinary Australian anaesthesia practice. Survey content was informed by literature from anaesthesia, Human Factors, occupational psychology, organisational behaviour, and patient safety.

A mixed-format questionnaire was used, combining established psychometric instruments with adapted and investigator-developed measures, a patient safety incident checklist, and optional open-ended questions[29]. This approach enabled established constructs such as burnout, fatigue, and perceived workload to be assessed alongside workplace factors that were considered particularly relevant to anaesthesia practice.

The questionnaire comprised six broad components:

1. **Participant characteristics**, including professional role, anaesthesia experience, workplace setting, employment status, weekly working hours, and on-call participation.
2. **Burnout**, assessed using the Copenhagen Burnout Inventory.
3. **Fatigue**, assessed using a modified nine-item Fatigue Assessment Scale.
4. **Cognitive workload and perceived situational awareness**, assessed using an adapted Raw NASA Task Load Index and an investigator-developed Situational Awareness measure.
5. **Organisational and workplace factors**, including staffing, workload, organisational support, psychological safety, fatigue management, production pressure, professional recognition, and workforce sustainability.
6. **Patient safety incident exposure and qualitative responses**, including eight categories of patient safety events experienced or witnessed during the preceding 12 months and four optional open-ended questions concerning workplace stress, wellbeing, and patient safety.

Established instruments were retained where they aligned with the study aims, while contextual adaptations and investigator-developed items were used to address organisational and cognitive factors not fully captured by the standard measures. These additional items were intended to provide exploratory workplace information rather than function as standalone diagnostic instruments.

Before distribution, the questionnaire underwent iterative review by experienced anaesthesia professionals to assess face validity, clarity, clinical relevance, and survey flow. Feedback resulted in minor revisions to wording, response options, and questionnaire structure. The final survey was administered electronically through Microsoft Forms and required approximately 15–20 minutes to complete.

2.4 Survey Measures

The questionnaire combined established psychometric instruments with adapted and investigator-developed measures. Scoring was structured so that higher scores consistently represented more of the construct being measured, except for Situational Awareness and Organisational Support, where higher scores represented more favourable outcomes.

[29] Kristensen et al., 2005; Michielsen et al., 2003; Hart & Staveland, 1988

2.4.1 Burnout

Burnout was assessed using the Copenhagen Burnout Inventory (CBI)[30]. The 19-item instrument comprised Personal Burnout (6 items), Work-related Burnout (7 items), and Patient-related Burnout (6 items). The original client-related domain was described as Patient-related Burnout to reflect the anaesthesia context.

Responses were converted to the established 0–100 CBI metric and mean scores were calculated separately for each domain, with higher scores indicating greater burnout. Scores of ≥50 were used descriptively to identify participants reporting at least moderate levels of burnout; these thresholds were not interpreted diagnostically.

2.4.2 Fatigue

Fatigue was assessed using a modified nine-item Fatigue Assessment Scale (FAS-9) based on the original FAS developed by Michielsen et al. (2003)[31]. Participants rated items on a five-point scale from 1 (*Never*) to 5 (*Always*). Reverse-scored items were recoded as required, and the nine items were summed to produce a total score ranging from 9 to 45, with higher scores indicating greater fatigue. Because the instrument was modified for this study, established diagnostic cut-offs from the original FAS were not applied.

2.4.3 Cognitive Workload

Perceived cognitive workload was assessed using an adapted Raw NASA Task Load Index (NASA-TLX)[32]. The six dimensions assessed mental demand, physical demand, temporal demand, perceived performance, effort, and frustration.

Each dimension was rated using seven ordered response categories from Very Low (1) to Very High (7). The perceived-performance item was reverse-scored so that higher scores consistently represented greater workload. An unweighted mean was calculated across the dimensions, with a minimum of four valid responses required, and was transformed from the original 1–7 metric to a 0–100 scale. Higher scores therefore represented greater perceived cognitive workload.

2.4.4 Situational Awareness

Perceived situational awareness and cognitive functioning were assessed using an eight-item investigator-developed measure addressing vigilance, information processing, interruptions, mental overload, fatigue, prioritisation, and stress during anaesthesia practice.

Participants responded using a five-point agreement scale. Items were recoded where necessary so that higher composite scores consistently represented more favourable perceived situational awareness and cognitive functioning. Scores were summed across the eight items, producing a possible range of 8–40.

Because this measure was developed for the present study, it was interpreted as an exploratory self-report measure rather than an objective measure of real-time clinical situational awareness or performance.

2.4.5 Organisational Support

Organisational conditions were assessed using 10 investigator-developed items addressing staffing adequacy, workload, organisational support, psychological safety, fatigue management, organisational commitment to wellbeing, production pressure, professional recognition, intention to leave, and perceived workplace burnout.

Items were rated on a five-point agreement scale and reverse-scored where required so that higher composite scores represented more favourable organisational conditions. Individual items were also retained for descriptive interpretation because they represented distinct aspects of workplace experience.

[30] Kristensen et al., 2005
[31] Michielsen et al., 2003
[32] Hart & Staveland, 1988

2.4.6 Patient Safety Incident Exposure

Patient safety experience was assessed using an eight-category checklist asking whether participants had experienced or witnessed selected patient safety events during the preceding 12 months. Categories included medication-, equipment-, and communication-related near misses; delayed recognition of deterioration; documentation errors; equipment- and medication-preparation errors requiring correction; and events resulting in formal incident reporting.

Each category was coded 0 (*No*) or 1 (*Yes*) and summed to produce a Patient Safety Incident Exposure score ranging from 0 to 8. Higher scores indicated exposure to a greater number of event categories, not greater event frequency or severity. The checklist was not treated as a psychometric scale because the items represented discrete event types rather than indicators of a single latent construct.

2.4.7 Qualitative Questions

Four optional open-ended questions asked participants about:

- contributors to workplace stress or burnout;
- changes that could improve staff wellbeing;
- the perceived effect of clinician wellbeing on patient safety; and
- any additional comments concerning cognitive workload, burnout, or patient safety.

Twenty-eight participants responded to the first question, 24 to the second, 25 to the third, and 14 provided additional comments. Responses to the first two questions were subsequently coded using descriptive content analysis, while the remaining responses were used descriptively to provide contextual information.

Table 1. *Summary of Study Measures*

Measure	Construct	Items	Response format	Scoring and interpretation
Copenhagen Burnout Inventory	Personal, work-related and patient-related burnout	19	Five-category frequency/intensity scales	Three 0–100 subscale scores; higher = greater burnout
Modified Fatigue Assessment Scale	Physical and mental fatigue	9	Five-point scale, 1–5	Sum 9–45; higher = greater fatigue
Adapted Raw NASA-TLX	Perceived cognitive workload	6	Seven-category scale, 1–7	Performance reverse-scored; unweighted mean transformed to 0–100; higher = greater workload
Situational Awareness measure	Perceived vigilance, awareness and cognitive functioning	8	Five-point agreement scale	Sum 8–40; higher = more favourable situational awareness
Organisational Support measure	Staffing, workload, support, fatigue management, recognition and workplace conditions	10	Five-point agreement scale	Composite score; higher = more favourable organisational conditions
Patient Safety Incident Exposure checklist	Breadth of exposure to patient safety event categories	8	Yes/No	Sum 0–8; higher = exposure to more event categories
Open-ended questions	Workplace experiences and improvement priorities	4	Free text	Descriptive content analysis

2.5 Data Collection and Data Management

Survey responses were collected using an anonymous online questionnaire administered through Microsoft Forms. Recruitment materials were first distributed on 30 May 2026, and completed responses were recorded from 31 May to 1 August 2026. The electronic format enabled participation across different geographical locations, workplace settings, professional groups, and roster patterns.

Before accessing the questionnaire, participants were provided with a Participant Information Statement describing the study purpose, eligibility criteria, expected completion time, voluntary nature of participation, confidentiality arrangements, potential risks, and proposed use of the data. Submission of the anonymous questionnaire constituted consent to participate, and participants could discontinue before submission without consequence.

The survey was designed not to collect names, email addresses, employer names, hospital identifiers, or other directly identifying information. Responses were stored electronically before export to Microsoft Excel for screening and preparation and subsequently to IBM SPSS Statistics for statistical analysis[33].

A total of 80 completed questionnaires were received. No submissions were excluded following eligibility, duplication, or completeness screening, and all 80 were retained in the quantitative dataset. Two isolated item-level responses were missing from the organisational measure; affected participants remained in the dataset and contributed to analyses for which valid data were available.

Survey responses were converted into numeric variables according to predetermined coding schemes. Reverse-worded items were recoded so that composite measures had consistent scoring directions, and total or mean scores were calculated for Personal Burnout, Work-related Burnout, Patient-related Burnout, Fatigue, Cognitive Workload, Situational Awareness, Organisational Support, and Patient Safety Incident Exposure. The original survey variables were retained alongside derived variables to preserve an auditable record of data transformation. Scores were checked against theoretically possible ranges before inferential analysis.

2.6 Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics, Version 31.0.2.0, with supplementary data preparation undertaken in Microsoft Excel[34]. Analyses were designed to describe the sample, assess internal consistency of the study measures, examine relationships among the principal variables, compare selected participant groups, and explore factors associated with Patient Safety Incident Exposure.

Continuous variables were summarised using means and standard deviations, with categorical variables reported as frequencies and percentages. Distributions were examined using histograms, normal Q–Q plots, skewness and kurtosis statistics, and the Shapiro–Wilk test. Data were also screened for implausible values and potential outliers before inferential analyses.

Internal consistency was assessed using Cronbach's alpha (α) [35] for the Personal Burnout, Work-related Burnout, and Patient-related Burnout subscales; modified FAS-9; adapted NASA-TLX; Situational Awareness measure; and Organisational Support measure. Coefficients of approximately .70, .80, and .90 were interpreted as acceptable, good, and excellent, respectively. Cronbach's alpha was not calculated for the Patient Safety Incident Exposure checklist because its items represented discrete event categories rather than indicators of a single underlying construct.

Relationships among Personal Burnout, Work-related Burnout, Patient-related Burnout, Fatigue, Cognitive Workload, Situational Awareness, Organisational Support, and Patient Safety Incident Exposure were examined using Pearson product–moment correlations. Correlations were interpreted with reference to absolute values of approximately .10, .30, and .50 as small, moderate, and large associations, respectively[36]. Higher Situational Awareness and Organisational Support scores represented more favourable outcomes.

[33] IBM Corp., 2025
[34] IBM Corp., 2025
[35] Cronbach, 1951
[36] Cohen, 1988

Professional-group differences were examined using Welch's one-way analysis of variance, which was selected because group sizes were unequal and homogeneity of variance could not be assumed consistently[37]. Comparisons included anaesthesia technicians/anaesthetic healthcare practitioners, anaesthetic nurses, consultant anaesthetists, and anaesthesia registrars. Students were excluded from these analyses because the subgroup was too small ($n = 4$) for meaningful inferential comparison. Outcomes were Personal Burnout, Work-related Burnout, Patient-related Burnout, Fatigue, Cognitive Workload, and Patient Safety Incident Exposure.

Where an omnibus professional-group comparison was significant, pairwise comparisons were performed using Welch's independent-samples *t*-tests[38]. Pairwise *p* values were adjusted using the Holm sequential procedure to control the family-wise error rate[39], and Hedges' *g* was calculated to describe the magnitude of between-group differences[40].

Participants who undertook on-call duties were compared with those who did not using Welch's independent-samples *t*-tests for the same six outcomes. Hedges' *g* was calculated for effect-size estimation. These on-call comparisons were exploratory and individual *p* values were not adjusted for multiple testing; they were therefore interpreted cautiously. The underlying analysis used two-tailed tests with statistical significance defined as $p < .05$.

An exploratory standard multiple linear regression was conducted with Patient Safety Incident Exposure as the dependent variable. Personal Burnout, Work-related Burnout, Patient-related Burnout, Fatigue, Cognitive Workload, Situational Awareness, and Organisational Support were entered simultaneously as predictors. Regression assumptions were evaluated using residual plots, assessment of residual normality, the Durbin–Watson statistic, tolerance values, and variance inflation factors. Because the outcome was a bounded count of event categories ranging from 0 to 8 and several predictors were strongly intercorrelated, the model was treated as exploratory and individual regression coefficients were interpreted cautiously.

Qualitative responses were analysed using descriptive content analysis. Responses concerning contributors to workplace stress and burnout and suggested improvements to staff wellbeing were reviewed iteratively and coded into recurring descriptive categories. Responses could receive more than one code where multiple issues were identified, and category percentages were calculated using the number of respondents to the relevant question as the denominator. Responses concerning the perceived relationship between wellbeing and patient safety, together with additional comments, were reviewed descriptively but were not included in the formal frequency coding. Direct quotations were retained in their original wording except where minimal de-identification was necessary.

Missing data were minimal. Pairwise deletion was used for correlation analyses, while analyses requiring complete observations used available complete cases; no missing values were imputed. All inferential tests were two-tailed with $\alpha = .05$, and findings were interpreted as associations rather than evidence of causation.

2.7 Ethical Considerations

This study involved an anonymous survey of adult anaesthesia professionals and students undertaking supervised anaesthesia training. Formal review or approval by a Human Research Ethics Committee was not obtained. The study was nevertheless designed with reference to the principles of respect, research merit and integrity, justice, and beneficence described in the *National Statement on Ethical Conduct in Human Research*[41].

Participation was voluntary. Before accessing the questionnaire, prospective participants were provided with a Participant Information Statement outlining the study purpose, eligibility criteria, expected completion time, voluntary nature of participation, confidentiality arrangements, potential risks, and intended use of the information collected. Proceeding with and submitting the anonymous questionnaire constituted consent to participate. Participants could discontinue at any point before submission without penalty; because submitted responses were anonymous, individual responses could not subsequently be identified and withdrawn.

[37] Welch, 1951
[38] Welch, 1947
[39] Holm, 1979
[40] Hedges, 1981
[41] National Health and Medical Research Council, 2023

The questionnaire addressed burnout, fatigue, workplace conditions, organisational support, and patient safety experiences. Participants were not required to answer optional open-ended questions and could cease participation before submission if they experienced discomfort. Patient safety questions concerned broad categories of events experienced or witnessed during the preceding 12 months and did not request identification of individual patients, colleagues, healthcare facilities, or specific incidents.

The questionnaire was designed not to collect names, email addresses, employer names, hospital identifiers, or other directly identifying information. Results were reported in aggregate form, and free-text responses were reviewed for potentially identifying details before inclusion in the manuscript. Where necessary, identifying information was removed while otherwise preserving participants' original wording.

Survey data were stored electronically in password-protected systems and exported to Microsoft Excel and IBM SPSS Statistics for preparation and analysis. Access to the research data was restricted to the researcher. The absence of formal ethics review is acknowledged as a governance limitation, and the study should not be represented as having received institutional ethics approval or exemption.

3. Results

Quantitative and qualitative findings are presented according to the study objectives. Results begin with participant characteristics and descriptive findings, followed by reliability, correlations, professional-group and on-call comparisons, exploratory regression, and qualitative findings. Statistical findings are interpreted as associations rather than evidence of causal relationships.

3.1 Participant Characteristics

All 80 completed survey submissions were retained in the final quantitative dataset. The sample represented a multidisciplinary anaesthesia workforce, with anaesthesia technicians/anaesthetic healthcare practitioners comprising the largest professional group (n = 30, 37.5%), followed by anaesthetic nurses (n = 21, 26.3%), consultant anaesthetists (n = 15, 18.8%), anaesthesia registrars (n = 10, 12.5%), and students (n = 4, 5.0%).

Participants represented a broad range of clinical experience and employment contexts. More than half had over 10 years of anaesthesia experience (n = 41, 51.3%), while 62.5% were employed full-time. Public hospitals were the most frequently reported primary work setting (n = 29, 36.3%), although private, mixed public/private, rural, and day-hospital settings were also represented. Most participants reported usually working between 30 and 49 hours per week (n = 62, 77.5%), and 44 participants (55.0%) undertook on-call duties.

Students were retained in descriptive, reliability, correlation, and regression analyses where valid data were available but were excluded from subsequent professional-group inferential comparisons because of the small student subgroup (n = 4).

Table 2. *Participant Characteristics (N = 80)*

Characteristic	Category	*n*	%
Professional role	Anaesthesia technician/anaesthetic healthcare practitioner	30	37.5
	Anaesthetic nurse	21	26.3
	Consultant anaesthetist	15	18.8
	Anaesthesia registrar	10	12.5
	Student	4	5.0
Years in anaesthesia	<1 year	5	6.3
	1–5 years	14	17.5
	6–10 years	20	25.0
	11–20 years	20	25.0
	>20 years	21	26.3
Primary work setting	Public hospital	29	36.3
	Private hospital	19	23.8

	Mixed public/private hospital	12	15.0
	Rural hospital	12	15.0
	Day hospital	7	8.8
	Other	1	1.3
Employment arrangement	Full-time	50	62.5
	Part-time	17	21.3
	Casual	11	13.8
	Agency	2	2.5
Usual weekly hours	<20 hours	3	3.8
	20–29 hours	13	16.3
	30–39 hours	41	51.3
	40–49 hours	21	26.3
	≥50 hours	2	2.5
On-call duties	Yes	44	55.0
	No	36	45.0

Note. Percentages may not total 100.0 because of rounding.

3.2 Burnout, Fatigue and Cognitive Workload

Descriptive statistics for burnout, fatigue, and perceived cognitive workload are presented in Table 3. Personal Burnout produced the highest mean Copenhagen Burnout Inventory score (M = 45.42, SD = 18.77), followed by Work-related Burnout (M = 42.77, SD = 20.19) and Patient-related Burnout (M = 32.76, SD = 25.72).

Using a CBI score of ≥50 as a descriptive indicator of at least moderate burnout, 35 participants (43.8%) met or exceeded this threshold for Personal Burnout, 29 (36.3%) for Work-related Burnout, and 18 (22.5%) for Patient-related Burnout. These thresholds were used descriptively and should not be interpreted as diagnostic prevalence estimates.

The modified FAS-9 produced a mean fatigue score of 20.83 (SD = 6.95) across the possible range of 9–45. Scores ranged from 10 to 37, indicating considerable variability in self-reported fatigue across the cohort. Because the FAS was modified for this study, established clinical cut-offs for the original instrument were not applied.

Perceived cognitive workload measured using the adapted NASA-TLX had a mean score of 60.59 (SD = 15.86) on the transformed 0–100 metric, with observed scores ranging from 25.00 to 94.44. The measure was analysed continuously; therefore, participants were not classified into low, moderate, or high workload categories.

Overall, the descriptive results demonstrated substantial variation in psychological wellbeing, fatigue, and perceived cognitive workload within the multidisciplinary sample. Personal and Work-related Burnout were more prominent than Patient-related Burnout when the descriptive CBI threshold was applied, while fatigue and workload scores also varied considerably between participants.

Table 3. *Descriptive Statistics for Burnout, Fatigue and Cognitive Workload (N = 80)*

Measure	Possible range	*M*	*SD*	Median	Observed range	≥50, *n* (%)
Personal Burnout	0–100	45.42	18.77	43.75	4.17–79.17	35 (43.8)
Work-related Burnout	0–100	42.77	20.19	39.29	3.57–92.86	29 (36.3)
Patient-related Burnout	0–100	32.76	25.72	29.17	0.00–100.00	18 (22.5)
Modified FAS-9	9–45	**20.83**	**6.95**	19.00	10.00–37.00	—
Adapted NASA-TLX	0–100	60.59	15.86	58.33	25.00–94.44	—

Note. M = mean; SD = standard deviation. The ≥50 criterion applies only to the Copenhagen Burnout Inventory subscales and was used descriptively rather than diagnostically. The modified FAS-9 and adapted NASA-TLX were analysed as continuous measures.

3.3 Organisational Conditions and Workplace Perceptions

Participants reported mixed perceptions of their organisational environments. Some aspects of day-to-day work were viewed relatively favourably, while staffing, fatigue management, organisational commitment to wellbeing, psychological safety, and production pressure emerged as less consistently positive areas.

Almost two-thirds of participants agreed that their workload was manageable (n = 51, 63.8%), and 39 participants (48.8%) agreed that they felt recognised and respected within their professional role. However, only 33 participants (41.3%) agreed that staffing levels were adequate for safe patient care, and 30 (37.5%) agreed that they felt supported by their workplace.

Perceptions relating to fatigue and organisational wellbeing were less favourable. Only 19 participants (23.8%) agreed that fatigue was appropriately managed within their workplace, while 22 (27.5%) agreed that their workplace valued staff wellbeing. Psychological safety was also variable: 34 participants (42.5%) agreed that they felt safe speaking up about concerns.

Production pressure was particularly prominent. Of the 79 participants who answered this item, 66 (83.5%) agreed or strongly agreed that production pressure negatively affected patient safety. This result reflects participants' perceptions and should not be interpreted as evidence that production pressure directly caused patient safety incidents.

Workforce sustainability concerns were also evident. Twenty-six participants (32.5%) agreed that they had considered leaving the profession during the preceding 12 months, while 47 (58.8%) agreed that burnout was a significant issue within their workplace.

Overall, the organisational findings revealed a contrast between participants' capacity to manage their immediate clinical workload and less favourable perceptions of some of the systems surrounding that work. In particular, fatigue management, organisational commitment to wellbeing, staffing, workplace support, and production pressure warrant attention when interpreting the relationships between organisational conditions and psychological wellbeing examined later in the Results.

Table 4. *Organisational and Workplace Perceptions (N = 80)*

Workplace statement	Valid *n*	Agree/strongly agree, *n* (%)
Staffing levels are adequate for safe patient care	80	33 (41.3)
I feel supported by my workplace	80	30 (37.5)
My workload is manageable	80	51 (63.8)
I feel psychologically safe speaking up about concerns	80	34 (42.5)
Fatigue is appropriately managed within my workplace	80	19 (23.8)
My workplace values staff wellbeing	80	22 (27.5)
Production pressure negatively affects patient safety	79	66 (83.5)
I feel recognised and respected within my professional role	80	39 (48.8)
I have considered leaving the profession in the past 12 months	80	26 (32.5)
Burnout is a significant issue within my workplace	80	47 (58.8)

Note. Values represent participants selecting *Agree* or *Strongly Agree*. Because several items are negatively worded, agreement does not consistently represent a favourable organisational outcome. One response was missing for the production-pressure item.

3.4 Patient Safety Incident Exposure

Participants were asked whether they had experienced or witnessed eight categories of patient safety events during the preceding 12 months. The measure captured exposure to different event categories within the workplace and did not determine whether participants had personally caused or been directly responsible for an incident.

Participants reported exposure to a mean of 3.99 event categories (*SD* = 1.98) from the eight categories assessed. Scores ranged from 0 to 8, indicating considerable variation in the breadth of patient safety events experienced or witnessed across the cohort.

The most frequently reported category was a communication-related near miss, endorsed by 54 participants (67.5%). This was followed by a patient safety incident resulting in formal reporting (*n* = 48, 60.0%), wrong equipment preparation requiring correction (*n* = 43, 53.8%), medication-related near misses (*n* = 42, 52.5%), and equipment-related near misses (*n* = 41, 51.3%). Medication preparation errors requiring correction were reported by 36 participants (45.0%), documentation errors affecting patient care by 35 (43.8%), and delayed recognition of patient deterioration by 20 (25.0%).

These findings demonstrate that participants encountered patient safety events across communication, medication, equipment, documentation, and patient-monitoring domains. Importantly, the cumulative score represented the number of different event categories experienced or witnessed, rather than the number of individual incidents. It did not measure event frequency, severity, preventability, resulting patient harm, or individual responsibility.

Higher Patient Safety Incident Exposure scores may therefore reflect greater opportunity to encounter or observe events—for example through clinical workload, professional responsibilities, case complexity, workplace setting, or after-hours activity—rather than poorer individual clinical performance. Associations between incident exposure and the psychological, cognitive, and organisational study variables are examined in the subsequent analyses.

Table 5. *Patient Safety Incident Exposure During the Preceding 12 Months (N = 80)*

Event category experienced or witnessed	*n*	%
Communication-related near miss	54	67.5
Patient safety incident resulting in formal reporting	48	60.0
Wrong equipment preparation requiring correction	43	53.8
Medication-related near miss	42	52.5
Equipment-related near miss	41	51.3
Medication preparation error requiring correction	36	45.0
Documentation error affecting patient care	35	43.8
Delayed recognition of patient deterioration	20	25.0

Note. Multiple categories could be endorsed. The cumulative Patient Safety Incident Exposure score represented breadth of exposure (*M* = 3.99, *SD* = 1.98; observed range = 0–8) rather than the frequency or severity of individual incidents.

3.5 Reliability of the Study Measures

Internal consistency was assessed using Cronbach's alpha for the three Copenhagen Burnout Inventory subscales, modified FAS-9, adapted NASA-TLX, Situational Awareness measure, and Organisational Support measure. Reliability coefficients ranged from $\alpha = .774$ to $\alpha = .938$, with all retained composite measures exceeding the prespecified acceptable threshold of $\alpha \geq .70$.

The Copenhagen Burnout Inventory demonstrated strong internal consistency. Personal Burnout produced $\alpha = .886$, Work-related Burnout $\alpha = .900$, and Patient-related Burnout $\alpha = .938$. The modified FAS-9 also demonstrated excellent internal consistency ($\alpha = .908$).

The adapted NASA-TLX demonstrated acceptable internal consistency ($\alpha = .774$). This lower coefficient relative to the burnout and fatigue measures is consistent with its assessment of several related but distinct workload dimensions and does not imply that the instrument measures a single homogeneous psychological construct.

The investigator-developed measures also performed satisfactorily within this sample. Situational Awareness demonstrated good internal consistency (α = .829), while Organisational Support demonstrated good internal consistency (α = .883). These findings supported use of their composite scores in subsequent analyses, although they do not establish broader psychometric validity and the measures should remain interpreted as exploratory.

Cronbach's alpha was not calculated for the Patient Safety Incident Exposure checklist, because its eight items represented distinct event categories rather than interchangeable indicators of one latent construct.

Table 6. *Internal Consistency of the Retained Study Measures*

Measure	Items	Cronbach's α	Interpretation
Personal Burnout	6	.886	Good
Work-related Burnout	7	.900	Excellent
Patient-related Burnout	6	.938	Excellent
Modified FAS-9	9	.908	Excellent
Adapted NASA-TLX	6	.774	Acceptable
Situational Awareness	8	.829	Good
Organisational Support	10	.883	Good

Note. Cronbach's alpha was not calculated for the eight-category Patient Safety Incident Exposure checklist because the items represented distinct event types rather than indicators of a single underlying construct. The modified FAS-9, adapted NASA-TLX, Situational Awareness, and Organisational Support measures should be interpreted in light of their adaptations or investigator-developed status.

3.6 Correlations Among the Principal Study Variables

Pearson correlations were used to examine relationships among Personal Burnout, Work-related Burnout, Patient-related Burnout, Fatigue, Cognitive Workload, Situational Awareness, Organisational Support, and Patient Safety Incident Exposure. The complete correlation matrix is presented in Table 7.

Burnout, fatigue, and cognitive workload were strongly interrelated. Personal Burnout was positively associated with Work-related Burnout ($r = .857$, $p < .001$), Fatigue ($r = .842$, $p < .001$), and Cognitive Workload ($r = .629$, $p < .001$). The strongest association in the analysis was between Work-related Burnout and Fatigue ($r = .881$, $p < .001$). Patient-related Burnout was also associated with Fatigue ($r = .690$, $p < .001$) and Cognitive Workload ($r = .691$, $p < .001$), while Fatigue and Cognitive Workload were strongly correlated ($r = .678$, $p < .001$).

Situational Awareness showed significant negative associations with all burnout, fatigue, and workload measures. The strongest relationship was with Patient-related Burnout ($r = −.779$, $p < .001$), followed by Cognitive Workload ($r = −.722$, $p < .001$) and Fatigue ($r = −.702$, $p < .001$). Because higher Situational Awareness scores represented more favourable perceived functioning, these relationships indicate that greater psychological and cognitive strain was associated with less favourable perceived situational awareness.

More favourable Organisational Support was associated with lower Personal Burnout ($r = −.626$), Work-related Burnout ($r = −.715$), Patient-related Burnout ($r = −.524$), Fatigue ($r = −.683$), and Cognitive Workload ($r = −.569$), with all $p < .001$. Organisational Support was also positively associated with Situational Awareness ($r = .467$, $p < .001$).

In contrast, Patient Safety Incident Exposure was not significantly correlated with any psychological, cognitive, or organisational measure. Correlations ranged from $r = −.063$ to $r = .129$, with all $p \geq .252$.

Overall, the analysis demonstrated substantial interrelationships among burnout, fatigue, cognitive workload, situational awareness, and organisational support, but no significant bivariate relationship between these constructs and the breadth of Patient Safety Incident Exposure.

Table 7. *Pearson Correlations Among the Principal Study Variables (N = 80)*

Variable	1	2	3	4	5	6	7	8
1. Personal Burnout	—							
2. Work-related Burnout	.857***	—						
3. Patient-related Burnout	.586***	.668***	—					
4. Fatigue	.842***	.881***	.690***	—				
5. Cognitive Workload	.629***	.678***	.691***	.678***	—			
6. Situational Awareness	−.614***	−.630***	−.779***	−.702***	−.722***	—		
7. Organisational Support	−.626***	−.715***	−.524***	−.683***	−.569***	.467***	—	
8. Patient Safety Incident Exposure	.033	.061	.129	.004	−.063	−.032	−.019	—

Note. Higher Situational Awareness and Organisational Support scores represent more favourable outcomes. Higher Patient Safety Incident Exposure scores represent exposure to a greater number of event categories experienced or witnessed during the preceding 12 months. *** $p < .001$. All tests were two-tailed. Patient Safety Incident Exposure was not significantly correlated with any other variable.

3.7 Professional-Group and On-Call Comparisons

Professional-group differences were examined among anaesthesia technicians/anaesthetic healthcare practitioners, anaesthetic nurses, consultant anaesthetists, and anaesthesia registrars. Students were excluded from these comparisons because of the small subgroup size ($n = 4$).

Significant professional-group differences were identified for Personal Burnout, Work-related Burnout, Patient-related Burnout, Fatigue, and Cognitive Workload, with all omnibus Welch tests reaching $p < .001$. Anaesthetic nurses reported the highest mean scores for each of these outcomes: Personal Burnout ($M = 58.93$), Work-related Burnout ($M = 59.69$), Patient-related Burnout ($M = 65.28$), Fatigue ($M = 28.05$), and Cognitive Workload ($M = 75.93$).

Holm-adjusted pairwise comparisons showed that anaesthetic nurses scored significantly higher than each of the other three professional groups across all five psychological and cognitive outcomes. Registrars also reported significantly greater Cognitive Workload than consultant anaesthetists. The magnitude of many nurse-group differences was substantial, indicating that the omnibus findings were not attributable solely to unequal subgroup sizes.

In contrast, professional groups did not differ significantly in Patient Safety Incident Exposure, Welch $F = 0.464$, $p = .709$. Mean incident-exposure scores were similar for technicians/AHPs ($M = 3.97$), anaesthetic nurses ($M = 4.38$), consultant anaesthetists ($M = 4.07$), and registrars ($M = 3.70$).

On-call comparisons:

Participants undertaking on-call duties ($n = 44$) did not differ significantly from those without on-call responsibilities ($n = 36$) in Personal Burnout, Work-related Burnout, Patient-related Burnout, Fatigue, or Cognitive Workload.

However, participants undertaking on-call duties reported exposure to a significantly greater number of patient safety event categories ($M = 4.39$, $SD = 1.83$) than participants who did not undertake on-call duties ($M = 3.50$, $SD = 2.06$), Welch $t = 2.01$, $p = .048$, Hedges' $g = 0.45$.

This difference should not be interpreted as evidence that on-call work caused additional patient safety incidents. Because the outcome represented categories of events experienced or witnessed, greater exposure

among on-call participants may reflect differences in clinical exposure, case mix, emergency activity, or opportunities to observe safety events.

Overall, professional role was associated with marked differences in psychological wellbeing and cognitive workload, with anaesthetic nurses consistently reporting the least favourable outcomes. Patient Safety Incident Exposure was similar across professional groups but modestly higher among participants undertaking on-call duties.

Table 8. *Professional-Group and On-Call Comparisons*

Panel A. Professional-group comparisons

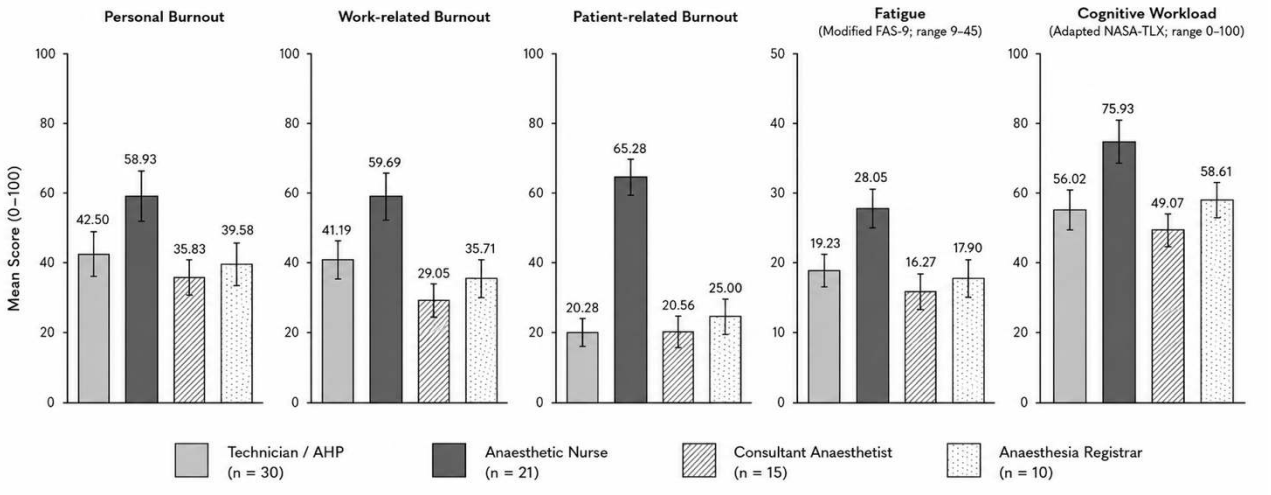
Outcome	Technician/AHP *n*= 30	Anaesthetic nurse *n*= 21	Consultant *n* = 15	Registrar *n* = 10	Welch *F*	*p*
Personal Burnout	42.50 (21.73)	**58.93 (13.26)**	35.83 (15.17)	39.58 (11.83)	9.700	<.001
Work-related Burnout	41.19 (23.12)	**59.69 (15.57)**	29.05 (11.20)	35.71 (5.05)	17.045	<.001
Patient-related Burnout	20.28 (16.48)	**65.28 (23.06)**	20.56 (12.04)	25.00 (12.11)	21.578	<.001
Fatigue	19.23 (6.68)	**28.05 (5.47)**	16.27 (4.43)	17.90 (2.42)	20.426	<.001
Cognitive Workload	56.02 (15.56)	**75.93 (13.62)**	49.07 (9.25)	58.61 (4.62)	16.324	<.001
Patient Safety Incident Exposure	3.97 (2.36)	4.38 (1.69)	4.07 (1.98)	3.70 (1.42)	0.464	**.709**

Panel B. On-call comparisons

Outcome	On-call *n* = 44	No on-call *n* = 36	Welch *t*	*p*	Hedges' *g*
Personal Burnout	45.55 (16.63)	45.25 (21.34)	0.07	.946	0.02
Work-related Burnout	42.37 (18.64)	43.25 (22.19)	−0.19	.850	−0.04
Patient-related Burnout	32.58 (24.91)	32.99 (27.03)	−0.07	.944	−0.02
Fatigue	20.34 (6.45)	21.42 (7.56)	−0.68	.501	−0.15
Cognitive Workload	60.73 (14.36)	60.42 (17.72)	0.09	.932	0.02
Patient Safety Incident Exposure	**4.39 (1.83)**	**3.50 (2.06)**	**2.01**	**.048**	**0.45**

Note. Values are *M* (*SD*). Students were excluded from professional-group comparisons. Pairwise professional-group tests used Holm-adjusted *p* values. On-call comparisons were exploratory and were not adjusted for multiple testing. AHP = anaesthetic healthcare practitioner.

Figure 2. *Psychological and Cognitive Outcomes by Professional Group*



Note. Values are mean scores with standard deviation error bars. Higher scores indicate greater burnout, fatigue and cognitive workload. Students (n = 4) were excluded from professional-group comparisons because of the small subgroup size.
AHP = anaesthetic healthcare practitioner.

3.8 Exploratory Multiple Regression Analysis

An exploratory standard multiple linear regression was conducted to examine whether Personal Burnout, Work-related Burnout, Patient-related Burnout, Fatigue, Cognitive Workload, Situational Awareness, and Organisational Support were independently associated with Patient Safety Incident Exposure. All seven predictors were entered simultaneously.

The overall regression model was not statistically significant, $F(7, 72) = 0.894$, $p = .516$. The model produced $R = .283$ and explained 8.0% of the variance in Patient Safety Incident Exposure ($R^2 = .080$); however, the adjusted R^2 was −.009, indicating little explanatory value after accounting for the number of predictors included.

None of the seven predictors made a statistically significant independent contribution to Patient Safety Incident Exposure. Patient-related Burnout produced the largest positive standardised coefficient ($\beta = .345$, $p = .087$), while Cognitive Workload produced the largest negative coefficient ($\beta = -.306$, $p = .102$); neither reached statistical significance. Personal Burnout ($\beta = .060$, $p = .802$), Work-related Burnout ($\beta = .248$, $p = .392$), Fatigue ($\beta = -.296$, $p = .294$), Situational Awareness ($\beta = .001$, $p = .995$), and Organisational Support ($\beta < .001$, $p = .999$) were also non-significant.

Regression diagnostics did not indicate major problems with residual independence, normality, linearity, or homoscedasticity. The Durbin–Watson statistic was 1.842, and standardised residuals ranged from −2.31 to 2.06. However, substantial overlap was evident among several psychological predictors. Work-related Burnout had the highest variance inflation factor (VIF = 6.52), followed by Fatigue (VIF = 6.12) and Personal Burnout (VIF = 4.41), consistent with the strong correlations identified in Section 3.6.

Overall, the regression analysis did not provide evidence that burnout, fatigue, cognitive workload, situational awareness, or organisational support independently explained variation in the breadth of patient safety incident categories experienced or witnessed within this sample. This finding is consistent with the preceding bivariate analyses, in which Patient Safety Incident Exposure was not significantly correlated with any principal psychological, cognitive, or organisational measure.

Because the dependent variable was a bounded count ranging from 0 to 8, and several predictors were strongly intercorrelated, the model should be regarded as exploratory. Importantly, the non-significant result does not demonstrate that clinician wellbeing or organisational conditions are unrelated to patient safety more broadly; it

indicates only that these variables did not explain variation in this particular measure of incident-category exposure.

Table 9. *Multiple Linear Regression Predicting Patient Safety Incident Exposure (N = 80)*

Predictor	*B*	*SE B*	β	*t*	*p*	95% CI for *B*	VIF
Constant	16.237	8.835	—	1.838	.070	−1.375, 33.849	—
Personal Burnout	.006	.025	.060	.252	.802	−.044, .056	4.408
Work-related Burnout	.024	.028	.248	.861	.392	−.032, .081	6.523
Patient-related Burnout	.027	.015	.345	1.737	.087	−.004, .057	3.090
Fatigue	−.084	.080	−.296	−1.058	.294	−.243, .074	6.117
Cognitive Workload	−.636	.384	−.306	−1.655	.102	−1.402, .130	2.676
Situational Awareness	.001	.076	.001	.007	.995	−.151, .152	3.390
Organisational Support	−.000	.039	<.001	−.001	.999	−.078, .078	2.171

Note. Dependent variable = Patient Safety Incident Exposure. $R = .283$; $R^2 = .080$; adjusted $R^2 = -.009$; $F(7, 72) = 0.894$, $p = .516$; standard error of estimate = 1.99; Durbin–Watson = 1.842. Cognitive Workload was entered into the SPSS model using the raw 1–7 NASA-TLX composite; therefore, its unstandardised coefficient (*B*) is expressed on that scale. The standardised coefficient (β) is unaffected by the subsequent linear transformation to the 0–100 metric.

3.9 Qualitative Findings

Optional open-ended responses provided contextual information about participants' workplace experiences. Twenty-eight participants responded to the question concerning contributors to workplace stress and burnout, 24 suggested changes to improve staff wellbeing, 25 commented on the perceived effect of clinician wellbeing on patient safety, and 14 provided additional comments.

3.9.1 Contributors to Workplace Stress and Burnout

Among the 28 participants who described contributors to workplace stress or burnout, the two most frequently coded categories were staffing shortages or inadequate skill mix ($n = 11$, 39.3%) and workload, overtime, or production pressure ($n = 11$, 39.3%). Leadership, organisational support, or professional recognition was identified by five participants (17.9%), while four (14.3%) referred to interpersonal conflict or disrespect. Less frequently identified concerns included clinical acuity or demanding cases, financial pressure, inadequate recovery opportunities, and equipment or resource constraints. Because individual responses could contribute to more than one category, percentages do not sum to 100%.

Participants frequently described staffing and workload as interconnected rather than independent issues. One respondent identified:

"Inadequate staffing, rest breaks not available always"

Another described:

"Pressure of service requirements - back log of waiting lists and putting more patients on lists, expectations that day staff will just stay on to finish over running lists."

Concerns also extended to leadership responsiveness and professional recognition, with one participant describing:

"Not being heard when you go to higher up with concerns and get dismissed Understaffed and under appreciated"

These quotations are drawn directly from the survey responses.

3.9.2 Suggested Improvements to Staff Wellbeing

Participants' proposed solutions largely reflected the organisational conditions identified as sources of strain. Increasing staffing or improving skill mix was the most frequently coded recommendation (n = 9, 37.5%), followed by improving leadership, listening, or professional recognition (n = 7, 29.2%) and reducing overtime, workload, or operating-list overbooking (n = 6, 25.0%). Improvements to pay, incentives, or the physical working environment were identified by three participants (12.5%), protected breaks and recovery by two (8.3%), and improved equipment or resources by one (4.2%).

Representative recommendations included:

"Enforcing rest breaks, more staff"

and:

"Listen to staff when they come with issues and solutions to some problems"

One participant specifically advocated for:

"Protected staff hours- no forced overtime. Flexible roster"

These responses indicate that suggested improvements were directed predominantly towards work-system and organisational changes, rather than solely towards individual coping strategies.

3.9.3 Perceived Relationship Between Wellbeing and Patient Safety

Twenty-five participants described how they believed clinician wellbeing could affect patient safety. These responses were reviewed descriptively rather than subjected to the formal category-frequency coding used for the first two questions. Participants commonly referred to concentration, communication, fatigue, attentiveness, frustration, and cognitive performance as potential mechanisms linking clinician wellbeing with clinical care.

For example, participants stated:

"With wellbeing being down, patients are at a higher risk of error, and a higher risk of poor communication"

and:

"Directly, fatigue, frustration impair cognition. Increases risks of near misses, decreases patient care"

Another summarised the effect of sustained strain more simply:

"There's a point where you just lose concentration."

These statements reflect participants' perceptions of potential mechanisms and should not be interpreted as evidence that poorer wellbeing caused patient safety incidents. This distinction is important because the quantitative analyses found no significant association between Patient Safety Incident Exposure and burnout, fatigue, cognitive workload, situational awareness, or organisational support.

Fourteen participants also provided additional comments. These expanded on prolonged working hours, management practices, differences between workplaces, training and skill mix, professional conflict, and the cumulative demands of clinical work. Detailed comments with greater potential to identify an individual or workplace were not reproduced.

Overall, the qualitative findings located many of the reported sources of strain—and the proposed solutions—within the organisation of work. Staffing and skill mix, workload and overtime, production pressure, leadership, recognition, workplace relationships, and opportunities for recovery were recurrent concerns. Participants also

perceived wellbeing as relevant to their capacity to sustain attention, communication, and safe clinical performance, although this perceived relationship was not reflected in the quantitative Patient Safety Incident Exposure measure.

Table 10. *Descriptive Content Analysis of Workplace Stressors and Suggested Improvements*

Question and category	*n*	%
Contributors to workplace stress/burnout (n = 28)		
Staffing shortages/inadequate skill mix	11	39.3
Workload, overtime and production pressure	11	39.3
Leadership, support and recognition	5	17.9
Interpersonal conflict/disrespect	4	14.3
Clinical acuity/demanding cases	2	7.1
Financial pressure	2	7.1
Breaks and recovery	1	3.6
Equipment/resource constraints	1	3.6
Suggested workplace improvements (n = 24)		
Increase staffing/improve skill mix	9	37.5
Improve leadership, listening and recognition	7	29.2
Reduce overtime, workload or overbooking	6	25.0
Improve pay, incentives or physical environment	3	12.5
Protect breaks and recovery	2	8.3
Improve equipment and resources	1	4.2

Note. Responses could be assigned to more than one category; therefore, frequencies and percentages do not sum to the number of respondents or 100%. Formal frequency coding was applied only to the first two open-ended questions.

4. Discussion

4.1 Principal Findings

The present study examined burnout, fatigue, cognitive workload, situational awareness, organisational support, and patient safety incident exposure within a multidisciplinary cohort of Australian anaesthesia professionals and students. Considered together, the findings suggest that clinician wellbeing and cognitive functioning are closely interconnected with perceptions of the organisational environment, while the relationship between these factors and reported patient safety incident exposure is substantially more complex.

The clearest finding was the strength of the relationships among burnout, fatigue, and cognitive workload. Work-related Burnout was particularly strongly associated with Fatigue (r = .881), while Personal Burnout was also strongly related to Fatigue (r = .842). Cognitive Workload was positively associated with all three burnout domains and Fatigue. These findings support the first hypothesis and indicate substantial overlap between occupational exhaustion, general fatigue, and the perceived cognitive demands of anaesthesia work. They should not, however, be interpreted as establishing which factor precedes another; the cross-sectional design permits identification of association but not temporal or causal direction[42].

A similarly consistent pattern was observed for Situational Awareness and Organisational Support. Participants reporting greater burnout, fatigue, and cognitive workload also tended to report less favourable perceived situational awareness and cognitive functioning. Conversely, more favourable Organisational Support was associated with lower burnout, lower fatigue, lower cognitive workload, and better Situational Awareness.

[42] Kristensen et al., 2005; Gregory & Edsell, 2014; Bakker & Demerouti, 2007

These findings support the second hypothesis and are compatible with a systems-based interpretation in which psychological wellbeing and cognitive capacity are experienced within, rather than independently of, the conditions under which clinicians work.

Professional-group comparisons demonstrated another notable pattern. Anaesthetic nurses reported the highest burnout, fatigue, and cognitive workload scores across all five psychological and cognitive outcomes, while consultant anaesthetists generally reported the lowest scores. These professional-group differences supported H3. Patient Safety Incident Exposure, examined as an additional group outcome, did not differ significantly between professional groups. The study was not designed to determine why these professional-group differences occurred, and they may reflect differences in workplace setting, duties, autonomy, roster patterns, direct patient-care demands, staffing arrangements, or other occupational factors rather than professional role itself.

The findings relating to patient safety incident exposure were especially important. Contrary to the fourth hypothesis, Patient Safety Incident Exposure was not significantly correlated with burnout, fatigue, Cognitive Workload, Situational Awareness, or Organisational Support. The exploratory multiple regression model was also non-significant, explaining only 8.0% of the variance in incident exposure, and none of the seven predictors made a significant independent contribution. This should not be interpreted as evidence that clinician wellbeing is irrelevant to patient safety. Rather, the incident measure captured the breadth of event categories experienced or witnessed, which may be influenced by clinical exposure, case complexity, professional responsibilities, workplace setting, reporting practices, and opportunities to observe incidents[43].

This distinction is illustrated by the on-call findings. Participants undertaking on-call duties reported exposure to a greater number of patient safety event categories than those without on-call responsibilities, despite showing no significant differences in burnout, fatigue, or cognitive workload. This pattern is compatible with greater exposure to emergency activity, after-hours care, changing acuity, or opportunities to encounter safety events rather than a direct effect of psychological strain. Because the on-call analyses were exploratory and were not adjusted for multiple testing, the $p = .048$ finding should be interpreted cautiously rather than as definitive evidence of an on-call effect.

The qualitative findings provided important context for these quantitative relationships. Participants repeatedly identified staffing and skill mix, workload and overtime, production pressure, leadership, organisational support, professional recognition, workplace relationships, and opportunities for recovery as contributors to workplace strain and as targets for improvement. These accounts largely located burnout and fatigue within the organisation of work rather than portraying them as individual failures of resilience.

Collectively, the findings therefore support a Human Factors and systems-based interpretation of clinician wellbeing. Burnout, fatigue, cognitive workload, situational awareness, and organisational support appear to form an interconnected set of workforce and cognitive outcomes within anaesthesia practice. The absence of a direct statistical relationship with Patient Safety Incident Exposure does not diminish the importance of those outcomes; rather, it cautions against reducing patient safety to a simple linear relationship between clinician distress and adverse events. Safe performance occurs within complex systems in which clinicians, teams, technologies, workload, organisational resources, and multiple defensive layers interact[44].

Hypotheses at a glance

For clarity, the findings can be summarised as:

- **H1 — Supported:** greater burnout was associated with greater fatigue and cognitive workload.
- **H2 — Supported:** more favourable Organisational Support was associated with lower burnout, fatigue and workload, and better Situational Awareness.
- **H3 — Supported:** burnout, fatigue, and cognitive workload differed significantly across professional groups.
- **H4 — Not supported:** the psychological, cognitive and organisational measures were not significantly associated with Patient Safety Incident Exposure.

[43] Hall et al., 2016; Tawfik et al., 2019; Reason, 2000
[44] Reason, 2000; Carayon et al., 2006; Holden et al., 2013; Kelly et al., 2023

4.2 Burnout, Fatigue and Cognitive Workload: Interconnected Dimensions of Clinician Performance

One of the clearest findings of the present study was the strength of the relationships among burnout, fatigue, and perceived cognitive workload. Work-related Burnout was strongly associated with Fatigue ($r = .881$, $p < .001$), while Personal Burnout was similarly associated with Fatigue ($r = .842$, $p < .001$). Cognitive Workload was also positively associated with Personal Burnout ($r = .629$), Work-related Burnout ($r = .678$), Patient-related Burnout ($r = .691$), and Fatigue ($r = .678$), with all associations reaching $p < .001$.

The particularly strong relationship between Work-related Burnout and Fatigue deserves careful interpretation. Approximately 78% of their variance was shared, indicating substantial overlap between occupational exhaustion and participants' broader experience of physical and mental fatigue. This is conceptually consistent with the Copenhagen Burnout Inventory, which places exhaustion at the centre of burnout while distinguishing exhaustion attributed to work from more general personal exhaustion[45].

Burnout and fatigue should nevertheless not be treated as interchangeable constructs. Fatigue may fluctuate in response to sleep loss, prolonged working hours, sustained cognitive effort, on-call activity, and inadequate recovery, whereas burnout generally reflects a more persistent response to unresolved occupational demands. Anaesthesia is particularly vulnerable to fatigue-related pressures because clinical work requires prolonged vigilance and the ability to respond rapidly to subtle or unexpected changes in patient condition[46]. The present cross-sectional data cannot establish whether fatigue contributed to burnout, burnout intensified the experience of fatigue, or both developed in response to common workplace conditions.

The relationships with Cognitive Workload can also be interpreted through Cognitive Load Theory. Working memory has finite processing capacity, while anaesthesia requires simultaneous integration of physiological monitoring, medications, equipment, communication, documentation, surgical progress, and anticipation of possible deterioration[47]. As clinical and organisational demands increase, a greater proportion of available cognitive resources may be required simply to maintain routine performance.

Not all cognitive demand is avoidable or undesirable. Much of the workload associated with anaesthesia reflects the intrinsic complexity of providing safe care. However, additional demands arising from interruptions, inadequate staffing, inefficient processes, production pressure, competing priorities, or insufficient recovery may increase the mental effort required without contributing directly to patient care. From this perspective, the relevant question is not whether anaesthesia should be cognitively demanding, but whether avoidable system demands consume resources that clinicians may require when clinical complexity suddenly increases.

Fatigue may further amplify this relationship. Reduced alertness or processing efficiency can make an otherwise familiar clinical task require greater effort, while sustained high workload may itself contribute to fatigue through prolonged concentration and repeated management of competing demands. The direction of this relationship cannot be determined from the present data, but its consistency supports examining psychological wellbeing and cognitive workload as interconnected rather than independent workforce outcomes.

The Situational Awareness findings provide further support for this interpretation. More favourable Situational Awareness scores were associated with lower Personal Burnout ($r = -.614$), Work-related Burnout ($r = -.630$), Patient-related Burnout ($r = -.779$), Fatigue ($r = -.702$), and Cognitive Workload ($r = -.722$), with all $p < .001$. Participants experiencing greater psychological strain therefore also tended to report greater difficulty with vigilance, prioritisation, awareness, and perceived cognitive functioning[48].

These findings require an important qualification. The Situational Awareness measure was an exploratory self-report measure, not an objective assessment of real-time clinical performance. Similarly, elevated burnout, fatigue, or NASA-TLX scores should not be interpreted as evidence that a clinician was unsafe or clinically impaired. Anaesthesia professionals may continue to function effectively despite considerable workload through

[45] Kristensen et al., 2005
[46] Gregory & Edsell, 2014
[47] Sweller, 1988; Sweller et al., 2011
[48] Endsley, 1995; Schulz et al., 2013

experience, pattern recognition, structured routines, teamwork, monitoring systems, cognitive aids, and communication processes[49].

This distinction between performance and the effort required to maintain performance is central to interpreting the study. A clinician may achieve the same observable clinical outcome under both low- and high-demand conditions, while the cognitive resources required to achieve that outcome differ substantially. Consequently, an apparently successful clinical system may still impose considerable psychological and cognitive costs on the workforce[50].

The findings are also compatible with the Job Demands–Resources model, which proposes that sustained occupational demands can contribute to exhaustion when they are not adequately balanced by resources such as staffing, support, autonomy, recovery opportunities, and effective work design[51]. The qualitative findings reinforce this interpretation: participants repeatedly identified staffing shortages, workload, overtime, production pressure, leadership, and recovery as important contributors to workplace strain.

Taken together, burnout, fatigue, and cognitive workload appear to provide complementary indicators of the pressure being experienced within the anaesthesia work system, rather than direct measures of clinical competence. Their strong interrelationships suggest that interventions aimed at only one construct may have limited effect if the underlying occupational demands remain unchanged. Sustainable improvement therefore requires attention to both the psychological wellbeing of clinicians and the organisational conditions that determine how much cognitive and emotional effort is required to deliver safe care.

4.3 Adaptive Performance and Resilience in Anaesthesia

The present findings can also be interpreted through the frameworks of Safety-II and Resilience Engineering. Burnout, fatigue, and cognitive workload were closely interconnected and were associated with less favourable perceived Situational Awareness; yet none of these measures was significantly associated with Patient Safety Incident Exposure. This pattern does not demonstrate resilience or adaptive performance directly, because neither was objectively measured. It does, however, highlight the importance of considering how clinicians and clinical systems maintain performance under variable and demanding conditions.

Traditional approaches to patient safety, often described as Safety-I, focus on understanding why adverse events occur by identifying errors, equipment failures, communication breakdowns, procedural deviations, and weaknesses in established defences. This approach has contributed substantially to anaesthesia safety through standardised monitoring, equipment checks, medication safeguards, incident reporting, crisis protocols, and simulation[52]. However, examining failure alone provides an incomplete account of how safe care is achieved during routine clinical work.

Safety-II extends this perspective by examining why work succeeds despite complexity, uncertainty, and operational variability[53]. Anaesthesia professionals continuously adjust to changing physiology, surgical developments, interruptions, staffing, equipment availability, competing priorities, and unexpected clinical events. Safe care therefore depends not only on compliance with procedures, but also on clinicians' capacity to anticipate, monitor, respond, and adapt as circumstances evolve[54].

Many of these adaptations are largely invisible precisely because they are successful. Clinicians may redistribute tasks when workload increases, seek assistance before available capacity is exceeded, alter the sequence of activities, clarify ambiguous communication, repeat medication or equipment checks, or increase monitoring when a patient's condition becomes less predictable. If the adjustment prevents a problem from progressing, there may be no adverse outcome and no formal record of the work required to achieve that outcome.

This distinction is important when interpreting the absence of an association between psychological strain and Patient Safety Incident Exposure. The incident measure captured the number of different event categories experienced or witnessed, not the frequency or severity of incidents, resulting patient harm, clinical performance, or the cognitive effort required to recognise and correct emerging threats. It therefore could not

[49] Fletcher et al., 2003; Gaba, 2000; Kelly et al., 2023
[50] Hollnagel, 2014; Hollnagel et al., 2006
[51] Demerouti et al., 2001; Bakker & Demerouti, 2007
[52] Gaba, 2000; Fletcher et al., 2003; Kelly et al., 2023
[53] Hollnagel, 2014
[54] Hollnagel et al., 2006; Kelly et al., 2023

capture the numerous adaptations through which clinicians or teams may have prevented hazards from progressing.

A related concept in Resilience Engineering is the distinction between work-as-imagined and work-as-done[55]. Work-as-imagined describes how clinical care is expected to occur according to policies, staffing models, role descriptions, procedures, and organisational plans. Work-as-done describes how care is actually delivered within complex clinical environments.

In anaesthesia, work-as-imagined may assume that appropriately skilled staff are consistently available, lists progress according to schedule, equipment functions as intended, breaks occur as planned, communication is complete, and tasks can be performed sequentially. Work-as-done may instead involve staff shortages, overrunning or additional cases, interruptions, unfamiliar team members, unavailable equipment, changing patient acuity, and several competing demands requiring simultaneous attention. Clinicians frequently bridge this gap through local adjustments that preserve workflow and patient care.

Such adaptation is both necessary and valuable, but it has limits. A system that functions only because clinicians repeatedly compensate for inadequate staffing, excessive workload, poor communication, inefficient processes, or insufficient organisational support should not be considered fully resilient. Resilience is not an unlimited capacity of individual clinicians to absorb increasing pressure. A resilient system provides sufficient resources, flexibility, support, and opportunities for recovery so that clinicians can adapt safely when variability occurs[56].

This distinction is particularly important in anaesthesia, where remaining composed, rapidly reprioritising, and responding effectively to uncertainty are core professional capabilities. These abilities are essential to clinical practice, but describing clinicians as resilient should not normalise chronic understaffing, missed breaks, repeated overtime, or sustained psychological strain. Individual adaptability may protect the system in the short term while simultaneously concealing organisational weaknesses that contribute to burnout and workforce attrition over time.

The study's Organisational Support findings reinforce this interpretation. More favourable organisational conditions were associated with lower Personal, Work-related, and Patient-related Burnout, lower Fatigue and Cognitive Workload, and better perceived Situational Awareness. Although these cross-sectional relationships cannot establish causation, their consistency suggests that clinicians' psychological and cognitive experiences were closely connected with how they perceived the systems surrounding their work.

Organisational resilience should therefore involve more than relying on clinicians to compensate when demand exceeds available resources. It requires appropriate staffing and skill mix, manageable workload, effective communication, supportive leadership, reliable equipment, sufficient recovery opportunities, and psychologically safe mechanisms for raising concerns. Resilient organisations should also learn from successful adaptations and routine work, not only from incidents and adverse outcomes. Repeated workarounds may identify mismatches between formal processes and clinical reality and provide opportunities for system redesign before those mismatches contribute to harm or workforce deterioration.

From this perspective, the absence of measured patient harm or a significant incident association should not be interpreted as evidence that workload and workforce strain are harmless. Clinicians may maintain an acceptable standard of care by drawing more heavily on concentration, experience, teamwork, structured routines, and professional commitment while the cognitive and psychological cost of doing so increases. The challenge for healthcare organisations is therefore not merely to develop clinicians who can tolerate increasingly difficult conditions, but to develop systems in which adaptive capacity can be used for genuine clinical variability rather than continuously compensating for preventable organisational deficiencies[57].

4.4 Organisational Conditions and Clinician Wellbeing

A consistent finding across the quantitative and qualitative components of this study was the close relationship between participants' perceptions of their organisational environment and their psychological and cognitive experiences at work. More favourable Organisational Support scores were associated with lower Personal

[55] Hollnagel, 2014; Hollnagel et al., 2006
[56] Hollnagel et al., 2006; Carayon et al., 2006; Holden et al., 2013
[57] Carayon et al., 2006; Holden et al., 2013; Hollnagel, 2014

Burnout ($r = -.626$), Work-related Burnout ($r = -.715$), Patient-related Burnout ($r = -.524$), Fatigue ($r = -.683$), and Cognitive Workload ($r = -.569$), together with better perceived Situational Awareness ($r = .467$); all associations were statistically significant at $p < .001$.

The strongest organisational association was with Work-related Burnout, which is particularly relevant because this CBI domain specifically reflects exhaustion attributed to work[58]. Although the cross-sectional design prevents conclusions about causal direction, the overall pattern is consistent with the proposition that clinician wellbeing cannot be understood independently of the conditions under which clinical work is organised and delivered.

These findings align with the Job Demands–Resources model, which proposes that occupational wellbeing reflects the balance between the demands placed upon workers and the resources available to meet those demands[59]. In anaesthesia, demands may include sustained vigilance, time pressure, interruptions, emergency work, increasing patient complexity, documentation, production expectations, and competing clinical priorities. Relevant resources include adequate staffing and skill mix, supportive leadership, effective communication, reliable equipment, protected recovery opportunities, professional recognition, education, teamwork, and the ability to raise concerns safely.

Staffing and skill mix emerged particularly strongly. Participants' qualitative responses described insufficient staffing, failure to replace absences, repeated overtime, and concerns about access to appropriately trained personnel. From a Human Factors perspective, staffing is more than a numerical workforce issue. It affects workload distribution, supervision, access to assistance, team familiarity, opportunities for recovery, and the capacity of a team to respond when clinical demand changes unexpectedly[60].

The availability of experienced colleagues may also provide an important form of cognitive support. In a complex anaesthesia environment, experienced team members contribute not only technical capability but also anticipation, cross-checking, task distribution, shared situational awareness, and assistance when workload escalates[61]. Where staffing or skill mix is inadequate, monitoring, communication, decision-making, and contingency planning may become concentrated among fewer individuals, increasing the cognitive burden carried by the remaining team.

Production pressure represented another prominent organisational concern. Participants described expectations to maintain operating-list efficiency while simultaneously managing clinical complexity, additional procedures, interruptions, administrative requirements, and constrained staffing. Operational efficiency is necessary within healthcare; however, it can become problematic when throughput expectations reduce the time available for preparation, checking, communication, education, and recovery.

This distinction is relevant to Cognitive Load Theory. Some workload is intrinsic to anaesthesia and cannot reasonably be removed. Other demands arise from the organisation of work—for example, unnecessary interruptions, duplicated documentation, poorly integrated technology, unclear processes, frequent task switching, or avoidable staffing deficits. Reducing these avoidable demands may preserve cognitive resources for monitoring, clinical reasoning, anticipation, communication, and response to unexpected deterioration[62].

Leadership and workplace culture were similarly prominent in participants' accounts. Supportive leadership was described in terms of being listened to, valued, consulted, and able to obtain assistance when demands became difficult. Conversely, limited communication, insufficient professional recognition, inadequate consultation, and perceived organisational unresponsiveness were described as contributors to psychological strain. This suggests that organisational support is experienced through everyday management practices, not simply through the availability of formal wellbeing programs.

Psychological safety is also relevant. The survey assessed speaking up as one component of the broader organisational construct, and participants' experiences were not uniformly favourable. The ability to ask questions, seek assistance, challenge decisions, discuss errors, and raise patient safety concerns without fear of

[58] Kristensen et al., 2005
[59] Demerouti et al., 2001; Bakker & Demerouti, 2007
[60] Carayon et al., 2006; Holden et al., 2013; Kelly et al., 2023
[61] Fletcher et al., 2003; Schulz et al., 2013; Kelly et al., 2023
[62] Sweller, 1988; Sweller et al., 2011

blame can support communication and shared learning. However, because psychological safety was not assessed as a separate validated scale, conclusions regarding this specific construct should remain descriptive.

Importantly, the qualitative findings converged with the quantitative pattern. Participants repeatedly identified staffing shortages, workload and overtime, production pressure, inadequate recovery opportunities, leadership, workplace culture, and professional recognition as sources of strain. Their proposed solutions similarly centred on increased staffing and appropriate skill mix, manageable workloads, protected breaks, responsive leadership, improved communication, and professional recognition.

These findings do not establish that unfavourable organisational conditions caused burnout or cognitive strain. The Organisational Support measure was investigator-developed, and participants experiencing greater burnout may also have perceived their workplace more negatively. Nevertheless, the consistency of the relationships across multiple independent wellbeing and cognitive outcomes, together with the qualitative responses, supports the importance of examining organisational conditions alongside individual wellbeing.

The practical implication is that interventions directed solely towards individual coping are unlikely to address all sources of workplace strain. Counselling, peer support, resilience education, and employee assistance programs may provide important support, but they cannot substitute for adequate staffing, sustainable workload, recovery opportunities, effective communication, supportive leadership, and appropriate work design. Where the demands arise principally from the work system, meaningful prevention must also occur at the system level[63].

4.5 Implications for Workforce Sustainability and Patient Safety

The findings have practical implications for workforce sustainability, clinical governance, and the future delivery of anaesthesia services. Burnout, fatigue, and cognitive workload are often considered primarily as occupational health concerns; however, their strong interrelationships suggest that they also reflect the conditions under which the anaesthesia workforce is required to function. Even without a demonstrated statistical relationship with Patient Safety Incident Exposure, sustained psychological and cognitive strain remains relevant to workforce retention, professional functioning, organisational resilience, and the capacity of services to maintain an experienced multidisciplinary workforce[64].

Workforce sustainability involves more than recruiting sufficient numbers of clinicians. Anaesthesia services depend upon the retention of experienced professionals, appropriate skill mix, supervision, education, team familiarity, and preservation of organisational knowledge. Loss of experienced staff may therefore affect not only workforce numbers but also the capacity to support less experienced clinicians and respond flexibly when clinical demand changes.

The present findings provide reason for organisational attention. Personal Burnout scores of ≥50 were reported by 43.8% of participants and Work-related Burnout scores of ≥50 by 36.3%, while burnout, fatigue, and Cognitive Workload were strongly interrelated. In addition, 26 participants (32.5%) reported having considered leaving the profession during the preceding 12 months. Although intention to leave was not retained as a separate inferential outcome and causation cannot be inferred, these findings indicate that workforce retention is an important context in which the wellbeing results should be considered.

Workforce pressure was also not distributed uniformly across professional groups. Anaesthetic nurses reported the highest Personal, Work-related, and Patient-related Burnout, Fatigue, and Cognitive Workload scores. This does not establish that professional role itself caused these differences; potential explanations include differences in work allocation, staffing, roster patterns, autonomy, recognition, clinical exposure, and workplace setting. Nevertheless, the consistency of the pattern suggests that organisation-wide averages may conceal important discipline-specific experiences. Workforce strategies should therefore involve consultation with individual professional groups and clinical teams rather than assuming that the same intervention will address the needs of all staff.

The qualitative findings provide practical direction for such strategies. Participants emphasised staffing and skill mix, manageable workload, protected recovery time, supportive leadership, professional recognition, education, and psychologically safe communication. A systems-based response could therefore include matching staffing

[63] Bakker & Demerouti, 2007; West et al., 2018; Carayon et al., 2006
[64] Sanfilippo et al., 2017; West et al., 2018

and skill mix to clinical demand, appropriate supervision, fatigue-aware rostering, limiting avoidable overtime, protecting meal and rest breaks, ensuring access to assistance during workload escalation, strengthening communication pathways, and involving clinicians meaningfully in decisions affecting their work.

Individual support remains important. Counselling, peer support, employee assistance services, mindfulness interventions, and resilience education may benefit clinicians experiencing distress. However, these approaches should complement rather than replace organisational intervention. They cannot fully compensate for persistent understaffing, excessive workload, missed breaks, inadequate recovery, communication problems, or limited organisational support[65].

The implications for patient safety require more cautious interpretation. Neither the bivariate analyses nor the exploratory regression demonstrated that poorer wellbeing or greater cognitive workload was associated with exposure to a greater breadth of patient safety incident categories. The full model was not significant, $F(7, 72) = 0.894$, $p = .516$, $R^2 = .080$. The study therefore does not support a claim that burnout or fatigue directly caused patient safety incidents[66].

At the same time, the absence of this association should not be interpreted as evidence that wellbeing is irrelevant to clinical governance. The patient safety measure captured categories of events experienced or witnessed rather than event frequency, severity, patient harm, individual responsibility, or the adaptive actions through which threats were detected and corrected. The on-call findings reinforce this distinction: participants undertaking on-call duties reported greater incident-category exposure despite showing no significant differences in burnout, fatigue, or Cognitive Workload, suggesting that clinical exposure and context may have influenced the checklist more strongly than psychological strain.

A useful governance implication is therefore to treat clinician wellbeing and conventional patient safety outcomes as related but distinct sources of information[67]. Incident reports, complications, mortality, complaints, and other outcome measures remain essential. However, periodic assessment of burnout, fatigue, workload, organisational support, psychological safety, and recovery may provide complementary information about pressures developing within the work system. These measures should not be treated as validated predictors of patient harm or used to assess the resilience of individual employees. Their potential value lies in identifying patterns at team or departmental level and evaluating whether changes to staffing, rostering, workflow, leadership, communication, or technology improve working conditions.

Education, technology, and leadership should similarly be considered through a systems lens. Simulation, orientation, continuing professional development, and competency development can strengthen preparedness and teamwork, but training cannot substitute for adequate staffing or sustainable workload. Likewise, electronic documentation, monitoring, decision-support systems, and emerging technologies may reduce cognitive burden when well designed but introduce additional alerts, duplication, interruptions, or task switching when poorly integrated. Human Factors principles should therefore inform implementation and evaluation of both workforce and technological change[68].

Ultimately, the study supports a balanced position: clinician wellbeing should neither be assumed to predict patient harm nor dismissed because a direct incident association was not demonstrated. Burnout, fatigue, cognitive workload, organisational support, staffing, leadership, and recovery collectively shape the conditions under which anaesthesia care is delivered. Protecting these conditions should therefore be regarded as a strategic workforce and governance priority, supporting retention, organisational resilience, and the sustainable delivery of high-quality anaesthesia care.

4.6 Strengths and Limitations

This study has several strengths. First, its multidisciplinary design reflects the team-based nature of contemporary anaesthesia practice. The sample included consultant anaesthetists, anaesthesia registrars, anaesthetic nurses, anaesthesia technicians/anaesthetic healthcare practitioners, and students undertaking supervised training, with participants drawn from varied workplace settings and levels of experience. This

[65] Bakker & Demerouti, 2007; Demerouti et al., 2001; West et al., 2018
[66] Hall et al., 2016; Tawfik et al., 2019
[67] Hall et al., 2016; Tawfik et al., 2019; Reason, 2000
[68] Carayon et al., 2006; Holden et al., 2013; Kelly et al., 2023

enabled psychological wellbeing, cognitive workload, organisational conditions, and patient safety incident exposure to be examined across a broader anaesthesia workforce rather than within a single profession.

A second strength was the integrated assessment of psychological, cognitive, organisational, and patient safety variables within the same study. Personal, Work-related, and Patient-related Burnout, Fatigue, Cognitive Workload, Situational Awareness, Organisational Support, and Patient Safety Incident Exposure were considered concurrently within a Human Factors and systems-based framework.

The study also combined established measures with contextually adapted and investigator-developed instruments. All retained composite measures demonstrated acceptable-to-excellent internal consistency, with Cronbach's alpha ranging from .774 to .938. The mixed-methods design provided an additional strength by combining quantitative relationships with qualitative accounts of staffing, workload, leadership, production pressure, recovery, professional recognition, and patient safety.

Several limitations must nevertheless be considered.

First, the cross-sectional design prevents determination of temporal or causal direction[69]. Although burnout, Fatigue, Cognitive Workload, Situational Awareness, and Organisational Support were strongly associated, the study cannot determine whether organisational conditions influenced wellbeing, whether psychological strain influenced perceptions of the workplace, or whether both reflected other shared factors.

Second, recruitment used voluntary convenience sampling through professional and workplace networks, email, social media, and participant sharing. This introduces potential self-selection bias, and because the number of eligible individuals who received or viewed the invitation was unknown, a response rate could not be calculated. The sample should therefore be considered exploratory and should not be interpreted as nationally representative of the Australian anaesthesia workforce.

Third, the sample size of 80 participants limited statistical power[70], particularly for professional-group and multivariable analyses. Group sizes were unequal, students were too few for professional-group inferential testing, and professional role may have been confounded with workplace setting, experience, roster patterns, autonomy, staffing arrangements, or direct patient-care demands. The substantially higher burnout, fatigue, and workload scores observed among anaesthetic nurses therefore require replication in larger samples before broader conclusions are drawn.

The regression analysis was similarly constrained by the sample size and substantial multicollinearity among the psychological predictors. Work-related Burnout and Fatigue produced VIF values of 6.52 and 6.12, respectively. The absence of significant independent predictors should therefore not be interpreted as definitive evidence that these constructs are unrelated to patient safety; rather, the model was unable to identify unique associations with the specific incident-exposure outcome within this sample.

Fourth, the study relied predominantly on self-report data. Burnout, fatigue, workload, Situational Awareness, Organisational Support, and patient safety exposure were based on participant perceptions and recollection and may therefore have been influenced by recall bias, current mood, social desirability, or recent workplace experiences. Collection of the principal variables within the same questionnaire may also have introduced common-method variance and contributed to the magnitude of some observed correlations.

Particular caution is required when interpreting the Situational Awareness measure. It assessed perceived awareness, vigilance, prioritisation, information processing, and cognitive functioning rather than objectively measured intraoperative situational awareness. The results therefore cannot be interpreted as evidence of actual clinical impairment.

Fifth, several instruments were modified or investigator-developed. Although the adapted FAS-9, NASA-TLX, Situational Awareness, and Organisational Support measures demonstrated satisfactory internal consistency, they have not undergone comprehensive external psychometric validation. Cronbach's alpha establishes internal

[69] von Elm et al., 2007
[70] Cohen, 1988

consistency within this sample but does not establish construct, criterion, or predictive validity. Direct comparison with studies using the original instruments should therefore be undertaken cautiously.

Sixth, the Patient Safety Incident Exposure checklist had important measurement limitations. It measured whether participants had experienced or witnessed eight different categories of events during the preceding 12 months, not the number of individual incidents. It did not capture frequency, severity, preventability, resulting patient harm, individual responsibility, or whether an event was detected and corrected before reaching the patient. Higher scores may therefore reflect greater clinical exposure, emergency or on-call activity, stronger event recognition, or different reporting cultures rather than poorer clinical performance.

The use of linear regression for this bounded 0–8 count outcome was also a limitation. Although residual diagnostics were satisfactory, linear regression may not fully represent the statistical properties of count data; accordingly, the model was appropriately treated as exploratory.

Seventh, anonymity protected participants but prevented analysis by individual hospital or employer. Potential clustering within workplaces, institutional reporting culture, local staffing models, leadership structures, and jurisdictional differences could therefore not be examined.

The qualitative component was also limited by its reliance on optional free-text responses. These responses provided valuable contextual information but were shorter and less detailed than interviews or focus groups and did not permit follow-up clarification. The descriptive content analysis should therefore be interpreted as an exploratory summary of recurring perceptions rather than evidence of thematic saturation or a comprehensive representation of the Australian workforce[71].

Finally, formal Human Research Ethics Committee review or approval was not obtained. Although the survey was anonymous and the study was designed with reference to recognised ethical principles, the absence of formal ethics review remains a governance limitation[72].

Taken together, these limitations mean that the strongest conclusions from the study concern the associations among psychological wellbeing, cognitive workload, perceived Situational Awareness, and Organisational Support within this participating cohort. The study does not establish causal pathways or demonstrate that burnout, fatigue, or workload caused patient safety incidents. Replication using larger representative samples, longitudinal designs, validated measures, objective cognitive assessments, and more detailed patient safety data is required.

4.7 Future Research

The present study provides preliminary evidence that burnout, fatigue, cognitive workload, perceived Situational Awareness, and Organisational Support are closely interconnected within multidisciplinary Australian anaesthesia practice. Future research should now move beyond cross-sectional association towards determining how these relationships develop over time, which workplace conditions contribute to them, and whether organisational interventions can meaningfully improve outcomes.

A first priority is larger, prospective, multicentre research. Longitudinal studies could determine whether changes in workload, staffing, rostering, recovery, or Organisational Support precede changes in burnout and fatigue, or whether these relationships operate bidirectionally. Recruitment across professional groups, jurisdictions, public and private services, metropolitan and regional settings, and differing levels of clinical acuity would improve generalisability and permit adjustment for potentially important confounders such as experience, employment status, weekly hours, shift work, on-call responsibilities, and workplace setting.

The professional-group findings also warrant targeted investigation. Anaesthetic nurses reported substantially higher burnout, fatigue, and Cognitive Workload than the other groups in this sample, but the present study could not determine why. Future research should examine whether these differences persist after accounting for direct patient-care responsibilities, workload, shift patterns, overtime, autonomy, staffing models, workplace setting, role clarity, professional recognition, and access to development opportunities. Qualitative interviews

[71] Elo & Kyngäs, 2008; O'Brien et al., 2014
[72] National Health and Medical Research Council, 2023

and workplace observation may be particularly valuable for identifying profession-specific demands that cannot be captured through professional title alone.

Further psychometric validation of the adapted and investigator-developed measures is also required[73]. The modified FAS-9, adapted NASA-TLX, Situational Awareness measure, and Organisational Support measure demonstrated satisfactory internal consistency in the present sample, but future studies should examine factor structure, test–retest reliability, convergent and discriminant validity, measurement invariance across professional groups, and sensitivity to organisational change.

Future research should also combine self-report measures with objective or performance-based assessment. NASA-TLX provides important information about perceived workload but does not directly measure cognitive capacity or clinical performance[74]. Potential complementary approaches include structured simulation, behavioural observation, eye tracking, reaction-time or secondary-task measures, and selected physiological measures. Multimodal assessment may provide a more complete understanding of how workload, fatigue, situational awareness, and performance change during routine and crisis anaesthesia care[75].

The measurement of patient safety outcomes requires particular refinement. Future studies should distinguish between exposure to an event, personal involvement, near-miss recognition, formal reporting, and actual patient harm. Prospective linkage with deidentified organisational data could examine medication incidents, equipment failures, communication events, unplanned escalation of care, perioperative complications, and other clinical outcomes while accounting for event frequency, severity, timing, case complexity, staffing, and reporting culture. Importantly, higher incident-reporting rates should not automatically be interpreted as evidence of poorer safety[76], because they may instead reflect stronger psychological safety or more mature reporting systems.

Research should also align the timescale of wellbeing measures with the outcomes being studied. Acute fatigue may affect cognition within a particular shift, whereas burnout may influence engagement, absence, workforce retention, or professional participation over much longer periods. Shift-level studies could therefore examine sleep, fatigue, staffing, interruptions, workload, and near misses concurrently, while longitudinal studies could investigate burnout in relation to absenteeism, turnover, and organisational stability.

Most importantly, future work should move towards evaluating organisational interventions, rather than continuing only to document the prevalence of burnout. Potential interventions include changes to staffing and skill mix, protected recovery time, fatigue-aware rostering, workload redistribution, leadership development, workflow redesign, professional recognition, and communication processes. Appropriate designs may include controlled before-and-after studies, interrupted time-series analyses, stepped-wedge trials, and other service-level evaluations capable of examining both effectiveness and implementation[77].

Such intervention studies should assess more than short-term improvements in self-reported wellbeing. Relevant outcomes include sustainability of change, staff retention, absenteeism, overtime, implementation fidelity, clinical workload, patient safety outcomes, and unintended consequences. Human Factors evaluation should also accompany the introduction of new technologies[78] to determine whether digital systems genuinely reduce cognitive burden or instead introduce additional alerts, duplication, task switching, or documentation demands.

Ultimately, the next phase of research should ask not simply whether anaesthesia professionals can continue to perform under pressure, but what cognitive, psychological, and organisational resources are required for that performance to remain sustainable. Progress will require multidisciplinary, longitudinal research combining validated self-report measures, objective cognitive and performance assessment, detailed workplace information, and more meaningful patient safety outcomes.

[73] Kristensen et al., 2005; Michielsen et al., 2003; Hart & Staveland, 1988
[74] Hart & Staveland, 1988
[75] Endsley, 1995; Schulz et al., 2013
[76] Reason, 2000; Hall et al., 2016
[77] Bakker & Demerouti, 2007; West et al., 2018
[78] Carayon et al., 2006; Holden et al., 2013; Kelly et al., 2023

5. Conclusion

This study examined the relationships among burnout, fatigue, cognitive workload, situational awareness, organisational support, and patient safety incident exposure within a multidisciplinary sample of 80 Australian anaesthesia professionals and students. By considering these constructs together, the study sought to move beyond an isolated focus on burnout and examine clinician wellbeing within the broader cognitive and organisational systems through which anaesthesia care is delivered.

The principal finding was that burnout, fatigue, and cognitive workload were closely interconnected. Work-related Burnout showed the strongest association with Fatigue ($r = .881$, $p < .001$), while Cognitive Workload was significantly associated with all three burnout domains and Fatigue. Substantial proportions of the cohort also recorded CBI scores of ≥50 for Personal Burnout (43.8%), Work-related Burnout (36.3%), and Patient-related Burnout (22.5%). These thresholds were descriptive rather than diagnostic, but they indicate that psychological and occupational exhaustion were important features of the participating workforce.

Greater burnout, fatigue, and Cognitive Workload were also associated with less favourable perceived Situational Awareness, while more favourable Organisational Support was associated with lower burnout, lower Fatigue, lower Cognitive Workload, and better Situational Awareness. Together with participants' qualitative accounts of staffing shortages, workload, overtime, production pressure, leadership, recovery, and professional recognition, these findings support a systems-based interpretation of clinician wellbeing.

Professional-group comparisons further demonstrated that workforce pressures were not experienced uniformly. Anaesthetic nurses reported the highest mean scores for Personal, Work-related, and Patient-related Burnout, Fatigue, and Cognitive Workload. However, the study cannot determine whether these differences arose from professional role itself or from associated factors such as work allocation, roster patterns, autonomy, staffing models, workplace setting, or direct patient-care demands.

In contrast, Patient Safety Incident Exposure was not significantly associated with any of the principal psychological, cognitive, or organisational measures, and the exploratory regression model was not significant, $F(7, 72) = 0.894$, $p = .516$, $R^2 = .080$. Professional groups also reported similar levels of incident exposure, while participants undertaking on-call work reported greater exposure despite no corresponding differences in burnout, fatigue, or Cognitive Workload.

This finding should not be interpreted as evidence that clinician wellbeing is irrelevant to patient safety. The incident measure captured the breadth of event categories experienced or witnessed, not event frequency, severity, resulting harm, personal responsibility, or the adaptive actions through which threats were recognised and corrected. The present study therefore does not establish that burnout or fatigue causes patient safety incidents, but neither does it demonstrate that sustained psychological strain is harmless.

From a Human Factors perspective, safe anaesthesia care emerges through interactions among clinicians, teams, technologies, monitoring systems, communication, procedures, supervision, and organisational safeguards[79]. Clinicians may maintain effective performance under demanding conditions through expertise, teamwork, structured checking, task redistribution, and other adaptive behaviours. However, the ability to continue performing should not be mistaken for evidence that those conditions are indefinitely sustainable.

The study therefore supports a broader conception of resilience. Resilience should not mean requiring clinicians to tolerate unlimited workload or continually compensate for preventable system deficiencies. Sustainable resilience requires systems that provide adequate staffing and skill mix, manageable workload, fatigue-aware rostering, protected recovery, supportive leadership, psychologically safe communication, professional recognition, education, reliable technology, and sufficient flexibility to respond when clinical demand changes.

The central contribution of this research is therefore not evidence of a simple pathway from burnout to patient harm. Rather, it demonstrates that clinician wellbeing, cognitive workload, perceived situational awareness, and organisational support form an interconnected network of experiences within multidisciplinary anaesthesia practice. These outcomes warrant attention because they affect clinicians, workforce stability, organisational

[79] Reason, 2000; Carayon et al., 2006; Holden et al., 2013; Kelly et al., 2023

capacity, and the resources available to sustain complex clinical work—even when a direct relationship with adverse events cannot be demonstrated.

Anaesthesia will inevitably remain cognitively demanding. Sustained vigilance, rapid decision-making, multidisciplinary coordination, and adaptation to uncertainty are intrinsic to the work and cannot be eliminated. What organisations can reduce are the avoidable cognitive and organisational burdens surrounding that work.

Protecting the wellbeing and cognitive capacity of the anaesthesia workforce should therefore be recognised as both a workforce priority and a component of sustainable clinical governance. The objective should not be to create clinicians capable of enduring ever-increasing pressure, but to create healthcare systems that enable clinicians to perform complex anaesthesia work safely without requiring the continual sacrifice of their psychological wellbeing.

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