OPEN ACCESS

Psychological safety in the perioperative environment: a cost-consequence analysis

Franklyn P Cladis ,[1] Mark Hudson,[1] Joel Goh[2]

► Additional supplemental material is published online only. To view, please visit the journal online (https://doi.org/10.1136/leader-2023-000935).

[1]Department of Anesthesiology and Perioperative Medicine, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA
[2]Global Asia Institute, National University of Singapore, Singapore

Correspondence to
Dr Franklyn P Cladis, Department of Anesthesiology and Perioperative Medicine, University of Pittsburgh Medical Center, Pittsburgh, PA 15232, USA; cladfp@upmc.edu

Received 27 October 2023
Accepted 19 February 2024

To cite: Cladis FP, Hudson M, Goh J. *BMJ Leader* Published Online First: [*please include* Day Month Year]. doi:10.1136/leader-2023-000935

ABSTRACT

Introduction Psychologically unsafe healthcare environments can lead to high levels of staff turnover, and unwanted financial burden. In this study, we investigate the hypothesis that lower levels of psychological safety are associated with higher levels of turnover, within an anaesthesiology department and we estimate the cost attributable to low psychological safety, driven by turnover costs.

Methods Psychological safety was measured in one academic department. The psychological safety score was correlated with 'intention to leave' using linear regression and Pearson correlation and a cost-consequence analysis was performed.

Results One hundred and thirty-eight physician anaesthesiologists (MDs) and 282 certified registered nurse anaesthetists (CRNAs) were surveyed. The response rate was 67.4% (93/138) for MDs and 60.6% (171/282) for CRNAs. There was an inverse relationship between psychological safety and turnover intent for both MDs (Pearson correlation −0.373, p value <0.0002) and CRNAs (Pearson correlation −0.486, p value <0.0002). The OR of intent to turn over in the presence of low psychological safety was 6.86 (95% CI 1.38 to 34.05) for MDs and 8.93 (95% CI 4.27 to 18.68) for CRNAs. The cost-consequence analysis demonstrated the cost of low psychological safety related to turnover per year was $337,428 for MDs and $14,024,279 for CRNAs. Reducing low psychological safety in CRNAs from 31.6% to 20% reduces the potential cost of low psychological to $8 876 126.03.

Conclusion There is a cost relationship between low psychological safety and turnover. Low psychological safety in an academic anaesthesiology department may result in staff turnover, and potentially high financial costs.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Psychological safety is recognised as an essential component to the success of healthcare team learning and performance.

WHAT THIS STUDY ADDS

⇒ The findings of this study demonstrate the correlation between low psychological safety and staff turnover. This turnover is associated with significant cost.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study demonstrates the economic burden of low psychological safety as it relates to staff turnover and cost. It is an easily understood metric for healthcare leaders.

INTRODUCTION

Psychological safety is the perception that one can take interpersonal risk in a team without fear of negative consequences.[1] It was first described by Schein and Bennis in the 1960s and the construct has been applied to individuals, teams and organisations.[2] The formulation of psychological safety as a team-based concept was developed in a 1999 landmark study of 51 work teams at a manufacturing firm.[1] A key finding of this study was that high levels of psychological safety drove greater learning behaviours, and ultimately, team performance. Teams often perform within a larger organisation (group) and psychological safety has been investigated and applied at the organisational level.[3]

With such robust associations between psychological safety and learning, it is perhaps unsurprising that research has also established positive associations between psychological safety and organisation performance. Studies have found positive associations in cases when performance is measured using either financial metrics or non-financial metrics.[1 4 5] Teams and organisations with higher degrees of psychological safety have demonstrated greater return on investment[3] and more learning, innovation and creativity.[4 5]

Psychologically unsafe environments can lead to high levels of staff turnover, which thereby impose an unwanted financial burden. The link between low psychological safety and higher rates of turnover has already been demonstrated in different industries.[6 7] Turnover is costly for organisations in general, and especially for those within professional service industries such as healthcare. Specifically, for healthcare organisations, costs are incurred through short-term measures to backfill the labour supply of providers who have left the organisation, often achieved through the engagement of locums or through overtime pay of existing employees. Subsequent costs include the costs of marketing, researching and recruiting new personnel to sustain long-term supply of clinical capacity. Even after a new staff member is successfully recruited, there are further costs incurred through sign-on bonuses and onboarding.

Indeed, if the same positive association between low psychological safety and turnover holds in healthcare, then it would also be meaningful to estimate the magnitude of this cost. Placing a dollar value on psychological safety has merit when discussing its value to an organisation's leadership. It is a metric that is easily understandable, and can

be especially useful in developing policy or when attempting to achieve organisational buy-in.

We elected to study psychological safety of individuals within an academic department of anaesthesiology. The Department of Anesthesiology and Perioperative Medicine at the University of Pittsburgh Medical Center is comprised of multiple hospital sites that taken together make up the department. The primary academic sites that house resident rotators include six hospitals. We studied these six hospital sites to investigate the hypothesis that lower levels of psychological safety of individuals within the organisation are associated with higher levels of turnover, of physician anaesthesiologists (MDs) and certified registered nurse anaesthetists (CRNAs). In addition, we estimate the cost attributable to a lack of psychological safety in the organisation, driven by turnover intent and turnover costs.

METHODS

Participants were invited by an email invitation that included the identity of the principal investigator, the description and purpose of the study, the estimated length of the study and the follow-up information. In addition, participants were notified that this was completely voluntary, anonymous and no identifying data would be collected. No incentives were provided. The survey was trialled by a small group of physician anaesthesiologists at the principal investigator's hospital site for technical and functional concerns. The survey was created with Qualtrics for automatic collection of deidentified data and was provided electronically via email as an open survey to each hospital site. The link allowed each participant to only participate once. Completeness checks were not included in the survey. The invitations were sent in December 2021 and collected for 2 months until the end of January 2022. The hospital sites that received the email invitations are listed in box 1.

Psychological safety was measured using a modification of the psychological safety survey developed by Edmondson.[1 8] Edmondson's survey of seven questions has been studied and the reliability and construct validity has been defined.[1] The questions from these surveys were modified by O'Donovan for the healthcare environment.[9] The modification involved input from healthcare professionals to improve the accuracy, quality and relevance of the adapted survey. We included three questions from Edmondson's original survey and four questions from her survey that were modified by O'Donovan to specifically address the healthcare environment. All the survey questions were presented on one page for the participant and are provided in online supplemental appendix.[9 10] Each question was presented in a 5-point Likert scale, and all the questions were scored positively.

To address validity, face and content validity was performed for the survey questions. The face validity was evaluated with 13 physicians and CRNAs after participating in the original survey. Six of the seven questions used in the survey were identified as relating to the concept of psychological safety by over 90% of the faculty and CRNAs. One question was identified as relating to the concept of psychological safety by over 75% of the faculty and CRNAs. Content validity was obtained from four content experts (physicians and coaches that teach psychological safety nationally). None of these content experts had previous exposure to the original survey. Six of the seven questions used in the survey were identified as relating to the concept of psychological safety by over 90% of the content experts. One question was identified as relating to the concept of psychological safety by over 75% of the content experts. One question about turnover intent (leave) within 12 months was asked. This question has been shown to predict actual turnover in physicians.[11] This question was also presented as a 5-point Likert scale but was scored inversely to the psychological safety questions.

The scores from the seven psychological safety questions were averaged to create an overall psychological safety score for each participant. The overall psychological safety score was then correlated with 'intention to leave' using linear regression and Pearson correlation. Odds ratios (OR) for turnover in the presence of low psychological safety were calculated by classifying both the psychological safety score and intention to leave of participants into binary categories. Participants were classified as having 'high psychological safety' if their overall psychological safety score was greater than a boundary value and having 'low psychological safety' otherwise. The boundaries selected included psychological safety scores less than 3.0, 3.25 and 3.5. The determination of the lower boundaries is further described in the results. Likewise, it was imperative to properly identify those individuals with intentions to leave. Participants were classified as 'intending to leave' if their response to the survey question about intention to leave was 4 or higher ('agreed' or 'strongly agreed').

A cost-consequence analysis was then performed using these data. The underlying premise for this analysis is that staff turnover is inherently costly to healthcare organisations because of hiring costs (eg, searching, marketing, recruiting, sign-on bonuses, moving expenses, etc) and additional costs incurred by hiring locum providers to cover labour shortages. If low psychological safety is positively correlated with high turnover, then it should also be associated with additional turnover costs. The purpose of this cost-consequence analysis is to evaluate the magnitude of turnover that is attributable to low psychological safety. A similar analysis, based on similar principles, has been previously performed to evaluate the attributable cost of burnout in physicians.[12] The Consolidated Health Economic Evaluation Reporting Standards reporting guidelines were used as part of the evaluation of this economic analysis.[13]

Box 1 University of Pittsburgh Medical Center hospital survey sites

Children's Hospital
Presbyterian Hospital
Shadyside Hospital
Magee-Women's Hospital
Mercy Hospital
Passavant

Statistical analysis

Descriptive statistics were performed for demographic data. Linear regression and Pearson correlation were performed to identify the strength of the relationship between psychological safety scores and turnover intent.

In order to construct the cost-consequence analysis, we defined the organisational-level annual cost attributable to low psychological safety as the product of three terms: (i) the number of employees at the organisation, (ii) the additional cost associated with turnover of one employee and (iii) the difference between the turnover rate and the turnover rate in an absence

of low psychological safety (ie, when all employees have high psychological safety). Below, we provide this definition and an equivalent formula:

$$\text{Cost attributable to low PS} = N \times C \times [P(T) - P(T \mid \text{high PS})]$$

$$= N \times C \times P(\text{low PS}) \times [P(T \mid \text{low PS}) - P(T \mid \text{high PS})]$$

Terms	Description
N	Number of employees
C	Turnover cost per employee
P(T)	Probability of turnover for all employees
p(T|high PS)	Probability of turnover in employees with high psychological safety
P(low PS)	Probability of low psychological safety for all employees
p(T|low PS)	Probability of turnover in employees with low psychological safety

The first two terms of the expression (number of employees, N, and turnover cost per employee, C) were estimated from organisational statistics and internal labour cost estimates from our home institution. The individual cost components used to estimate the turnover cost per employee are reported in Table 3. The first of these components was premium wage, which captured the labour costs incurred by engaging an MD/CRNA locum tenens to cover the clinical duties of the departing MD/CRNA. Because it was possible that currently employed MDs were used to cover these duties, this component was reported as a range, where the lower value of the range reflected the scenario where locums were not engaged, and the upper value reflected the scenario where locums were engaged. The latter prevalence terms in the cost expression above were estimated from the psychological safety survey. We assumed that the prevalence of turnover intent from the survey was an accurate measure of actual turnover because it is well-known that these are highly correlated. In one physician study the intention to leave was more predictive than job dissatisfaction for actual leaving.[11] Separate estimates were performed for MDs and CRNAs.

RESULTS

The survey was sent to a total of 138 MDs and 282 CRNAs across six hospital sites of the Department of Anesthesiology and Perioperative Medicine at the University of Pittsburgh Medical Center. The response rate was 67.4% (93/138) for MDs and 60.6% (171/282) for CRNAs. Most MD respondents were male (71%) and most CRNA respondents were female (73%). The gender distribution found in the survey mirrors the gender distribution in the department for MDs and CRNAs. Overall psychological safety scores were not significantly different between males and females in either the MD or CRNA group. See table 1 for details. There is an inverse relationship between psychological safety and turnover intent for both MDs and CRNAs. The correlation is statistically significant for both MDs and CRNAs, and the correlation is stronger for the CRNA group (figures 1 and 2). The R^2 value is 0.139 for the MD group and 0.236 for the CRNAs.

A primary objective was to properly identify those individuals with low psychological safety. The psychological safety data is skewed to the right (positively) for both MD and CRNA scores. We investigated using the mean for each group and going one SD to the left to ideally capture those truly with low psychological safety. When performing this for the MDs, the cut-off was 3.1. Choosing a score of 3.5 or 4 would capture some with reasonably high psychological safety and since the analysis is concerned with identifying those with low psychological safety, the cut-off of 3.0 was used for the cost-consequence analysis. Cut-off points less than 3.0 could potentially overstate the findings of this study. The range of ORs for both MDs and CRNAs with 95% CIs are provided in table 2. This boundary value range varied between 3.0 and 3.5 in our analysis.

ORs were calculated to determine the odds of turnover intent in the presence of low psychological safety for different boundary values. The boundaries selected included psychological safety scores less than 3.0, 3.25 and 3.5. The ORs were statistically significant for all low psychological safety boundaries less than 3.25 for the MDs. The ORs for the CRNAs were statistically significant for all low psychological safety boundaries less than 3.5 (see table 2).

The estimated values of the prevalence and cost inputs for the cost-consequence analysis are presented in table 3. The prevalence estimates are based on a psychological safety boundary value of 3.0. Results of the cost-consequence analysis are presented in online supplemental table. The cost of low psychological safety per MD from intention to turnover was $1638 if premium pay was not required (no locums) and $5292 if premium pay was required. When multiplied by the number of physician anaesthesiologists in the department (206 MDs), the total cost per year was $337,478 and $1,090,289, respectively. The cost of low psychological safety per CRNA from intention to turnover was higher at $30,890. When multiplied by the number of CRNAs in the department (454 CRNAs), the total cost per year was $14,024,279. The higher cost for CRNAs is related to the lower psychological safety scores, higher intention to turnover, and higher cost to on-board. If psychological safety scores could be raised to mirror the MDs, the total cost per year decreases to $8,876,126.

Table 1 Demographics of participating physician anaesthesiologists (MDs) and certified registered nurse anaesthetists (CRNAs)

	MDs	CRNAs	P value
Total surveyed	138	282	
Response rate (%)	67.4 (47–100)	60.6 (35–73)	
Gender			
Female	29%	73%	
Male	71%	27%	
Psychological safety scores			
Female	3.65	3.36	MD 0.198
Male	3.9	3.51	CRNA 0.936

DISCUSSION

This study has demonstrated that there is a relationship between psychological safety in physician anaesthesiologists and nurse anaesthetists and turnover intent. This relationship is negative (inverse), and the correlation is statistically significant for both groups. While the correlation is statistically significant for both MDs and CRNAs, the correlation is stronger for the CRNA group. The CRNAs demonstrated a stronger inverse relationship between psychological safety and turnover intent (Pearson correlation, MD=−0.373 vs CRNA=−0.486). The prevalence of turnover intent is higher for the CRNAs and the number of CRNAs with low psychological safety is larger when compared with the MDs.

The R^2 value for the MDs demonstrates that approximately 14% of the data fits the regression model. The R^2 value for the CRNAs is 0.239 suggesting that approximately 23% of the data fits the regression model. A larger proportion of the variance for turnover intent is explained by psychological safety for CRNAs

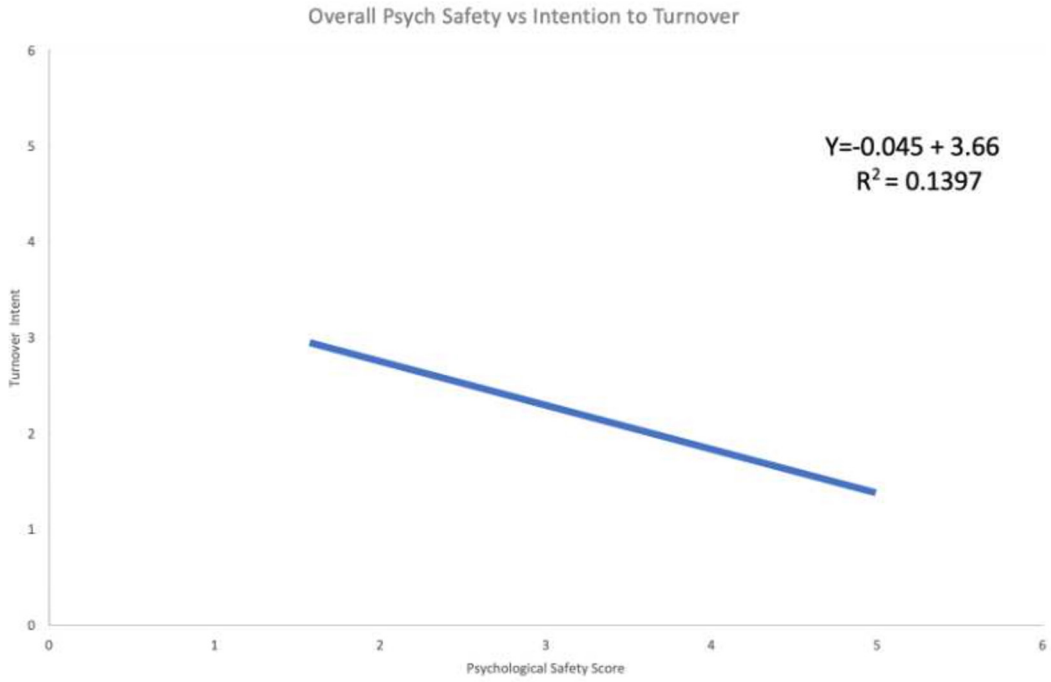

Figure 1 This is a linear regression for the physicians with the y-axis labeled "intention to turnover" and the x-axis "Psychological safety score". There is a negative relationship with psychological safety and intention to turnover. The Pearson correlation is -0.373, p-value < 0.0002, R^2 =0.1397.

than for MDs. While there is a statistically significant inverse relationship between psychological safety and turnover intent, the proportion of variance of turnover cannot be explained entirely by psychological safety. This indicates that other factors do play a role in turnover and these factors likely include age, burnout, and physical health. Although other factors likely play a role in turnover, our analysis demonstrates that psychological safety appears to be one of them.

ORs of intention to leave were calculated for several boundaries of low psychological safety. If low psychological safety is defined as a psychological safety score of less than 3.0 (highest score=5, lowest score=1) the odds of a physician anaesthesiologist with

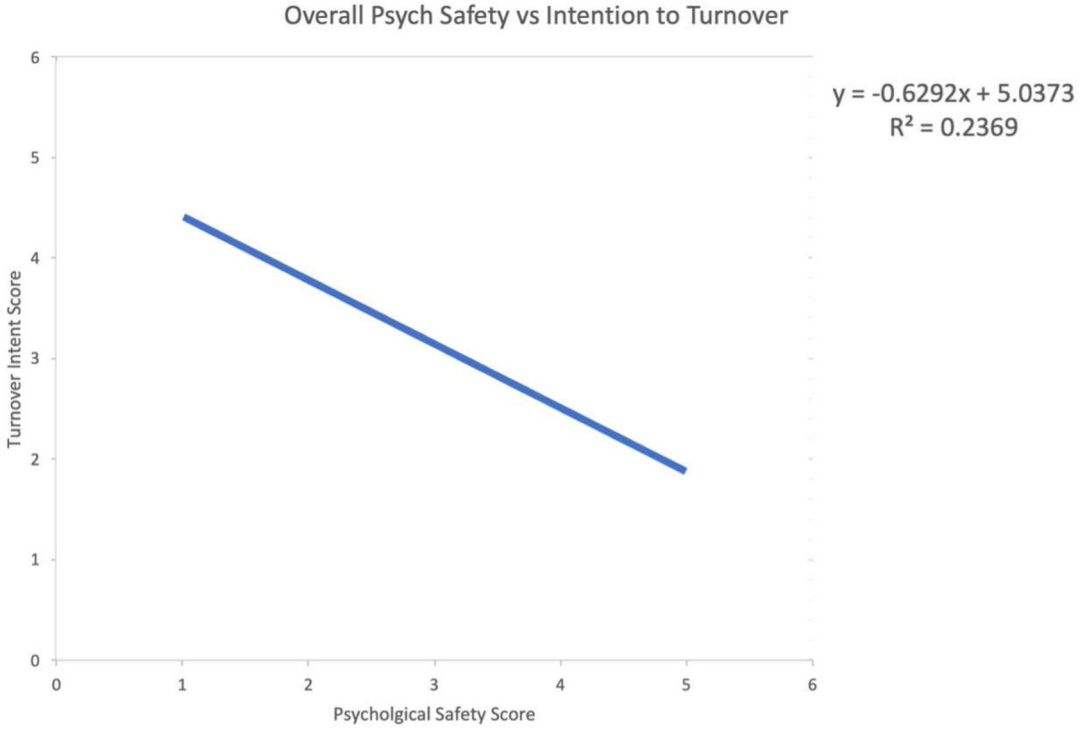

Figure 2 This is a linear regression for the CRNAs with the y-axis labeled "intention to turnover" and the x-axis "Psychological safety score". There is a negative relationship with psychological safety and intention to turnover. The Pearson correlation is -0.486, p-value < 0.0002, R^2 =0.239.

Table 2 Estimated ORs of turnover with psychological safety for physicians and CRNAs using different boundary values

Definition of psychological safety‡	MDs	CRNAs
Psych safety score >3.00	6.86* (95% CI 1.38 to 34.05)	8.93*** (95% CI 4.27 to 18.68)
Psych safety score >3.25	6.31* (95% CI 1.28 to 31.17)	6.06*** (95% CI 3.00 to 12.21)
Psych safety score >3.50	4.13† (95% CI 0.85 to 19.95)	7.06*** (95% CI 3.42 to 14.61)

†p<0.1, *p<0.05, **p<0.01, ***p<0.001.
‡Where 5=high psychological safety, 1=low/no psychological safety.
CRNAs, certified registered nurse anaesthetists; MDs, physician anaesthesiologists.

low psychological safety leaving the department is six times greater than a physician with high psychological safety (table 2). The odds of a CRNA with low psychological safety leaving the department is eight times greater than a CRNA with high psychological safety (table 2). One of the challenges is defining the limit for low psychological safety. Should an individual with a psychological safety score of 3 be considered low or high? As described in the Methods section, a score of 3.5 or 4 will capture some with reasonably high psychological safety and since the analysis is concerned with identifying those with low psychological safety, the cut-off of 3.0 was used for the cost-consequence analysis. The range of ORs for both MDs and CRNAs with 95% CIs are provided in table 2.

A cost-consequence analysis was performed using the prevalence data from the survey. The cost-consequence analysis is designed to determine the financial contribution of psychological safety as it relates to turnover. The cost-consequence analysis demonstrated that low psychological safety may have a significant financial impact by increasing the probability of turnover. The cost for MDs and CRNAs is presented in an online supplemental table. The cost that is attributable to low psychological safety per MD in the Department of Anesthesiology per year ranges from $1638 to $5292. This value must be multiplied by all the physician faculty in the department because it is the cost related to low psychological safety for each physician member. When this is multiplied by the number of physician faculty in the department (206), the total cost of low psychological safety as it relates to turnover per year ranges from $337,428 to $1,090,289. The difference in cost depends on the use of premium pay and its duration of use. If all vacancies from the turnovers can be filled in by extra shifts from existing anaesthesiology physicians within the department, no cost from premium pay occurs. The turnover cost per physician with and without premium wages are shown in an online supplemental table.

Table 3 Input parameters for cost-consequence analysis

	MDs	CRNAs
Organisational statistics		
Number of employed MDs/CRNAs	206	454
OR and prevalence estimates		
OR of turnover with low psych safety*	6.86	8.93
Prevalence of turnover with low psych safety	22.2%	67.3%
Prevalence of turnover with high psych safety	4.0%	19.7%
Prevalence of low psych safety	19.4%	31.6%
Cost estimates		
Premium wage (locums per month)×duration	$0–17 250 (0–100%)×6 mo†	$15 964 (228%)×6 mo†
Orientation pay	$9000‡	$42 181
Recruiting and moving costs	$35 000	$35 000
Signing bonus	–	$30 000
Administrative costs for onboarding	$2400	$2400
Total cost	$46 400–$149 900	$205 367

*These values assume that psychological safety is present when scores are >3.0 and intention to turnover is present when scores are >3.0.
†Premium wage (per month)=(locums annualised salary−department annualised salary)/12 months.
‡Assumes pay ($200/hour)×9 hour workday×5 days orientation.
§Assumes $263.63/hour×40 hours work week×4 weeks orientation.
CRNAs, certified registered nurse anaesthetists; MDs, physician anaesthesiologists.

The cost that is attributable to low psychological safety per CRNA per year in the department is substantially higher at $30,890.4. When this value is multiplied by the number of CRNAs in the department (454), the cost of low psychological safety per year in the Department of Anesthesiology as it relates to turnover is $14,024 279. The cost for the CRNAs is significantly higher than the physician anaesthesiologists for several reasons. The prevalence of low psychological safety is more than 50% greater for the CRNAs than MDs (31.6% vs 19.4%) and the prevalence of CRNAs intending to leave, regardless of level of psychological safety (both high and low) is significantly greater (table 3). In addition, the department used premium wages to fill CRNA vacancies, and these premium wages are roughly 300% greater than base wages. The duration of the vacancy also becomes important and the average duration of a CRNA vacancy for the department at the time of the study was 6 months. Finally, CRNAs receive a signing bonus and they are paid their salary during the orientation period which can extend for 4–6 weeks.

It is difficult to determine the aetiology of the difference in the psychological safety scores for CRNAs versus MDs. The survey was performed toward the end of the COVID-19 pandemic during the great 'resignation'. While resignations occurred in all healthcare professionals, nursing professions seemed to be impacted by this more significantly. It is possible this may have been a factor. In addition, burnout has been reported to be higher in female healthcare team members more than male members and given the larger percentage of female CRNAs, compared with MDs, this may have also played a role.[14]

Many studies have touted the benefits of psychological safety for education, learning, team performance and healthcare safety.[4 15 16] Most agree that higher degrees of psychological safety are good, but few studies have described the economic impact of low psychological safety. It is often only after a dollar value is placed on a concept that it becomes valued by leadership. Much like burnout,[12] this study sought to identify the economic value of psychological safety as it relates to staff turnover. Psychological safety viewed through the lens of an economic analysis should provide valuable information for leaders of medical organisations.

Since there is a clear cost relationship between low psychological safety and turnover, efforts to raise psychological safety should have a positive impact on turnover and cost. For example, based on the cost-consequence equation, if the psychological safety scores of CRNAs could be raised, there could be a significant potential reduction in turnover. Reducing the prevalence of low psychological safety in the CRNAs from 31% to 20% (more like the physicians) would reduce the potential cost of low psychological safety for the department to $8, 876, 126.03 (online supplemental table). Addressing the issue of low psychological safety is not costless and the barriers may be significant. Some of the barriers associated with creating psychological safety in the healthcare environment include perceived hierarchy, perceived lack of knowledge, dominant personalities and authoritarian leadership style.[17] Several of these factors are an inherent part of the existing healthcare culture. Changing culture is difficult but

it can be done over time with education, training and coaching. There would be costs associated with training departmental champions and it would take time to train individuals within the department. While there would be costs associated with these activities, we believe these would be outweighed by the benefits of creating an environment that has a higher degree of psychological safety. These benefits could possibly extend beyond just turnover and include increased patient safety.

There are limitations to this analysis. One limitation is the small number of survey respondents. Although the response rate was good, the total number of respondents only account for a limited number of datapoints. Another limitation of the study is the low R^2 value for the linear regressions. The variance in turnover is only partially explained by changes in psychological safety. This suggests that other factors are contributing to turnover. Environments with low psychological safety often coexist with other variables that increase turnover and these may include burnout, age, physical health and not feeling heard.[18] Finally, this study makes behavioural assumptions from survey data, and this limits the findings.

In summary, this study demonstrates that the absence of psychological safety in an academic anaesthesiology department may have significant implications for turnover, which in turn entails high financial costs. The costs used for this analysis are related to turnover, which are easier to quantify, but healthcare personnel with low psychological safety may also have significant costs related to patient care and patient safety. Although the costs of such factors are difficult to quantify, their importance to the practice of healthcare is uncontroversial and their relationship with psychological safety is not difficult to perceive: patient care and safety may be compromised when healthcare personnel withdraw, hide mistakes and withhold concerns. This relationship has also been established in previous studies.[19–21]

Psychological safety is important for how departments of academic medical centres function and this study highlights the importance of this construct in healthcare. If psychological safety of the physicians and CRNAs can be augmented through actions taken by leadership, people may stay and reduce turnover, and this could have significant implications for hospital finance and for patient care and patient safety.[22]

There are several opportunities to improve psychological safety. The expectation of psychological safety as part of an organisation's culture can be created by talking about it, teaching it and building it into the system.[8 16] These opportunities can be initiated at the individual, team and organisational level. It is essential that this be a top-down process and affectively valued by leadership. In academic healthcare systems this leadership is often provided by the chair at the department level and the division chiefs at the team level. Leaders that demonstrate behaviour consistent with high psychological safety model vulnerability and curiosity and ask questions that invite engagement. They reframe mistakes and failure as a normal part of learning and applaud the learning and growth that occurs from it. When members in the division do speak up, fail or ask for help, they need to be met with a response that is constructive, respectful and emotionally regulated. All of this can be achieved while maintaining high-performance standards. Rudeness or incivility cannot be tolerated. It compromises learning, communication, conflict resolution and patient care.[23–26] It destroys psychological safety.

It is worth emphasising that psychological safety does not mean that every idea will be adopted, all opinions are correct or that poor performers are unaccountable. Instead, it is about demanding candour, openness and respect, so that members of a department can share and learn and grow. When organisations combine high psychological safety with high performance pressures, they learn, contribute, challenge, innovate and create. In the context of healthcare, this is where high-quality patient care can be optimised. However, when members within a department are exposed to high performance pressure with low psychological safety, they experience anxiety and they may withdraw, stop contributing, cover up mistakes and turnover.[8] As we have demonstrated in this cost-consequence analysis, this comes with a price. Developing and maintaining psychologically safe environments is not easy and it is a continuous process. However, failing to do so could have financial consequences for academic departments.

Twitter Franklyn P Cladis @Fcladis

Acknowledgements Thank you to Toni Orsino MBA CRNA for her assistance and support throughout the project. Thank you to Donald V Moser for his guidance and input. His help made the analysis a better product.

Contributors FPC designed the study in consultation with MH. FPC created the survey and collected the data. JG created the cost-consequence analysis and provided primary input on the data analysis. FPC, MH and JG assisted in drafting and editing the manuscript. All authors discussed the results and commented on the manuscript. Toni Orsino MBA CRNA provided assistance and support throughout the project. Donald V Moser provided guidance and input throughout the project. FPC is responsible for the overall content as guarantor.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval The study was reviewed by the Institutional Review Board of the University of Pittsburgh. IRB approval was obtained and the requirement for informed consent was waived.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. This was a non-funded study. The data can be shared upon reasonable request.

ORCID iD

Franklyn P Cladis http://orcid.org/0000-0002-4789-0958

REFERENCES

1 Edmondson AC. Psychological safety and learning behavior in work teams. *Adm Sci Q* 1999;44:350–83.
2 Schein EH, Bennis W. *Personal and organizational change through group methods*. New York, NY: Wiley, 1965.
3 Baer M, Frese M. Innovation is not enough: climates for initiative and psychological safety, process innovations, and firm performance. *J Organ Behavior* 2003;24:45–68.
4 Kessel M, Kratzer J, Schultz C. Psychological safety, knowledge sharing, and creative performance in healthcare teams. *Creat Innov Manage* 2012;21:147–57.
5 Gu Q, Wang GG, Wang L. Social capital and innovation in R&D teams: the mediating roles of psychological safety and learning from mistakes. *R D Manag* 2013;43:89–102.
6 Yanchus NJ, Periard D, Osatuke K. Further examination of predictors of turnover intention among mental health professionals. *J Psychiatr Ment Health Nurs* 2017;24:41–56.
7 Yanchus NJ, Periard D, Moore SC, *et al*. Predictors of job satisfaction and turnover intention in VHA mental health employees: a comparison between psychiatrists,

psychologists, social workers, and mental health nurses. *Hum Serv Organ Manag Leadersh Gov* 2015;39:219–44.
8 Edmondson AC. *The fearless organization: creating psychological safety in the workplace for learning, innovation, and growth*. Hoboken, NJ: John Wiley & Sons, 2019.
9 O'Donovan R, Van Dun D, McAuliffe E. Measuring psychological safety in healthcare teams: developing an observational measure to complement survey methods. *BMC Med Res Methodol* 2020;20:203.
10 O'Donovan R, McAuliffe E. Exploring psychological safety in Healthcare teams to inform the development of interventions: combining observational, survey and interview data. *BMC Health Serv Res* 2020;20:810.
11 Hann M, Reeves D, Sibbald B. Relationships between job satisfaction, intentions to leave family practice and actually leaving among family physicians in England. *Eur J Public Health* 2011;21:499–503.
12 Han S, Shanafelt TD, Sinsky CA, *et al*. Estimating the attributable cost of physician burnout in the United States. *Ann Intern Med* 2019;170:784–90.
13 Husereau D, Drummond M, Augustovski F, *et al*. Consolidated health economic evaluation reporting standards 2022 (CHEERS 2022) statement: updated reporting guidance for health economic evaluations. *BMC Med* 2022;20:23.
14 Linzer M, Griffiths EP, Feldman MD. Responding to the great resignation: detoxify and rebuild the culture. *J Gen Intern Med* 2022;37:4276–7.
15 Appelbaum NP, Santen SA, Aboff BM, *et al*. Psychological safety and support: assessing resident perceptions of the clinical learning environment. *J Grad Med Educ* 2018;10:651–6.
16 Murray JS, Kelly S, Hanover C. Promoting psychological safety in healthcare organizations. *Mil Med* 2022;187:808–10.
17 Remtulla R, Hagana A, Houbby N, *et al*. Exploring the barriers and facilitators of psychological safety in primary care teams: a qualitative study. *BMC Health Serv Res* 2021;21:269.
18 Kerrissey MJ, Hayirli TC, Bhanja A, *et al*. How psychological safety and feeling heard relate to burnout and adaptation amid uncertainty. *Health Care Manage Rev* 2022;47:308–16.
19 Derickson R, Fishman J, Osatuke K, *et al*. Psychological safety and error reporting within veterans health administration hospitals. *J Patient Saf* 2015;11:60–6.
20 Edmondson AC. Learning from mistakes is easier said than done: group and organizational influences on the detection and correction of human error. *J Appl Behav Sci* 1996;32:5–28.
21 Ridley CH, Al-Hammadi N, Maniar HS, *et al*. Building a collaborative culture: focus on psychological safety and error reporting. *Ann Thorac Surg* 2021;111:683–9.
22 Tucker AL, Nembhard IM, Edmondson AC. Implementing new practices: an empirical study of organizational learning in hospital intensive care units. *Manag Sci* 2007;53:894–907.
23 Riskin A, Erez A, Foulk TA, *et al*. Rudeness and medical team performance. *Pediatrics* 2017;139:e20162305.
24 Fida R, Laschinger HKS, Leiter MP. The protective role of self-efficacy against workplace incivility and burnout in nursing: a time-lagged study. *Health Care Manage Rev* 2018;43:21–9.
25 Swendiman RA, Edmondson AC, Mahmoud NN. Burnout in surgery viewed through the lens of psychological safety. *Ann Surg* 2019;269:234–5.
26 Rahim A, Cosby DM. A model of workplace incivility, job burnout, turnover intentions, and job performance. *J Manag Dev* 2016;35:1255–65.