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Attitudes toward complication and near-miss reporting and the perceived reporting-feedback environment among anaesthesia team members in Türkiye: an exploratory cross-sectional online survey

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Research Article

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Abstract

Background

Incident and near-miss reporting supports organisational learning and patient safety. We described anaesthesia team members' attitudes to reporting, perceived systemic and psychological barriers, and the institutional reporting-feedback environment, and explored factors associated with receiving feedback often or always.

Methods

In this cross-sectional online survey, 422 anaesthesia team members were recruited by convenience sampling. A study-specific 23-item Likert questionnaire was analysed at item level and was not treated as a validated scale. Because actual reporting behaviour was not measured and no verifiable skip logic restricted the feedback question to participants who had submitted a report, often/always feedback was interpreted as a marker of the perceived reporting-feedback environment. Analyses included multivariable logistic regression, Firth penalised logistic regression, five-category ordinal logistic sensitivity analysis, alternative three-category coding of reporting-system status, 2,000-resample bootstrap internal validation, and professional-role comparisons with Holm correction.

Results

The sample included 194 anaesthesiologists (46.0%), 157 anaesthesia technicians/technologists (37.2%), and 71 residents (16.8%). A formal reporting system was reported by 67.3% and formal training by 52.4%; 36.7% reported receiving feedback often or always. In the primary model, formal system availability (aOR 7.98, 95% CI 3.61–17.65) and formal training (aOR 2.44, 95% CI 1.38–4.32) were associated with regular feedback. Firth estimates were similar (OR 7.23 and 2.35, respectively), and the ordinal model showed concordant associations (OR 5.86 and 3.42). The optimism-corrected AUC was 0.779 and Brier score 0.184. After Holm correction, 19 of 23 items differed across professional roles.

Conclusions

Anaesthesia team members strongly supported incident reporting, but concerns about blame and legal or administrative consequences, workload, hierarchy, and limited feedback remained common. Formal reporting systems and training were associated with a more favourable perceived reporting-feedback environment, not directly measured reporting behaviour. Findings are exploratory and should be interpreted in light of the cross-sectional convenience sample and non-validated study-specific questionnaire.

Background

Anaesthesia and perioperative care require rapid decision-making in settings characterised by high workload, time pressure, and close interdependence among team members. Incident and near-miss reporting systems are intended not merely to record events but to support organisational learning and reduce recurrence [1–4]. In an earlier survey of anaesthesia teaching hospitals in Türkiye, most respondents considered critical-incident reporting necessary, yet formal reporting systems were available in only a limited proportion of institutions [2]. This discrepancy suggests that a positive attitude toward reporting does not, by itself, create a functioning learning system.

Safety culture encompasses interrelated domains such as teamwork, management support, organisational responses to error, openness of communication, and event reporting. Both the original Hospital Survey on Patient Safety Culture (HSOPSC) and the revised HSOPSC 2.0 have been validated in Turkish settings [5–7]. Studies using the operating-room version of the Safety Attitudes Questionnaire (SAQ-OR) have likewise highlighted teamwork climate, safety climate, perceptions of management, working conditions, and recognition of stress as relevant dimensions of perioperative safety culture [8–10].

Hierarchy and psychological safety may also shape whether perioperative concerns become visible. Operating-room research has identified hierarchical gradients, organisational culture, and limited training as barriers to speaking up, whereas supportive responses from senior team members can encourage future voice behaviour and improve team functioning [11–14]. Incident reporting therefore needs to be considered in relation to system design, organisational culture, feedback loops, and team relationships rather than as an individual behaviour alone.

Systematic reporting of complications and near misses is one of the main mechanisms through which patient-safety risks can be identified and converted into organisational learning. The World Health Organization has emphasised that incident reporting and learning systems should not function simply as repositories of events; they should feed analysis, learning, and risk-reduction processes [1].

Effective reporting systems depend not only on staff believing that reporting matters, but also on the presence of a safe, accessible process that generates visible feedback. Systematic reviews have consistently identified fear of blame or punishment, legal concerns, cumbersome reporting procedures, insufficient training, weak managerial support, and lack of feedback as major barriers to reporting [15–17]. These findings place reporting within the broader context of safety culture and organisational learning.

Patient-safety incidents can also affect the healthcare professionals involved. The so-called second-victim phenomenon has been associated with guilt, anxiety, persistent rumination, and temporary loss of professional confidence after adverse events [18, 19]. For this reason, assessments of reporting culture should also consider staff experiences after an event and the support available within the institution.

The aim of this study was to describe anaesthesia team members' attitudes toward complication and near-miss reporting, perceived systemic and psychological barriers, and the institutional reporting-feedback environment at item level, and to explore individual and institutional factors associated with reporting that feedback was received often or always. The study was not designed to estimate actual reporting behaviour, national prevalence, or a validated psychometric construct.

Methods

Study design and participants

We conducted an exploratory cross-sectional online survey of anaesthesia team members to examine views on complication and near-miss reporting and perceived systemic, psychological, and institutional factors related to the reporting process. A total of 423 questionnaires were submitted. The primary analytic sample comprised 422 participants who completed all 23 Likert items, corresponding to an analytic completion rate of 99.8% among submitted questionnaires. Because the survey was distributed through open social-media channels, the denominator of eligible individuals who were reached was unknown and this figure was not interpreted as a conventional response rate. Reporting was structured with reference to the STROBE statement for cross-sectional observational studies [20].

Study setting and data collection: Data collection began after ethics approval. The questionnaire was created in Google Forms and remained open for six months. Potential participants in Türkiye were reached through social-media channels, resulting in a non-probability convenience sample. Reminder posts were shared every 15 days, and Google Forms settings intended to limit multiple submissions by the same individual were enabled. Because distribution occurred through open social media, the total number of eligible individuals who viewed the survey and the number of unique visitors could not be determined reliably; a conventional response rate therefore could not be calculated. The available study records also did not contain platform logs sufficient to calculate view or participation rates. For CHERRIES reporting, the elements that could be verified from the available records—consent flow, number of submitted questionnaires, analytic completion, and the approach used to discourage duplicate responses—were reported; view and participation metrics were unavailable [21].

The first survey item obtained informed consent to participate. Participants who selected 'Yes' proceeded to the questionnaire; the survey ended for those who declined, and no research data were collected from them.

Questionnaire and variables

The questionnaire was organised around reporting attitudes, structural barriers, concerns about blame and legal consequences, organisational culture, feedback and learning, psychological effects after an event, hierarchy, and perceived needs for improvement and training. The available study documentation did not contain verifiable details of a formal literature-based item-development process, expert-panel

review, cognitive pretesting or pilot testing, or content-validity indices. Accordingly, the questionnaire is not presented as a validated psychometric scale. The 23 Likert items were analysed primarily as individual study items. Cronbach's alpha and mean inter-item correlations for prespecified item groupings were treated as descriptive, exploratory indicators of internal consistency rather than evidence of construct validity; no composite score was created for groupings with inadequate internal consistency.

The questionnaire recorded professional role, sex, age, years of experience in anaesthesia, institution type, current work setting, and average number of on-call shifts per month. It also asked whether a formal incident/complication reporting system existed at the participant's institution, whether the participant had received formal training on that system, how often feedback was received after incident reporting, and whether the participant had experienced at least one complication or near miss during the previous 12 months. Twenty-three five-point Likert items assessed reporting attitudes, structural barriers, concerns about blame and legal consequences, organisational culture, feedback and learning, psychological effects, hierarchy, and intentions related to system improvement and training (1 = strongly disagree; 5 = strongly agree).

Outcome definition

Outcome definition
The survey separately asked whether participants had experienced a complication or near miss during the previous 12 months, but it did not ask whether such an event had actually been reported. The item on frequency of receiving feedback after incident reporting was completed by all participants in the analytic dataset, and no verifiable branching record was available to confirm that the item had been shown only to participants who had submitted a report. For the primary binary analysis, 'Often' and 'Always' were classified as regular feedback, whereas 'Never', 'Rarely', and 'Sometimes' were classified as non-regular feedback. This cut-point was an analytic operationalisation rather than a validated clinical threshold. The outcome was therefore interpreted as an indicator of the participant's perceived institutional reporting-feedback environment, not as actual reporting behaviour or as feedback experienced only after a verified report.

Statistical analysis

Categorical variables were summarised as counts and percentages. Likert items were reported as means, standard deviations, and the proportions in the top two categories (agree/strongly agree), neutral category, and bottom two categories (disagree/strongly disagree). Item-level descriptive findings were the primary unit of interpretation. Internal consistency of prespecified item groupings was explored using Cronbach's alpha and mean inter-item correlations. Items 9, 15, and 18 were reverse-coded within the relevant exploratory groupings to align item direction. These groupings were not treated as validated subscales, and no composite score was calculated when internal consistency was inadequate.

Univariable associations between regular feedback and categorical variables were examined with Pearson's chi-square test, with Cramér's V as the effect-size measure. The primary multivariable logistic regression included professional role, institution type, professional experience, monthly on-call frequency, presence of a formal reporting system, formal training, and experience of an incident during the previous 12 months. In the primary model, the reporting-system variable compared 'Yes' with 'No/Do not know'. To assess small-sample bias arising from sparse cells, the same covariates were analysed using Firth penalised logistic regression; 95% confidence intervals and p values were obtained from profile penalised likelihood. Sensitivity to dichotomising the outcome was examined with a proportional-odds ordinal logistic model that retained the five ordered feedback categories (Never, Rarely, Sometimes, Often, Always). To test whether 'Do not know' should be distinguished from 'No', the reporting-system variable was recoded as three categories, using 'No' as the reference, and re-analysed with Firth regression. Exploratory comparisons of the 23 Likert items across professional roles used Kruskal-Wallis tests with Holm correction across the 23 omnibus tests. For prespecified items related to blame, legal concerns, institutional support, feedback, staff support, and hierarchy, post-hoc pairwise Mann-Whitney U tests were performed with Holm correction within each item. Internal validation of the primary logistic model used 2,000 bootstrap resamples, with apparent and optimism-corrected ROC-AUC and Brier scores reported. All tests were two-sided with $p < 0.05$ considered statistically significant. The additional analyses were interpreted as exploratory robustness and sensitivity analyses.

Statistical software: Analyses were performed in Python 3.13.5. Data management and numerical operations used pandas 2.2.3 and NumPy 2.3.5; statistical tests and regression models used SciPy 1.17.0 and statsmodels 0.14.6; ROC-AUC and Brier scores were calculated with scikit-learn 1.8.0. Firth logistic regression was implemented using Jeffreys-prior penalised likelihood, and a fixed random-number seed was used for bootstrap resampling.

Ethical approval and consent

The study was approved by the Ankara Bilkent City Hospital No. 1 Medical Research Scientific and Ethics Evaluation Board (TABED; approval no. TABED 1-26-2215). Participation was voluntary.

Informed consent

was obtained electronically through the first survey item. Participants who agreed continued to the questionnaire; those who declined exited the survey and contributed no research data.

Results

The analytic sample comprised 422 participants: 194 anaesthesiologists (46.0%), 157 anaesthesia technicians/technologists (37.2%), and 71 anaesthesiology residents (16.8%). Women accounted for 68.0% of the sample. Demographic and professional characteristics are shown in Table 1.

Table 1
Demographic and professional characteristics of participants

Characteristic	Category	n	%
Professional role	Anaesthesiologist	194	46.0
Professional role	Anaesthesia technician/technologist	157	37.2
Professional role	Anaesthesiology resident	71	16.8
Sex	Female	287	68.0
Sex	Male	135	32.0
Age group	26–30	100	23.7
Age group	≥ 46	88	20.9
Age group	31–35	79	18.7
Age group	41–45	79	18.7
Age group	36–40	66	15.6
Age group	≤ 25	10	2.4
Experience in anaesthesia	≥ 16 years	117	27.7
Experience in anaesthesia	11–15 years	88	20.9
Experience in anaesthesia	4–6 years	80	19.0
Experience in anaesthesia	7–10 years	71	16.8
Experience in anaesthesia	1–3 years	47	11.1
Experience in anaesthesia	< 1 year	19	4.5
Institution type	Training and research hospital	194	46.0
Institution type	State hospital	111	26.3
Institution type	University hospital	82	19.4
Institution type	Private hospital	35	8.3
Average on-call shifts per month	4–6	177	41.9
	None	97	23.0
	1–3	93	22.0
	7–9	48	11.4
	≥ 10	7	1.7

A formal incident/complication reporting system was reported by 67.3% of participants, 52.4% reported having received formal training on the reporting system, and 58.5% reported at least one complication or near miss during the previous 12 months. Overall, 36.7% reported receiving feedback often or always after incident reporting. Institutional reporting characteristics and clinical exposure are summarised in Table 2.

Table 2
Institutional reporting environment and clinical exposure

Characteristic	Category	n	%
Formal incident/complication reporting system	Yes	284	67.3
Formal incident/complication reporting system	Do not know	82	19.4
Formal incident/complication reporting system	No	56	13.3
Formal training on the reporting system	Yes	221	52.4
Formal training on the reporting system	No	201	47.6
Frequency of feedback after incident reporting	Often	117	27.7
Frequency of feedback after incident reporting	Sometimes	106	25.1
Frequency of feedback after incident reporting	Never	102	24.2
Frequency of feedback after incident reporting	Rarely	59	14.0
Frequency of feedback after incident reporting	Always	38	9.0
Complication/near miss in the past 12 months	Yes	247	58.5
Complication/near miss in the past 12 months	No	175	41.5
Current work setting (multiple responses)	Operating room	369	87.4
Current work setting (multiple responses)	Intensive care unit	98	23.2
Current work setting (multiple responses)	Pain clinic	12	2.8
Current work setting (multiple responses)	Palliative care	39	9.2
Current work setting (multiple responses)	Non-operating-room anaesthesia	69	16.4

At item level, agreement was high that near misses should be reported even when no patient harm occurred (mean 4.57, SD 0.77) and that incident reporting improves patient safety (mean 4.64, SD 0.64). Concern about being personally blamed was reported by 76.5% of participants, 76.8% believed reporting could have legal or administrative consequences, and 65.6% agreed that hierarchy within the anaesthesia team makes reporting more difficult. The full item distributions are presented in Table 3.

Table 3
Item-level distribution of Likert responses

No.	Item	Mean	SD	Top-two-box %	Neutral %	Bottom-two-box %
1	Near-miss events should be reported even when no patient harm occurs.	4.57	0.77	91.5	5.0	3.6
2	I believe that incident reporting improves patient safety.	4.64	0.64	94.5	4.3	1.2
3	When incidents are not reported, the health system loses opportunities to learn.	4.56	0.75	92.2	5.5	2.4
4	A heavy clinical workload makes incident reporting more difficult.	4.41	0.90	87.7	6.6	5.7
5	The current reporting system is not practical or user-friendly.	3.99	1.05	66.1	25.8	8.1
6	I would report more incidents if the reporting process were faster and simpler.	4.26	0.94	79.1	15.6	5.2
7	I worry about being personally blamed when I report an incident.	4.08	1.09	76.5	10.9	12.6
8	I think incident reporting may lead to legal or administrative consequences.	4.14	1.02	76.8	14.2	9.0
9	Staff who report incidents are supported and not blamed in my institution.	3.59	1.23	50.5	33.2	16.4
10	Complications are generally addressed as system problems rather than individual errors.	3.73	1.17	60.2	24.2	15.6
11	Managers explicitly encourage incident reporting.	3.62	1.25	54.5	25.1	20.4
12	I believe that processes following incident reports are handled fairly and transparently.	3.44	1.31	47.6	29.6	22.7
13	I receive feedback about the outcome after I report an incident.	3.76	1.08	63.3	23.5	13.3
14	I see incident reporting lead to tangible changes in clinical practice.	3.72	1.13	59.2	25.6	15.2
15	I do not think incident reporting provides meaningful benefit in practice.	3.48	1.30	52.1	21.1	26.8
16	A complication or near miss that I experience stays on my mind for a long time.	4.33	0.85	89.1	5.0	5.9

No.	Item	Mean	SD	Top-two-box %	Neutral %	Bottom-two-box %
17	I experience a temporary loss of professional confidence after such events.	3.82	1.17	67.1	15.6	17.3
18	Staff who experience a complication receive psychological or professional support in my institution.	3.31	1.38	45.3	22.7	32.0
19	The stress I experience reduces my willingness to report incidents.	3.83	1.15	65.6	18.7	15.6
20	Hierarchy within the anaesthesia team makes incident reporting more difficult.	3.81	1.19	65.6	16.1	18.2
21	Reporting incidents is more difficult for residents and technicians/technologists.	3.97	1.09	74.2	13.3	12.6
22	I would report more incidents if the reporting system were improved.	4.30	0.80	84.8	12.6	2.6
23	Regular training on incident reporting would increase my willingness to report.	4.24	0.89	82.0	13.5	4.5

Exploratory internal-consistency analyses yielded relatively high alpha coefficients for some prespecified item groupings, whereas the blame/legal-concern/support, feedback/organisational-learning, and second-victim/psychological-impact groupings showed inadequate internal consistency. Negative alpha values were observed for feedback/organisational learning (alpha = -0.275) and second-victim/psychological impact (alpha = -0.086). These findings did not support treating those items as unidimensional subscales, and no composite score was created for the inadequate groupings. The values in Table 4 are descriptive reliability indicators only and should not be interpreted as evidence of psychometric validity.

Table 4
Exploratory internal-consistency indicators for prespecified item groupings

Item grouping	No. of items	Coding	Cronbach α	Mean inter-item r	Descriptive interpretation
Reporting and safety attitudes	3	Same direction	0.866	0.692	Relatively high descriptively
System friction / structural barriers	3	Same direction	0.786	0.550	Acceptable descriptively
Blame/legal concern/support	3	Item 9 reverse-coded	0.182	0.101	Inadequate for a unidimensional score
Just culture / managerial support	3	Same direction	0.892	0.733	Relatively high descriptively
Feedback / organisational learning	3	Item 15 reverse-coded	-0.275	-0.037	Inadequate for a unidimensional score
Second-victim / psychological impact	4	Item 18 reverse-coded	-0.086	0.047	Inadequate for a unidimensional score
Hierarchical barriers	2	Same direction	0.844	0.733	Relatively high descriptively
Intention to report after improvement/training	2	Same direction	0.793	0.661	Acceptable descriptively

In exploratory univariable analyses, institution type, presence of a formal reporting system, formal training, and professional experience were associated with reporting feedback often or always. Cramér's V was larger for the formal reporting-system and formal-training variables than for the other characteristics (Table 5). Because no multiplicity correction was applied to these univariable comparisons, the results were considered exploratory rather than confirmatory.

Table 5
Univariable associations with reporting feedback often or always

Characteristic	Category	Total n	Often/always n	%	p	Cramér V
Professional role	Anaesthesiology resident	71	21	29.6	0.380	0.068
	Anaesthesia technician/technologist	157	61	38.9		
	Anaesthesiologist	194	73	37.6		
Institution type	State hospital	111	42	37.8	0.004	0.180
	Training and research hospital	194	72	37.1		
	Private hospital	35	21	60.0		
	University hospital	82	20	24.4		
Formal reporting system	Do not know	82	9	11.0	< 0.001	0.430
	Yes	284	145	51.1		
	No	56	1	1.8		
Resmi eğitim	Yes	221	121	54.8	< 0.001	0.387
	No	201	34	16.9		
Son 12 ayda olay	Yes	247	93	37.7	0.716	0.018
	No	175	62	35.4		
Monthly on-call shifts	0	97	43	44.3	0.209	0.086
	1–3	93	32	34.4		
	≥ 4	232	80	34.5		
Professional experience	4–10 years	151	44	29.1	0.011	0.146
	≤ 3 years	66	21	31.8		
	≥ 11 years	205	90	43.9		

Note: p values and Cramér's V refer to the omnibus comparison across all categories of each variable. Outcome: Often/Always feedback versus Never/Rarely/Sometimes. Univariable analyses were exploratory and were not adjusted for multiple testing.

In the exploratory multivariable model, reporting the presence of a formal reporting system (aOR 7.98, 95% CI 3.61–17.65; p < 0.001) and having received formal training (aOR 2.44, 95% CI 1.38–4.32; p = 0.002) were associated with regular feedback. Working in a university hospital (aOR 0.44, 95% CI 0.20–0.96; p = 0.039) and having at least four on-call shifts per month (aOR 0.52, 95% CI 0.28–0.99; p = 0.047)

were associated with lower odds of regular feedback. Because only 1 of 56 participants in the 'No' reporting-system category reported regular feedback, the estimate for the formal-system variable may be unstable and should be interpreted cautiously. The model contained 155 outcome events and 12 slope parameters. The ROC-AUC was 0.805, the Hosmer-Lemeshow p value was 0.443, and McFadden's pseudo-R2 was 0.214; these were treated as descriptive model measures rather than evidence of validated predictive performance.

Table 6
Factors associated with perceived regular feedback: exploratory multivariable logistic regression

Variable	aOR	95% CI	p
Technician/technologist vs resident	0.86	0.33–2.22	0.751
Anaesthesiologist vs resident	0.52	0.19–1.42	0.201
Training and research vs state hospital	0.97	0.55–1.74	0.928
Private vs state hospital	1.91	0.73–4.99	0.187
University vs state hospital	0.44	0.20–0.96	0.039
≤ 3 years vs 4–10 years	1.47	0.59–3.68	0.408
≥ 11 years vs 4–10 years	1.47	0.85–2.54	0.164
1–3 on-call shifts vs 0	0.68	0.33–1.38	0.283
≥ 4 on-call shifts vs 0	0.52	0.28–0.99	0.047
Reported formal system: Yes vs No/Do not know	7.98	3.61–17.65	< 0.001
Formal training: Yes vs No	2.44	1.38–4.32	0.002
Incident in past 12 months: Yes vs No	1.47	0.85–2.56	0.168

Robustness and sensitivity analyses largely preserved the direction of the primary findings. In Firth penalised logistic regression, reporting the presence of a formal system was associated with regular feedback (OR 7.23, 95% CI 3.46–16.31; p < 0.001), as was formal training (OR 2.35, 95% CI 1.35–4.13; p = 0.002). Working in a university hospital remained associated with lower odds (OR 0.46, 95% CI 0.21–0.97; p = 0.041), whereas the estimate for at least four on-call shifts per month was borderline (OR 0.54, 95% CI 0.28-1.00; p = 0.051). In the five-category ordinal model, a formal system (OR 5.86, 95% CI 3.47–9.90; p < 0.001) and formal training (OR 3.42, 95% CI 2.08–5.62; p < 0.001) were associated with higher feedback categories. University-hospital employment (OR 0.54, 95% CI 0.30–0.96; p = 0.034) and being an anaesthesiologist rather than a resident (OR 0.46, 95% CI 0.23–0.95; p = 0.035) were associated with lower feedback categories.

Table 7
Firth penalised logistic regression and ordinal sensitivity analysis

Variable	Firth OR (95% CI)	p	Ordinal OR (95% CI)	p
Technician/technologist vs resident	0.86 (0.34–2.19)	0.754	0.65 (0.33–1.31)	0.227
Anaesthesiologist vs resident	0.53 (0.20–1.43)	0.209	0.46 (0.23–0.95)	0.035
Training and research vs state hospital	0.97 (0.55–1.72)	0.927	0.92 (0.58–1.45)	0.716
Private vs state hospital	1.86 (0.74–4.87)	0.190	1.91 (0.91–4.01)	0.089
University vs state hospital	0.46 (0.21–0.97)	0.041	0.53 (0.30–0.95)	0.034
≤ 3 years vs 4–10 years	1.45 (0.59–3.57)	0.412	0.95 (0.50–1.81)	0.869
≥ 11 years vs 4–10 years	1.45 (0.85–2.49)	0.173	1.15 (0.76–1.76)	0.502
1–3 on-call shifts vs 0	0.69 (0.34–1.38)	0.298	0.76 (0.44–1.32)	0.335
≥ 4 on-call shifts vs 0	0.54 (0.28-1.00)	0.051	0.69 (0.42–1.15)	0.155
Formal system: Yes vs No/Do not know	7.23 (3.46–16.31)	< 0.001	5.86 (3.47–9.90)	< 0.001
Formal training: Yes vs No	2.35 (1.35–4.13)	0.002	3.42 (2.08–5.62)	< 0.001
Incident in past 12 months: Yes vs No	1.45 (0.85–2.51)	0.175	1.16 (0.77–1.75)	0.471

Note: Firth 95% confidence intervals and p values were based on profile penalised likelihood. In the ordinal model, OR > 1 indicates greater odds of being in a higher feedback category under the proportional-odds assumption.

When the formal reporting-system variable was analysed in three categories, Firth regression using 'No' as the reference yielded an OR of 24.59 for 'Yes' (95% CI 6.10-225.09; p < 0.001) and 5.86 for 'Do not know' (95% CI 1.27–56.27; p = 0.021). The wide confidence intervals, particularly in the context of only 1 of 56 participants in the 'No' category reporting regular feedback, confirmed substantial imprecision. The analysis nevertheless supported retaining 'Do not know' as conceptually distinct from 'No' in sensitivity analyses. Bootstrap internal validation reduced the apparent AUC from 0.805 to an optimism-corrected value of 0.779 and changed the Brier score from 0.172 to 0.184. Across the bootstrap distribution, the 95% percentile interval was 0.771–0.854 for AUC and 0.147–0.185 for the Brier score.

Table 8
Alternative coding of the formal reporting-system variable and bootstrap internal validation

Analysis	Estimate	95% CI / interval	p / interpretation
Three-category Firth: System Yes vs No	24.59	6.10-225.09	< 0.001
Three-category Firth: System Do not know vs No	5.86	1.27–56.27	0.021
Three-category Firth: Formal training Yes vs No	2.40	1.37–4.26	0.002
Bootstrap ROC-AUC (2,000 resamples)	0.805 → 0.779	0.771–0.854	Apparent → optimism-corrected
Bootstrap Brier score (2,000 resamples)	0.172 → 0.184	0.147–0.185	Lower values indicate better performance

Note: The three-category Firth model was adjusted for the same covariates as the primary model. Bootstrap intervals represent the percentile distribution of apparent performance measures across 2,000 resamples. Corrected values were calculated by subtracting mean bootstrap optimism for AUC and adding mean performance deterioration for the Brier score.

Professional role was associated with 19 of the 23 Likert items after Holm correction. Among the prespecified items of particular clinical interest, anaesthesiologists reported higher scores than technicians/technologists and residents for concern about personal blame (item 7; H = 26.87; Holm p < 0.001), concern about legal or administrative consequences (item 8; H = 28.44; Holm p < 0.001), support for staff who report incidents (item 9; H = 60.23; Holm p < 0.001), feedback after reporting (item 13; H = 50.32; Holm p < 0.001), psychological or professional support after a complication (item 18; H = 62.50; Holm p < 0.001), perceived hierarchical barriers to reporting (item 20; H = 21.10; Holm p < 0.001), and the perception that reporting is more difficult for residents and technicians/technologists (item 21; H = 19.86; Holm p < 0.001). For these selected items, post-hoc comparisons were significant between anaesthesiologists and each of the other two professional groups, whereas technicians/technologists and residents did not differ significantly. Adjusted results for all 23 items are provided in Appendix 2.

Discussion

The main finding of this study is the coexistence of strong support for incident reporting with substantial concerns about blame and legal or administrative consequences, high workload, hierarchical barriers, and limited feedback. This pattern suggests that reporting culture within anaesthesia teams is shaped not only by individual willingness to report but also by system design and psychological safety. The multivariable analyses should be viewed as secondary, exploratory analyses that complement the descriptive findings; the cross-sectional, self-reported design does not support causal inference.

Our findings also provide contemporary context for earlier anaesthesia-specific reporting research from Türkiye. In that study, most anaesthesiologists considered critical-incident reporting necessary, but

formal reporting systems were reported in only 37% of institutions, and insufficient training and practical barriers to use were highlighted [2]. In the present study, 67.3% of participants reported that a formal system was available at their institution. Because the two studies differ in sampling approach, institutional distribution, and response options, including the presence of a 'Do not know' category in the current survey, these percentages should not be interpreted as evidence of a temporal trend.

The results are consistent with the broader safety-culture literature. Turkish studies using the HSOPSC have identified event-reporting frequency and the organisational response to error as relevant dimensions of safety culture [5, 6]. Studies using the SAQ-OR have shown that teamwork and safety climate can vary across professional groups and institutions and that measurement structure requires separate validation [8–10]. The low and, in some groupings, negative internal-consistency estimates in our study reinforce the need to avoid treating study-specific item clusters as validated scales.

The findings on hierarchy are also in line with perioperative research. Syntheses of speaking-up behaviour in the operating room have identified hierarchy, organisational culture, and training as important determinants of whether staff challenge authority or voice safety concerns [11]. More recent work has emphasised that limited psychological safety and steep authority gradients can suppress speaking up, while the response of senior team members can influence whether concerns are raised again in the future [12–14]. Accordingly, the findings on hierarchy and fear of blame are better understood as features of team and organisational culture than as individual reluctance alone.

The sample included several professional roles and hospital types. Professional role was not independently associated with the primary binary outcome, although anaesthesiologists had lower odds than residents of being in a higher feedback category in the ordinal sensitivity analysis. At item level, professional-role differences were more pronounced: 19 of 23 items remained different across groups after Holm correction. For the selected items on blame and legal concerns, institutional support, feedback, and hierarchy, anaesthesiologists reported higher scores than both technicians/technologists and residents. These findings do not imply that one professional group experiences a uniformly better or worse safety culture; rather, they suggest that the same organisational environment may be perceived differently across roles.

Although approximately two-thirds of participants reported that their institution had a formal reporting system, only 36.7% reported receiving feedback often or always after reporting. This gap suggests that the presence of a reporting mechanism does not necessarily translate into a visible learning loop for staff. The WHO has emphasised that effective reporting systems should generate learning and safety improvement rather than simply collect events [1]. Systematic reviews have likewise identified limited feedback, weak organisational support, and inadequate training as barriers to effective patient-safety learning systems [15–17].

The item-level findings indicate a strong recognition of the value of reporting near misses and of the contribution of reporting to patient safety. At the same time, high agreement that workload makes reporting difficult and that a faster, simpler process would increase willingness to report shows that

favourable attitudes do not automatically translate into a workable reporting process. Complex or time-consuming systems, workload, and poor usability are well-described barriers in the literature [15–17].

Psychological safety was another prominent concern. More than three-quarters of participants reported concern about personal blame and about possible legal or administrative consequences of reporting. This is consistent with systematic reviews identifying fear and punitive organisational climates as major barriers to reporting [15–17]. A reporting platform alone is therefore unlikely to be sufficient; staff also need confidence that reporting will not lead to retaliation, stigmatisation, or unfair treatment. Just-culture principles, managerial support, and transparent processes are as important as the technical features of the reporting system.

Feedback after reporting emerged as a central theme in both the descriptive and multivariable analyses. In the primary model, perceived availability of a formal reporting system and formal training were strongly associated with regular feedback. Firth regression, which reduces bias in the presence of sparse cells, preserved the direction and ordering of these associations, and the ordinal model also supported associations of a formal system and training with higher feedback categories. However, when the system variable was analysed in three categories, both the 'Yes' and 'Do not know' estimates relative to 'No' had very wide confidence intervals. This reflects the extreme sparsity of regular feedback in the 'No' category and indicates that instability was reduced but not eliminated. The results should therefore be interpreted as exploratory associations that were directionally consistent across several sensitivity analyses, not as causal effects or precise effect sizes.

The psychological effects of complications and near misses were also substantial. Overall, 89.1% of participants agreed that such events remained on their mind for a long time, and 67.1% reported a temporary reduction in professional confidence. Previous research has described intrusive memories, anxiety, guilt, regret, and professional consequences among healthcare workers involved in adverse events [18, 19]. In contrast, fewer participants felt that their institution provided psychological or professional support after a complication, suggesting that post-event staff support deserves greater attention within patient-safety programmes.

Hierarchy was widely perceived as a barrier: 65.6% agreed that hierarchy within the anaesthesia team makes reporting more difficult, and 74.2% agreed that reporting is more difficult for residents and technicians/technologists. In team-based, time-pressured specialties such as anaesthesia, the ability of staff in less senior positions to raise concerns safely is a core component of safety culture. High agreement that reporting would increase if the system were improved and if regular training were provided suggests that at least some of these barriers may be modifiable.

From a psychometric perspective, the 23 Likert items should not be interpreted as a validated scale. Although several prespecified item groupings had relatively high alpha coefficients, negative alpha values for the feedback/organisational-learning and second-victim/psychological-impact groupings indicated that the full set of proposed groupings could not be represented reliably as unidimensional subscales. The study was therefore interpreted as an item-based survey, and no composite scores were

created for inadequate groupings. Future work should establish the measurement structure through expert review and content-validity assessment, cognitive pretesting and pilot work, factor analysis based on polychoric correlations, and reliability measures such as McDonald's omega in independent samples.

Some associations observed in univariable analyses weakened after multivariable adjustment. In the Firth model, university-hospital employment remained associated with lower odds of regular feedback, whereas the estimate for at least four monthly on-call shifts became borderline. Bootstrap internal validation reduced the AUC from 0.805 to 0.779 and increased the Brier score from 0.172 to 0.184, indicating modest optimism in apparent model performance. The model should therefore not be used for out-of-sample prediction without independent validation; its purpose here is descriptive and hypothesis-generating.

Finally, the multivariable outcome was not actual incident-reporting behaviour. Participants were asked whether they had experienced a complication or near miss during the previous 12 months, but not whether that event had been reported. There was also no verifiable skip-logic record showing that the feedback question had been restricted to participants who had submitted a report. The model therefore identifies factors associated with a perceived environment in which feedback is received often or always, not determinants of reporting behaviour. This distinction is important when separating reporting rates from the staff-experienced component of the organisational learning loop.

Limitations

Several limitations should be considered. First, the cross-sectional, self-reported design precludes temporal or causal inference and is susceptible to recall, social-desirability, and common-method bias. Voluntary participation and non-probability convenience sampling may have introduced selection bias. Because the survey was distributed through open social media, the total number of eligible individuals reached and the number of unique visitors were unknown; neither a conventional response rate nor CHERRIES view and participation rates could be calculated. The findings should therefore not be generalised as nationally representative estimates for all anaesthesia teams in Türkiye. Institution-level reporting-system characteristics were based on participant reports and were not verified against institutional records.

Second, there were important measurement and outcome limitations. Actual reporting behaviour was not measured directly, and there was no verifiable skip logic confirming that the feedback item was restricted to participants who had made a report; the outcome therefore represents the perceived reporting-feedback environment rather than verified post-reporting experience. The questionnaire was developed for this study, and its item-development and content-validity process was not fully documented, so it cannot be considered a validated psychometric instrument. Third, no a priori sample-size calculation was available and institution identifiers were not collected, preventing assessment of within-institution clustering, intraclass correlation, or cluster-robust standard errors. Sparse-cell bias was examined with Firth regression, the binary outcome definition with an ordinal model, the 'Do not know'

coding with a three-category sensitivity analysis, and model optimism with bootstrap AUC and Brier scores. Even so, estimates from the three-category reporting-system model remained imprecise because very few participants in the 'No' category reported regular feedback. The role-by-item analyses were exploratory; Holm correction reduced but did not eliminate the risks of multiplicity and chance findings. Without institution-level data and external validation, the results should not be interpreted as national prevalence estimates, causal effects, or a definitive prediction model.

Conclusions

Positive attitudes toward complication and near-miss reporting coexisted with substantial concerns about workload, blame, legal or administrative consequences, hierarchy, and limited feedback among anaesthesia team members. Perceived availability of a formal reporting system and formal reporting training were associated with a more favourable perceived reporting-feedback environment rather than with directly measured reporting behaviour. Firth, ordinal, and alternative-coding sensitivity analyses were broadly consistent with the main association, while bootstrap validation indicated modest optimism in apparent model performance. Professional-role analyses further suggested that perceptions of safety culture and feedback differ within anaesthesia teams. These findings are exploratory and should be tested in studies using validated instruments, institution-level sampling, and independent validation.

Abbreviations

aOR
adjusted odds ratio
AUC
area under the receiver operating characteristic curve
CHERRIES
Checklist for Reporting Results of Internet E-Surveys
CI
confidence interval
HSOPSC
Hospital Survey on Patient Safety Culture
OR
odds ratio
ROC
receiver operating characteristic
SAQ-OR
Safety Attitudes Questionnaire-Operating Room
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology.

Declarations

Ethics approval and consent to participate

The study was approved by the Ankara Bilkent City Hospital No. 1 Medical Research Scientific and Ethics Evaluation Board (TABED; approval no. TABED 1-26-2215). Participation was voluntary. Electronic informed consent was obtained from all participants before access to the survey questions.

Clinical trial number

Clinical trial number: not applicable.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The author declares that she has no competing interests.

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Authors' contributions

Suzan Öztürk Selçuk conceived and designed the study, developed the questionnaire, collected and curated the data, supervised and verified the statistical analyses, interpreted the findings, drafted and critically revised the manuscript, and approved the final version. The author takes full responsibility for the integrity and accuracy of the work.

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