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# Critical airway-related incidents and near misses in anaesthesia: a qualitative study of a critical incident reporting system☆

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## Abstract

**Background:** Many serious adverse events in anaesthesia are retrospectively rated as preventable. Anonymous reporting of near misses to a critical incident reporting system (CIRS) can identify structural weaknesses and improve quality, but incidents are often underreported.

**Methods:** This prospective qualitative study aimed to identify conceptions of a CIRS and reasons for underreporting at a single Swiss centre. Anaesthesia cases were screened to identify critical airway-related incidents that qualified to be reported to the CIRS. Anaesthesia providers involved in these incidents were individually interviewed. Factors that prevented or encouraged reporting of critical incidents to the CIRS were evaluated. Interview data were analysed using the Framework method.

**Results:** Of 3668 screened airway management procedures, 101 cases (2.8%) involved a critical incident. Saturation was reached after interviewing 21 anaesthesia providers, who had been involved in 42/101 critical incidents (41.6%). Only one incident (1.0%) had been reported to the CIRS, demonstrating significant underreporting. Interviews revealed highly variable views on the aims of the CIRS with an overall high threshold for reporting a critical incident. Factors hindering reporting of cases included concerns regarding identifiability of the reported incident and involved healthcare providers.

**Conclusions:** Methods to foster anonymity of reporting, such as by national rather than departmental critical incident reporting system databases, and a change in culture is required to enhance reporting of critical incidents. Institutions managing a critical incident reporting system need to ensure timely feedback to the team regarding lessons learned, consequences, and changes to standards of care owing to reported critical incidents. Consistent reporting and assessment of critical incidents is required to allow the full potential of a critical incident reporting system.

**Keywords:** airway management; critical incident reporting; near-miss; patient safety; qualitative study

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**Editor's key points**

- Fostering critical incident reporting could ultimately improve patient care and safety.
- This prospective qualitative single-centre observational study assessed anaesthesia provider conceptions of a critical incident reporting system (CIRS), reasons for underreporting or barriers to reporting, and factors that facilitate reporting using semi-structured interviews of anaesthesia providers who had been involved in airway-related critical incidents.
- Of 3668 airway management procedures, 101 (2.8%) involved a critical incident, but only one incident (1.0%) had been reported to the CIRS, demonstrating significant underreporting.
- Barriers to reporting incidents included a perceived risk of identifiability, a perceived poor attitude to error, a lack of feedback, and lack of changes resulting from entries.

One way to ensure high-quality patient care is to assess weaknesses within a complex healthcare system continuously, for example, by reporting critical incidents and near misses. Critical incidents in medicine are unwanted or unexpected incidents that without intervention could have led to physical or mental impairment of the patient or their relatives. Root cause analysis or other methods of incident investigation can highlight individual or system-level weaknesses that can then be targeted to improve patient safety and prevent future events.[1]

Critical incident analysis was introduced to aviation in 1954 to reduce airplane crashes caused by technical failures.[2] In the 1970s anaesthetists adopted critical incident reporting,[3,4] which is now an established technique to improve safety and quality in many medical specialties[5–7] and commonly implemented using web-based platforms.[8] It has been reported that critical incidents occur in 3.5% of anaesthesia cases.[9]

CIRSs aim to anonymously record critical incidents. The following requirements for successful incident reporting were identified[10]: (1) CIRSs have to be strictly confidential and the department must have an open-minded attitude to errors; (2) feedback about consequences resulting from reported events enhances reporting; and (3) an analytical framework must be applied to understand why things happened and how a similar event could be prevented from happening again. It is unclear whether these requirements are fulfilled by current CIRS platforms.

In anaesthesia, incidents related to airway management remain a leading cause of morbidity and mortality.[11] However, little is known about structural or systemic weaknesses that influence airway management.[12] Using a prospective before-and-after study design, we reported an analysis of undesired major and minor events related to airway management in more than 7000 general anaesthesia cases. Major events were defined as death, brain damage, emergency front of neck access, and unanticipated ICU admission (as in the NAP4 study[12]), and minor events included other undesired occurrences, such as difficult bag-mask ventilation, hypoxaemia, unplanned use of specialised equipment, failure to advance a tracheal tube, oesophageal intubation, soft tissue injury to lips or the mucosa, and others. Airway-related events were captured and recorded in a prospective way using a combination of electronic questionnaires, the presence of study personnel in operating rooms querying each anaesthesia case with the responsible anaesthesia team during the study period, and a review of the electronic anaesthesia patient data management system to minimise the risk of missing events. Analysis of frequently occurring events led to several changes in departmental airway management strategies, which reduced the incidence of these events.[13]

The relatively high incidence of airway-related events in this study was out of proportion to events reported to our departmental CIRS. The overall incidence of airway events was higher in our study than in two recently published studies (6.0% and 0.08%).[9,10] The definition of events was different in these studies and was broader in our study. Moreover, it is likely that the active prospective screening for events, with the presence of study personnel in operating rooms during data collection decreased the likelihood of underreporting compared with longer-term audits with self-reporting only.

The aim of this prospective qualitative observational study was to identify anaesthesia provider conceptions of a CIRS, reasons for underreporting or barriers to reporting, and factors that facilitate reporting of critical incidents using semi-structured interviews of anaesthesia providers who had been involved in airway-related critical incidents.

## Methods

This prospective qualitative observational study aiming to investigate possible underreporting of critical incidences in a CIRS system was performed in the Department of Anaesthesiology and Pain Medicine, Bern University Hospital, Bern, Switzerland, with ethics committee approval (Cantonal Ethics Committee of Bern, approval number 092/15, amendment 1) and written informed consent of all participants.

Independently from the CIRS platform, and as part of a prospective before-and-after study aiming to detect and improve structural weaknesses in airway management, all airway management procedures in the department were actively and prospectively assessed for adverse events over a period of 2 months. Analysis of frequently occurring events was followed by implementation of an intervention bundle targeting these events, which resulted in an overall reduction of events from 15% to 11%.[13] Recorded events included major events, such as death or unplanned admission to the ICU, and minor events, such as difficult visualisation during laryngoscopy or tissue trauma caused by airway management.[13] This incidence of airway events was in stark contrast to departmental CIRS entries. This led to the current study which aimed to identify anaesthesia providers' conceptions of CIRS, reasons for underreporting, and factors that facilitate reporting of critical incidents by means of semi-structured interviews of anaesthesia providers who had been involved in airway-related critical incidents.

All airway-related events occurring during the baseline period of the before-and-after study[13] were screened to identify airway-related events that would qualify as critical incidents and thus should be reported to the departmental CIRS. All airway-related events were assessed individually by two members of the research group (TP and CR) and classified as critical or non-critical incidents. If there was disagreement, the case was further reviewed by two additional members of the research group (RG and LT) and disagreement was resolved

Table 1 Semi-structured interview guide.

| | Semi-structured questions | Elaborating questions |
|---|---|---|
| 1 | Were you involved in this case? | If not, could you please tell us who was? |
| 2 | Could you please (nonetheless) describe the case for us? | What memories do you have? |
| 3 | We saw that _____? How did you experience this incident? | - Could you please (if possible) describe for us what happened?<br>- Did you expect it?<br>- Was it simple/normal/critical/problematic?<br>- What do you mean? |
| 4 | Do you know what a critical incident reporting system (CIRS) is? | |
| 5 | Do you know if we have a CIRS at our department? | |
| 6 | What are your personal criteria for reporting to the CIRS? | |
| 7 | Did you report this case to the CIRS? | Why/why not? |
| 8 | Do you know if someone else did report this case? | |
| 9 | Did you talk about the incident after it happened? | If yes, did this lead to a change of your future practice? What changed? |
| 10 | Do you believe that talking about the incident with colleagues/friends replaced a report in the CIRS for you? | Why/why not? |
| 11 | Have you previously reported to the CIRS here in this hospital? | |
| 12 | Do you recall other cases that you could have reported to the CIRS? | What were the reasons for not reporting? |
| 13 | Do you know how to report to the CIRS? | |
| 14 | What is in your point of view the purpose of the CIRS? | |
| 15 | Do you find the CIRS useful? | |
| 16 | Do you think the anonymity of the CIRS is kept? | Why/why not? |
| 17 | What is in your point of view a reasonable expenditure of time for a report? | |
| 18 | What would simplify reporting? | Is there something you would like to change about the CIRS? |
| 19 | How do you personally benefit from the CIRS? | |
| 20 | Is there something you would change, to make you benefit more from the CIRS? | |

by discussion. The assessment was subjective but adhered to the definition of a critical incident according to the departmental CIRS as an unwanted or unexpected incident that without intervention could have led to a physical or mental impairment to the patient or their relatives.

Anaesthesia providers involved in these airway events qualifying as critical incidents were asked if they were willing to participate in the study. Priority was given to providers involved in several critical incidents. With written informed consent, individual semi-structured interviews were conducted to assess whether the incident had been reported to the CIRS platform and to assess the reasons for reporting or not reporting the incident. The interview guide is provided in Table 1. The interview questions focused on participants' conceptions of the CIRS, barriers to reporting incidents, and factors that might facilitate entries into a CIRS.

Because of the observational and qualitative character of this study, no formal sample size calculation was performed. Interviews were performed until no new information could be gained by adding additional interviews (saturation). All interviews were carried out by two members of the research group (TP and JM). Both interviewing researchers were newly appointed as research fellows in the department at the time of the interviews and did not personally know the interviewees, nor were they in any way superior to the interviewees or could have taken disciplinary actions against the interviewees as a result of the interviews. Thus, the atmosphere during the interviews was positive and open. The interviews were performed in an unused office in the department during working hours in the local language, German. They were not recorded to ensure a relaxed atmosphere that allowed study participants to share their honest thoughts and opinions, which enhanced participation. Field notes were taken during the interviews and typed into a secured spreadsheet directly after the interviews. To ensure anonymity, all providers were referred to without sex in the spreadsheet, and no details of events were described.

The transcripts of the interviewers' field notes were analysed using the Framework method.[14] This involved a process of 'coding', where the term 'code' is used for a 'descriptive or conceptual label that is assigned to excerpts of raw data'.[14] The researchers first applied specific keywords (codes) to paragraphs in order to summarise the important topics of a paragraph. There were no fixed codes, that is, the researchers coded the paragraphs using keywords of their choice. In a second step, researchers agreed on a common set of codes, that is, codes that recurred throughout the interviews (common themes). These codes were then grouped into categories and a matrix of categories and codes was generated. Data were added to the matrix ('charted') such that for each category data from the transcripts were summarised in the matrix to facilitate interpretation and extraction of findings.

## Results

During the observation period of 2 months, our former study reported 3668 airway management procedures with 566 (15.4%) procedures involving at least one airway-related

event.[13] Of these, 101 cases (2.8% of anaesthesia cases) were rated as critical incidents that would have qualified to be reported to the departmental CIRS platform. In these cases, 74 different anaesthesia providers were responsible for airway management.

Involved anaesthesia providers were approached and all agreed to participate in the study. After 21 interviews (28% of involved anaesthesia providers), saturation was reached and no further providers were approached or interviewed. Six (28.6%) interviewees were consultants, 13 (61.9%) were registrars, and two (9.5%) were anaesthesia nurses. Nine (42.9%) were female. Median time since graduation was 7 (interquartile range [IQR] 5–9, range 0–28) yr, and they had a median of 4 (IQR 3–8, range 1–28) yr of experience in anaesthesia. The 21 interviewees had been involved in a total of 42 of the 101 critical incidents (41.6%). Of the 101 critical incidents, only one (1.0%) had been reported to the CIRS platform. Figure 1 depicts the study flowchart.

Through analysis by the Framework method,[14] six categories of codes were identified (Fig. 2): (1) confidentiality of CIRS and error culture, (2) feedback, (3) impact of CIRS on future clinical care, (4) general conceptions about CIRS, (5) criteria for reporting critical incidents to a CIRS, and (6) obstacles and factors that facilitate CIRS reporting.

## Category 1: concerns regarding identifiability of the reported incident and error culture

For the most part, anaesthesia providers believe that anonymity of the CIRS platform is assured. However, some mentioned concerns regarding the identifiability of reported incidents or involved healthcare providers, as they indicated that it is always possible to find out who the responsible person during a reported incident was. Particularly after severe adverse events, the anonymity of the provider might not be guaranteed as involved healthcare professionals frequently talk about such cases as a way of coping with difficult situations. Also, once the case is presented for teaching purposes, some team members might remember who was involved in the event. This seems to be dependent on the size of the hospital: the bigger the hospital, the higher the chance for anonymity (Table 2, quotes 1–4).

Some providers expressed that they simply trust that the review board responsible for the CIRS would not try to find out details of the healthcare professionals involved. It was highlighted that it is important that the CIRS board consists of healthcare professionals who are not involved in promotions or career-changing decisions for staff members. It seems to be especially important that superiors cannot see who reported an incident, and that reporting can be done electronically and anonymously without the possibility to track the reporting person (Table 2, quotes 5 and 6).

In contrast, several participants explained that they purposefully did not perform anonymous entries to the CIRS platform. This was linked to their conception that critical incidents reported to the CIRS were related to system errors rather than personal errors and that they wished to receive direct feedback (Table 2, quotes 7 and 8).

The CIRS was identified as a means to help create a more open error culture; however, this goal was still not achieved. Most interviewees mentioned that there is a need for a more open error culture, acknowledging that everyone makes mistakes (Table 2, quotes 9–11).

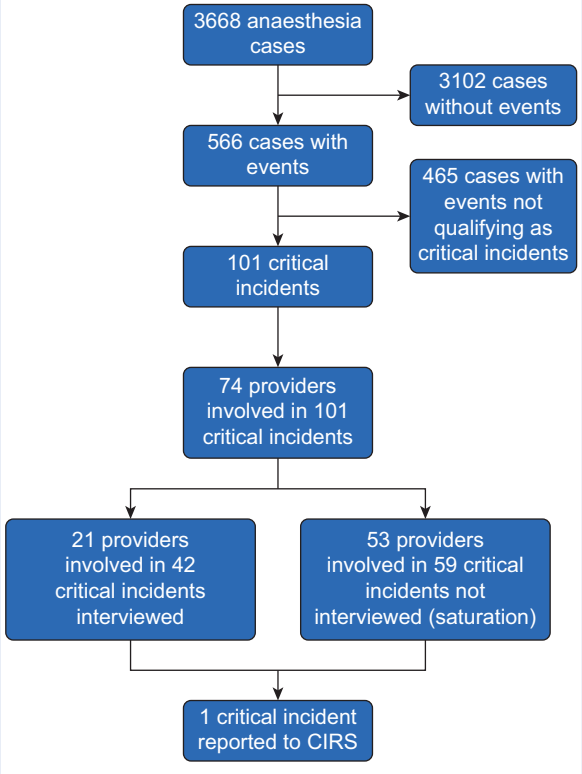


Fig 1. Study flowchart. CIRS, critical incident reporting system.

## Category 2: feedback

Most participants were not satisfied with either the quantity or the quality of feedback they received from the CIRS review board. There was a widespread wish for more regular feedback about reported incidents. Some highlighted that they do benefit from cases that are presented to the department, whereas others stated that they do not learn from the CIRS as the analysis and presentation of cases is felt to be insufficient or lacking insight. Some participants mentioned a system that requires an active process such as logging into a CIRS platform to read about incidents will not reach many healthcare providers. More passive processes to inform providers, such as e-mails or lectures, were deemed more likely to reach the team. The feedback should go beyond the generic recommendation to be more careful or alert in the future (Table 2, quotes 12–18).

More frequent departmental presentations and discussions of CIRS cases (to account for absences owing to shift work or leave), regular e-mails discussing CIRS cases to read on one's own time, an option to provide entries nonanonymously to receive personal feedback from the CIRS board, and more information and training on how to access reported CIRS cases were mentioned as options for improvement of the system (Table 2, quotes 19 and 20).

## Category 3: impact of CIRS on future clinical care

CIRS entries led to specific changes in the department in the past, such as modified guidelines for insulin administration. The only CIRS entry that was made by one of the participants

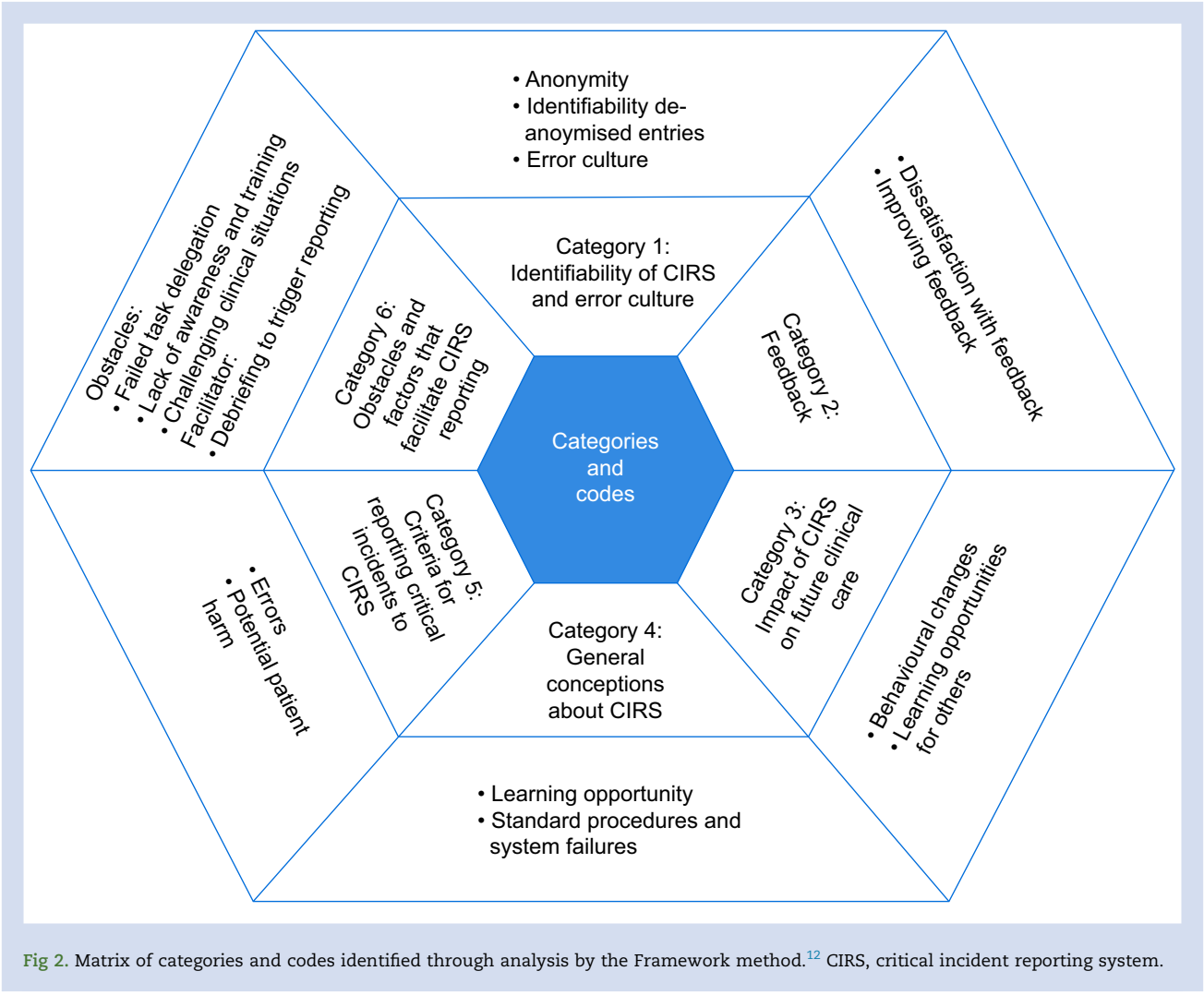


Fig 2. Matrix of categories and codes identified through analysis by the Framework method.[12] CIRS, critical incident reporting system.

during the study period also led to changes in clinical care. Debriefing of critical incidents, even if they are not reported to the CIRS, also seems to lead to changes in anaesthesia providers' behaviour (Table 2, quote 21).

Learning opportunities provided by the CIRS seem to be negatively affected by the limited number of CIRS entries. Additionally, the potential to learn from critical incidents is limited if few CIRS entries are discussed within departmental teaching sessions. Healthcare professionals do, however, agree that CIRS offers a degree of learning potential, especially the potential to make others aware of errors or problems that occurred to help avoid similar situations (Table 2, quotes 22 and 23).

### Category 4: general conceptions about CIRS

A prominent purpose of the CIRS was described as the potential to learn from critical incidents (Table 2, quote 24). Other aims of the CIRS mentioned by participants were to uncover systematic failures rather than provider failures; to eliminate potential systemic sources of mistakes; to question, improve, and optimise procedures and daily routines, such as by establishing checklists; to sensitise others to a problem; and to document unique problems that occur as a result of human errors. Critical incidents seem to happen sometimes because of accumulation of 'minor' or 'careless' mistakes. Because mistakes are bound to happen, the CIRS seems to help define clear procedures, responsibilities, and cooperation. The CIRS platform also seems to allow healthcare professionals to express what they are worried about if there is an incident. There is however the risk that even though the goal of a CIRS is to uncover systematic failures, it might still fail to do so (Table 2, quotes 25–27).

### Category 5: criteria for reporting critical incidents to CIRS

Mistakes and procedural problems often prompt reporting to a CIRS. Examples mentioned were wrong drug administered, time pressure causing mistakes, mistakes that caused no consequences or harm to the patient, equipment failures, or critical information that was lost during the handover of a patient from one healthcare professional to another. Some were reluctant to report mistakes without consequences and

Table 2 Paraphrased exemplary quotes. CIRS, critical incident reporting system.

| Category 1: concerns regarding identifiability of the reported incident and error culture | | Quote number |
|---|---|---|
| **Anonymity** | *I think the anonymity of CIRS is kept, except if something really bad has happened. In this case, people talk about the event, and it makes no longer sense to do a CIRS entry.* | 1 |
| | *The anonymity of CIRS is sort of kept. If a serious incident occurs, everybody will know about it. If the case is presented many will remember. Hence, it is no longer anonymous.* | 2 |
| | *CIRS is useful, however, in a small hospital it is never anonymous.* | 3 |
| | *I think the anonymity of CIRS is kept, however, there are cases the entire hospital knows. Then, it is not really anonymous. But the team in our hospital is big, which fosters anonymity.* | 4 |
| **Identifiability** | *I have experienced myself that confidentiality is not kept. In a small hospital, I was approached about a CIRS entry I had made on the day after I had made this entry.* | 5 |
| | *I do believe that confidentiality is kept. The CIRS team is a team consisting of a nurse, a registrar, and a consultant who analyse the cases, not the bosses who might want to preclude your future career.* | 6 |
| **De-anonymised entries** | *I think the anonymity of the CIRS is kept. I do, however, make my entries including my name since I hope for feedback. I don't care if it is anonymous or not, but I believe it is good that the option to make anonymous entries exists, for those who appreciate anonymity.* | 7 |
| | *I never make anonymous entries. It is about system errors, not about personal errors. It will take a generation to change this way of thinking.* | 8 |
| **Error culture** | *CIRS is useful, it is used more and more. We have to get away from 'We should not make mistakes'. Everybody makes mistakes.* | 9 |
| | *The anonymity of CIRS is not really kept, if we talk about a case. However, with a good error culture, CIRS would not have to be anonymous. But unfortunately, we are not there, yet.* | 10 |
| | *CIRS is useful. It creates an error culture that is somewhat more open. The aim should be to only document things that will help others. It should be limited to relevant cases and it should be anonymous.* | 11 |
| **Category 2: feedback** | | |
| **Dissatisfaction with feedback** | *CIRS is useful, at least if something happens with the information. But this is not the case. I have not learned much from it up until now.* | 12 |
| | *I find CIRS useful if it is done properly. That means, if it leads to a seminar or teaching session. In our hospital, this happens only twice a year.* | 13 |
| | *CIRS is useful, but it is not discussed enough. We do have sessions once in a while, but these are very rare.* | 14 |
| | *I haven't personally benefitted from CIRS yet. Cases are presented, but usually the conclusion is limited to 'You have to be more careful!'* | 15 |
| | *I do not benefit from CIRS, I do not know where to find meaningful results of the CIRS process.* | 16 |
| | *Generally, CIRS is useful. I do, however, not hear a lot about it. I do consider it useful, but up until now I have not noticed much about it.* | 17 |
| | *Yes, I find CIRS useful. I do however feel that I don't get much feedback at our hospital. It seems like there is feedback once a year. Perhaps it's because I miss sessions due to night shifts. But the implementation is mediocre.* | 18 |
| **Improving feedback** | *At the weekly Grand Rounds we sometimes get informed about something. It would be useful to also receive e-mails once in a while. People don't actively go and look for reports on CIRS entries somewhere in a database.* | 19 |
| | *I would benefit more, if more frequent CIRS sessions were held, where cases are discussed.* | 20 |
| **Category 3: impact of CIRS on future clinical care** | | |
| **Behavioural changes** | *We discussed both events after the intervention. I am sure I was even more 'alert' afterwards and prepared myself even better for the next case.* | 21 |
| **Learning opportunities for others** | *An entry should help others to avoid mistakes. I make an entry when something could have happened. Another criterion for me is that you should be able to learn something from a CIRS entry.* | 22 |
| | *I don't make the entries for myself, but for others.* | 23 |
| **Category 4: general conceptions about CIRS** | | |
| **Learning opportunity** | *The purpose of CIRS is that something should be learned from a situation. The learning effect for others should be the focus.* | 24 |
| **Standard procedures and system failures** | *The purpose of CIRS is to question routines. Are things we do more dangerous than we think? Is it bad luck if something bad happens or is there more to it?* | 25 |
| | *The purpose of CIRS is to improve structures. Establish standard procedures and checklists. It is usually about careless mistakes or slips that accumulate, and mistakes cannot be entirely abolished. It helps to define clear standard procedures, routines, and cooperations.* | 26 |
| | | 27 |

Continued

Table 2 Continued

| | | |
|---|---|---|
| | *CIRS helps discover gaps in the system. Are there any control mechanisms that do not work as intended? Unfortunately, it often doesn't work this way, but this would be the goal.* | |
| **Category 5: criteria for reporting critical incidents to CIRS** | | |
| **Errors** | *I enter cases into CIRS in which I should have done something better, for example, if I made a mistake due to time pressure. I didn't report this case because I would not change how I acted.* | 28 |
| | *I make a CIRS entry, if it was a critical incident. For example, if a wrong drug was administered.* | 29 |
| **Potential patient harm** | *I enter cases where something went wrong. A case, in which the patient did not suffer any harm, but from which the team can learn something.* | 30 |
| | *A case should be reported if there was a potential for patient harm without real patient harm that was caused by avoidable circumstances.* | 31 |
| **Category 6: obstacles and factors that facilitate CIRS reporting** | | |
| **Failed task delegation** | *I didn't make a CIRS entry for this case. But I definitely said that it needed one. I did delegate it.* | 32 |
| | *The question is: Who should do the CIRS entry, if a mistake is noticed. It is often not clearly communicated who should do the entry.* | 33 |
| **Lack of awareness and training** | *CIRS would have to be more present. I have never talked about it with anybody. It has never been a topic.* | 34 |
| | *The awareness of its availability and of its benefits for others would likely lead to more CIRS entries or to entries that are not limited to life-threatening cases.* | 35 |
| | *To benefit more, everyone needs more information. I am not sure how many of the staff know where to make a CIRS entry.* | 36 |
| | *The greatest difficulty is where to find it. It is not present on each desktop. I don't think it requires many steps to find it, but it definitely has to be on every computer.* | 37 |
| **Challenging clinical situations** | *We did not report this case to CIRS. There was no mistake or error. It simply was a complex case.* | 38 |
| **Debriefing to trigger reporting** | *Talking about a case should not replace a report in CIRS, but a discussion of this case could have triggered a CIRS entry. For example, if I would have realised that the anaesthesia nurse did not have enough experience to perform the intubation.* | 39 |

would only report mistakes as critical incidents if there was potential for others to learn from the mistake (Table 2, quotes 28 and 29). If a patient is in danger or if there is avoidable potential harm for a patient, incidents are more likely to be reported to a CIRS, whereas cases that lead to actual patient harm are not likely to be reported to a CIRS (Table 2, quotes 30 and 31). In case of patient harm and particularly in cases of patient harm that could potentially lead to litigation providers reported that they would likely not report a case considering that CIRS might be accessed by hospital or legal authorities.

### Category 6: obstacles and factors that facilitate CIRS reporting

Of the healthcare professionals involved in a critical incident, who is responsible for entering the incident into a CIRS system is not always clear, as there are different CIRS systems for anaesthesia and surgical services. Superiors sometimes delegated the task to a trainee, but failed to check for completion of the task (Table 2, quotes 32 and 33).

A lack of awareness about the existence and benefits of a CIRS was an important obstacle for CIRS reporting (Table 2, quotes 34 and 35). Additionally, a lack of time during clinical care prevented entries: providers mentioned that the need for a login and the need to do entries after completion of their direct patient-centred clinical duties hindered entries. Prior personal bad experiences with CIRS reporting might limit willingness to report.

Lack of training or knowledge on how to report a critical incident to the CIRS or how to access reported cases for review was mentioned as another obstacle to CIRS reporting (Table 2, quotes 36 and 37). Healthcare providers also regularly seem to not report critical clinical situations that are perceived as challenging situations without committed errors (Table 2, quote 38).

Personal judgement that critical incidents are not worthy or suited to be reported also interferes with reporting. There seems to be doubts about which cases should or should not be reported as critical incidents to the CIRS. If in doubt, healthcare providers seem to prefer not report the incident. A possible mitigation strategy mentioned was using incident debriefing to determine whether an incident should be reported to CIRS (Table 2, quote 39).

During the interviews, some participants were emotional when talking about critical incidents experienced, and described their stress during the clinical situations and their relief after the situations were over. Not wanting to re-experience the stress might contribute to not reporting to the CIRS platform.

## Discussion

We assessed anaesthesia providers' conceptions of a CIRS and the factors that prevent or encourage healthcare professionals from using it to report critical incidents. In this qualitative study in which we used semi-structured interviews, interviewees mainly expressed that CIRS is a potentially helpful tool, but only one of 21 interviewed providers involved in a critical incident had reported the case to the departmental CIRS. The interviews revealed variable views on the aims of the CIRS and the various factors that hinder reporting of cases, which can guide efforts to increase critical incident reporting.

Confidentiality was identified as a necessary requirement for a successful CIRS.[8] Many providers expressed concerns regarding identifiability of the reported incident and involved healthcare providers, particularly in severe incidents and in smaller hospitals. The study confirmed that trust in anonymity, confidentiality, and trust that information entered into the CIRS will not be misused is essential for CIRS reporting. The results thus confirm that taking actions to enhance trust in anonymity and confidentiality will improve use of a CIRS. However, in a small institution and with specific and detailed entry of a critical incident into a local CIRS, it will often be possible to conclude from the entry which providers were involved. In some instances, less detailed or less specific entries could overcome this problem, but lack of information could impede learning from the incident. Another option to overcome the issue of real or perceived lack of anonymity and confidentiality is use of existing large-scale national and international web-based incident reporting systems in anaesthesia,[15,16] which enhance anonymity by including large numbers of incidents. However, awareness of these reporting systems would have to be promoted, and might not be relevant to local settings. Reporting of incidents that cause patient harm might vary from country to country depending on whether incident reporting qualifies as legally protected data or not, with possible liability issues.

Another previously described factor relevant to a CIRS is the attitude to error.[8] Anaesthesia is a complex system involving a dynamic environment with unforeseen events and a large interprofessional team that can predispose to human errors.[17] In anaesthesia, similar to other complex systems with frequent human–human and human–machine interactions, incidents usually occur as a result of unpredictable combinations of human and organisational or systemic failures when there are gaps in safety barriers.[17] Also, cognitive processes in decision-making and factors such as overconfidence play a role in human error in the anaesthesia environment, which requires quick and complex decisions that are susceptible to cognitive errors.[18] For example, it is well recognised that fixation errors can contribute significantly to anaesthesia-related morbidity and mortality.[19]

The interviews revealed that anaesthesia providers differentiate between personal and systemic errors, and that this differentiation affects CIRS reporting. With regard to attitudes to error, the failure culture was deemed worth improving. Therefore, incidents related to systemic errors seemed to be more easily reported than incidents related to personal errors, particularly when confidentiality was in doubt. Differentiation between personal and systemic errors also impacted on CIRS reporting at a conceptual level. Some interviewees see CIRS as a tool to help eliminate systemic errors and will thus only report systemic errors. Others see CIRS as a tool to foster individual learning. These concepts were used to explain reasons for or against reporting incidents. That systemic errors are more easily reported to a CIRS than personal errors is interesting as others have postulated that issues on an organisational or system level are also easier to target than failures or unsafe acts at the individual level.[17,20]

Feedback was previously reported as an important factor for a successful CIRS.[8] In our interviews, feedback and learning from the departmental CIRS were deemed insufficient in both quantity and quality. As learning from errors was an important topic for most interviewees, the usefulness of CIRS will be questioned if no learning effect from CIRS entries is perceived. Indeed, during the study there was only one departmental teaching session where incidents reported to CIRS were discussed. Cases were presented without making reference to the CIRS database and the word CIRS was not mentioned. Interestingly, this failure to make maximum use of the few critical incidents that do get reported to CIRS seems to extend beyond the individual departmental CIRS. A recent review of studies on CIRS found that only 37% of studies described actions taken to prevent future critical incidents.[21]

The subjective assessment of whether an event is a critical incident or not, a lack of team communication to define which team member will do the entry, and different concepts regarding the aims of the CIRS all result in underreporting of incidents. A CIRS can contribute to identifying possible structural weaknesses, but if reporting does not embrace all relevant cases, learning opportunities to improve healthcare and patient safety are missed. The next step will be to target the reported barriers to reporting by institutional measures, such as improving feedback from CIRS entries to the department, raising awareness about the importance of CIRS entries, and demonstrating how entries are performed and reviewed.

This was a single-centre study of perceptions of a CIRS; reasons for or against reporting incidents might differ in different settings or contexts. Most interviewees were physicians and only a few were nurses. Although it is unclear if perceptions differ between these two provider groups, physicians are the primarily responsible anaesthesia provider in most countries. Interviews always rely on the willingness of the interviewees to openly express their thoughts without fear of repercussions. This risk was mitigated by the fact that two new staff members performed the interviews and participants did not have to fear judgement by their superiors. Participants were interviewed in the context of real cases they had experienced, moving the interviews away from theory to real life and allowing them to more specifically address the issue of why specific incidents were not reported.

In conclusion, this study revealed significant underreporting of critical airway incidents to a departmental CIRS. Interviews showed a wide range of criteria to reporting a case to the CIRS and an overall high threshold for reporting a critical incident. Barriers to reporting incidents included a perceived risk of identifiability, a perceived poor attitude to error, a lack of feedback, and a lack of changes resulting from entries. A change in error culture was reported to be needed to maximise learning from critical incidents. Simultaneously, actions can be taken on a systemic level to encourage providers to enter more events into a CIRS to decrease underreporting. Creating a structure of systematic assessment of reported incidents with discussion and dissemination of lessons learned to the entire team would maximise learning from reported cases.

## Authors' contributions

Study design: THP, RG, MKB
Participant recruitment: THP
Data analysis and interpretation: THP, SN, LT, RG, MKB
Drafting of the manuscript: THP, SN, LT, RG, MKB
Agreed to the final version of this manuscript: all authors

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## Declaration of interest

The authors report no relevant conflict of interest.

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