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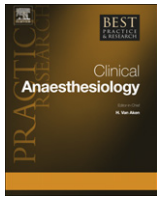

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# Incident reporting in anaesthesiology

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Incident reporting can be a powerful tool to detect weaknesses in the complex system of anaesthesiology. Having its roots in aviation, incident reporting today is used in a variety of medical disciplines at the local and even on the national level. Strength of incident reporting is the potential for learning from rare and potentially dangerous events. To properly set up an incident reporting system requires certain conditions to support and motivate reporters. It, furthermore, needs a sound definition or a model of a critical incident as well as a strategy to analyse the reported events. In Europe, a number of countries already run a national reporting system in anaesthesiology with large collections of critical events. These national systems, furthermore, distribute hazard warnings to spread the information on critical incidents among all specialists in that country.



*"To not be allowed to err is not to be allowed to learn."* (G.I. Rochlin)[1]

Incident reporting is a tool for quality improvement. It has proven beneficial in numerous disciplines, such as aviation, nuclear power plant operation and the oil industry.[2–4] The primary idea behind the concept of incident reporting lies in the learning potential to be derived from extraordinary, critical events.

High-risk industries always carry the risk of the unknown in their performance.[5] In addition, every system is only as safe as the involved structure, technique and processes are. This often depends largely on the knowledge of the engineers, programmers, program directors, etc., who define and construct processes and systems. This knowledge of the system designers is crucial for safety, and depends on their expertise and experience. No planning or research can ever take every situation into account. If an

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unusual situation that nobody ever has considered develops (with no guideline or standardised operating procedure, or SOP, in place), a rigid system will fail.[6] Experience can lead to expertise, and incident reporting offers this experience. Furthermore, incident reporting acts like a 'window to the system', revealing weaknesses of the systems involved.[5,7,8]

However, not only system engineers can profit from incident reporting, but also every operator 'at the sharp end' can have a benefit, as the cases others have experienced can increase the knowledge of everybody in that system. Further, especially, in a rigid system, the knowledge of the teams and individuals involved is crucial: their capabilities and their experiences are important in these situations, as they perhaps must extemporise and sometimes even disregard existing rules.

Therefore, it is mandatory that the knowledge of these 'operators at the sharp end' is maximal.

Incident reporting is like storytelling, and storytelling is one resource to gain experience from.[9] This is especially true in so-called non-linear systems with complex couplings. These systems are defined as systems where one event can have an effect at a completely remote location.[6] In linear interactions, event and effect are tightly coupled. Hence, the effect can more or less be anticipated (and almost fail-proofed designed by systems engineers). In non-linear, complex interactions, this effect can be very remote, and it needs much planning and research to budget for all the possibilities.

Incident reporting is like storytelling. It means telling each other about rare events that happened and for some reason were extraordinary or unexpected. These reports then can be collected as a kind of organisational experience or they can be used to improve systems. At its best, reported incidents are used to improve the system because it not necessarily needs to have repeated events or near misses of the same kind happening again and again before a change is triggered. Using so-called 'plan-do-check-act' (PDCA) cycles, incidents can serve as the triggering point to start an improvement process.

## Development of the critical incident technique

The technique of critical incident analysis was first introduced by Flanagan in 1954.[10] It was an outgrowth of studies in the Aviational Psychology Program of the United States Army Air Forces in World War II, but has since been used in a variety of different ways. The aviation domain, in particular, has used this technique to overcome safety problems both in military and civil aviation.[11]

The first application of the technique of incident reporting in anaesthesia was in the field of ergonomics of anaesthetic equipment.[12] Cooper then adapted this technique to uncover patterns of frequently occurring incidents in an anaesthesia department.[13] The first to start using the critical incident technique in a national plan were the Australians. The Australian Patient Safety Foundation, formed in 1987, set up and co-ordinated the Australian Incident Monitoring Study (AIMS).[14] The 'Critical Incident Reporting System' (CIRS) from Switzerland was the first system in anaesthesiology that used Internet technology to collect reports and distribute the results and recommendations worldwide.[15]

Nowadays, incident reporting is established not only in anaesthesia and intensive care medicine but also in a wide variety of medical domains.[16–19] It is used locally in hospitals but also at national levels in developed and developing countries all over the world. The main purpose of all these incident reporting systems lies in their potential for learning from individual cases that did or had the potential to lead to an adverse event. Together with techniques from quality management, incident reporting systems can help improve the complex process of care in anaesthesiology and other domains in health care.[20,21]

## Understanding critical incidents

### *Definition of a critical incident*

The question of how to define critical events in anaesthesiology and how to distinguish them from accidents is a continuing debate. In aviation, incidents are differentiated from accidents simply on the basis of not doing any harm to personnel (passengers and staff) and only minor damage to the equipment.[11] The problem in the medical field lies in the very variable outcome of incidents.[22] Many scenarios have a potential for a very serious outcome, but many ultimately only result in patient dissatisfaction, unplanned intensive care unit (ICU) admittance or some minor and temporary morbidity.

A model adopted from aviation and from the oilindustry[3] can help to define a critical incident (Fig. 1).[23] Every 'occurrence' or 'non-routine' situation can have its origin in the processes, the technique, the environment and the humans/teams or in a combination of all of these factors. This event can either return to normal operations (if the primary defences, such as SOPs, are in place and function sufficiently) or develop into a critical one when these primary defences fail. Next, the question is critical whether there are recoveries of this critical situation available or not. If they are not available or not working, an accident will happen. If they are functioning, the situation ends as a near miss.

This model offers a good understanding of the development of an 'occurrence' into an accident or a near miss with the critical incident in between. From this model, the following characteristics of critical incidents and incident reporting can be derived:

- incidents and accidents have the same precursors;
- analysing incidents can give insight into recoveries that prevent an incident developing into an accident; therefore, they can have huge learning potential;
- stopping the error-chain analysis at the incident level excludes the sometimes difficult aspect of 'outcomes', where legal implications may complicate things; and
- incidents must not always have a negative outcome.

## Systems requirements for successful incident reporting

### *Confidentiality and attitudes to error*

First, incident reporting systems have to be confidential, in the sense that reporters must know that the submitted information will not be used against them.[21] In an early editorial, Cooper stated, "Why should we expect clinicians to report their own adverse outcomes if reporting might jeopardise their career?"[24]

Once confidentiality is assured, cultural aspects of the organisation in which the reporting takes place are important. These aspects must be considered on two levels. The first is at the level of the professional culture, as doctors have highly unrealistic attitudes about their vulnerability to error.[25] The second aspect lies at the level of the organisational culture. Organisations must recognise and

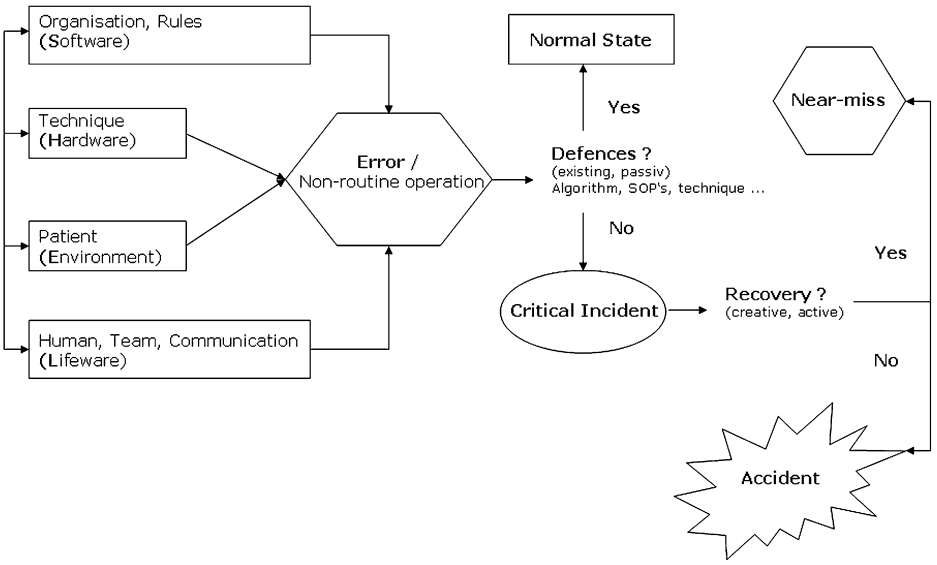


**Fig. 1.** Model for the definition of the terms 'critical incident', 'near miss' and 'accident'.[23]

publicly acknowledge the inevitability of human error and adopt a non-punitive stance towards error – not only at the individual's level but also at the system's level.[25] The common saying, "We must learn from our mistakes or be doomed to repeat them," captures the essence of error management in a blame-free organisation. Furthermore, this open-minded acknowledgement implies a strong potential for learning. "Human learning takes place through action. Trial-and-error defines limits, but its complement, trial-and-success, is what builds judgement and confidence. To not be allowed to err is not to be allowed to learn."[1]

*Information feedback*

Essential for the motivation to participate in such incident reporting systems is the need to spread the received information about critical events and to let the reporters learn of any consequences resulting from these reported events.[21] Users of such systems should not only be asked to submit their report, but also should have an immediate benefit from participating.

The following aspects are crucial for reporter motivation:

- display the reported incident as soon as possible after an initial check by the systems administrator for any inappropriate content (personal details of patient or team member, accusations and blaming, etc.);
- offer peer comment or expert opinion, if requested; and
- give feedback on any action following the report of that incident and also if no action has been taken.

*Analytical framework*

Reporting of a critical incident by itself is not sufficient to improve safety. Hence, an analytical framework must be applied to understand why things happened, what conditions were in favour and how a similar event can be prevented from happening again in the future.[21]

Analysing critical incidents has one major aspect:

- to learn about weaknesses with regard to optimisation of the involved process, the system or technique and the conditions people and teams work in.

The principal approach to analysing critical incidents lies in the scope of the analysis. It would be a too-superficial strategy to stay with the analysis at the individual level. James Reason has introduced the so-called 'Swiss cheese model' for system failures.[26] This implies that several boundaries with imminent weaknesses often are aligned in sequence, and if these weaknesses are not overlapped by protective layers, an event can unresistingly progress into failure. Layers of these system boundaries are aspects, such as the organisation, technique, processes, teams and individual level. Therefore, any analysis must take all these layers into account to not miss any co-factor that led to or supported the development of failure. With this model in mind, it is obvious that so-called 'human failure' is more or less always involved, simply because humans are nearly always the last barrier in a chain of events (so-called 'operators at the sharp end'). Hence, any event analysis that finds human error must be careful to not stop the analytical process at that level but ask: have there been any cofounding variables in the processes, the technique or the organisation that led to or favoured human error?

This 'Swiss cheese model' has then been developed into the 'Threat and error model' and the 'Organisational accident model'.[27] With a similar approach as in the 'Swiss cheese model', work psychologists now define the following layers:

- organisation and culture as latent failures;
- contributory factors as error-and violation-producing conditions (work/environment, team, individual, task and patient factors);

- care delivery problems as active failures (unsafe acts, errors and violations); and
- defences and barriers.

Different systematic approaches exist that try to look at the whole system in investigating critical events or near misses or accidents. The most familiar is the 'root cause analysis' approach of the Joint Commission in the US. The Veterans Hospital Administration has developed a structured interview with triage questions following this technique of 'root cause analysis'.[28]

Root cause analysis tries to identify all the single causes that finally led to this incident or error. This approach, though trying to look into a variety of causative aspects, suggests that there is one or perhaps a few root causes that should be addressed. Working psychologists criticise this approach as a potentially gross oversimplification.[29]

Another tool for investigation in contrast to root cause analysis is systems analysis. Adams and Vincent have developed this analysis under the name of the 'London protocol'.[30]

Systems analysis is an attempt to look into the future by identifying weaknesses that potentially lead to the next incident.[8] If the purpose is to achieve a safer health-care system, then finding out 'what' happened and 'why' in a root cause analysis is only a way station in the investigation. The real purpose is to take the incident to reflect on what it reveals about the gaps and inadequacies in the health-care system. This is in contrast to the root cause analysis a proactive, forward-looking approach.

## Strengths of incident reporting

The advantages of incident reporting are:

- Quantity: Incidents happen far more often than severe accidents. Therefore, analysing incidents provides a far broader database in a given amount of time.
- Recoveries: The analysis of incidents gives the opportunity to look for recoveries out of dangerous situations. Such analyses cannot be carried out as with accidents, simply because there is no recovery when an accident has happened.
- Root cause information: Incident analysis can lead to the root causes of errors. These detected root causes can then form the basis of very strong quality-improvement actions.
- Learning: Exchanging the experience on critical events has a strong teaching potential even for experienced professionals, thus empowering people and teams.

## Weaknesses and limitations of incident reporting

### *Underreporting*

Underreporting and the lack of an appropriate denominator is certainly a major handicap of voluntary reporting systems.[21] There is evidence that we still face a huge underreporting of critical incidents. In a study of predefined critical incidents that were automatically detectable (blood-pressure drop or desaturations during anaesthesia), it was found that only 4% of the automatically detected events were voluntarily reported.[31] The same was true in a simulator environment where participants were exposed to critical events and were encouraged to report their experience later in an incident reporting system. Even under such obvious conditions, an inaccurate reporting of critical events was found.[32]

### *Reasons for not reporting*

A study by Vincent et al. looked for reasons for not reporting adverse incidents in two obstetrical units.[33] The main reasons were fears that junior staff would be blamed, high workload and the belief

that the circumstances or outcome of a particular case did not warrant a report. The participants of this study recommended that for a successful reporting, there should be:

- induction training for all clinical and nursing staff on risk management and incident reporting;
- continuing education on the aims and importance of risk management and incident reporting;
- a clear statement that all members of staff, regardless of profession and grade, are responsible for reporting;
- a clearly defined list of reportable incidents/indicators drawn up in consultation with medical and nursing staff, and a clear definition of incidents and drug errors to be reported;
- 'user-friendly' incident reporting forms;
- clarity on how to report, whether in writing, by telephone or in person to the risk manager;
- encouragement for staff to report an incident even if they are unsure whether it is necessary to do so;
- a designated person on each shift, who is responsible for checking that any incident occurring during that shift is reported;
- a Trust/Hospital policy of 'no blame' and no disciplinary action except in cases of gross misconduct, repeated errors despite retraining or criminal negligence; and
- regular feedback to staff regarding the action taken as a result of their reports.

Particularly the last point is important in motivating people to participate in reporting systems, as no obvious action and no feedback to reported incidents means no more reports in the future.[34]

*Bias*

Another problem with the anonymous character of such incident reporting systems lies in the impossibility to validate the submitted information and the possible bias of reporters using such systems.[21] First, there can be some uncertainty about 'who' is reporting and 'what' gets reported.[35] Knowing the outcome of a certain case can also influence both the reporter and the analyst. Jayasuriya found that compliance with reporting was high with more serious events and poor in the case of common events or when successful recovery had occurred.[36] When it comes to analysis, grading and evaluation of the reported events, knowing the outcome also influences the judgement. Caplan et al. asked anaesthesiologists to judge on the question of appropriateness of care in 21 theoretical cases involving adverse anaesthetic outcome.[37] The original outcome in each case was classified as either temporary or permanent. The authors then generated a matching alternate case identical to the original in every respect except that a plausible outcome of opposite severity was substituted. They could demonstrate that knowledge of the severity of outcome can influence a reviewer's judgement of the appropriateness of care, in that quality of care was judged more harshly in cases with poor outcome.[37]

This outcome bias is minimised in analyses of incidents as compared with accident evaluations, simply because there must be no adverse outcome in the majority of incidents. This is another advantage of dealing with incidents instead of accidents.

## Reporting on the national level

Besides all the advantages that incident reporting has on the local level, the national or large-scale collection of critical incidents also has its potential.[38] The main advantage on the national level lies in learning aspects. In addition, certain clusters of similar events that only rarely happen locally might perhaps show patterns on a larger scale and by that give the reason to be distributed among other anaesthetists to potentially avoid this event from happening in other places.

*Examples of national incident reporting systems*

Besides the very early AIMS study,[14] there exist quite a number of national incident reporting schemes in Europe. Countries as, for example, Germany,[39,40] Spain, Hungary,[41] Denmark,[42] the UK[20,43,44] and

Switzerland (Critical Incident Reporting and Reacting Network, CIRRNET)[45] have established systems in place to collect and distribute critical incidents in anaesthesiology on a national level. The idea underlying all of these large-scale reporting systems is to distribute information to all connected departments. Some incidents do not only point to improvement opportunities at the local level, but also show potential for risk that can be used in every department of anaesthesiology.

Furthermore, collecting rare events on a national or supra-regional level gives the opportunity to detect certain clusters or frequencies that perhaps may not show up on the local level.

The disadvantage of national reporting systems often lies in the distance between the reporter and the incident reporting administrator. Due to its often anonymous or de-identified approach, questions from the administrator back to the reporter are often not possible, impeding the clarification of certain details, perhaps not initially reported.

When it comes to reviewing the incidents on a national level, the different national systems in place often have a board of experts that can function as peers in reviewing the different reported incidents. This group of experts can offer sound feedback upon request to individual reported cases as is the fact in the German system.[39] Furthermore, when hazard warnings or safety alerts are distributed by this national reporting system, such a review board is mandatory so as to give these recommendations the significance needed to have their maximum adherence in that country. In the UK, the 'safe anaesthesia liaison group' publishes summaries of incidents reported to the corresponding incident reporting system.[43] In Germany, a 'case of the month' is published at regular intervals with comments and even notes on legal implications.[46] In the Swiss project CIRRNET, nearly every second month, 'Quick Alerts' are circulated by a review committee of experts to all national departments of anaesthesiology, even to those departments that do not actively participate in the reporting of events nationally.[47] Topics covered by these 'Quick alerts' were as diverse as product warnings with kinking epidural catheters or mal-produced endotracheal tubes, caution warnings in look-alike ampoules or procedure warnings in small children with peripheral ports in the recovery room or on the ward, to only mention a few.

## Conclusion

Incident reporting can be a powerful tool to detect weaknesses in the complex system of anaesthesiology. It can lead the way to improve our speciality, and can act as a tool for constant learning.

## Conflict of interest

None.

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