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Improving Safety Through Incident Reporting

Richard P. Dutton

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Abstract Incident report systems capture structured data and the nuanced details of clinical care in a narrative format. Incident reports are used to identify and aggregate cases in which a serious adverse event (or near miss) occurs. Reporting systems can function within a department of anesthesiology, within a healthcare facility, or on a regional or national level. Technology has made it easier to capture incidents through the use of intuitive online reporting tools. Incidents are used to generate teaching cases for educational presentations and simulation that emphasize elements of safe and effective anesthesia care. Trends seen in incident reports can identify emerging risks to patient safety, a common occurrence with rapidly advancing surgical equipment and procedures. Aggregation of incident reports into regional and national systems will identify rare risks of anesthesia care that can be prevented through redesign of monitors and devices, changes in thinking, and heightened provider awareness.

Keywords Quality · Safety · Incident report · Adverse event · Near miss · Anesthesia Incident Reporting System

R. P. Dutton
Anesthesia Quality Institute, 520 N. Northwest Highway, Park Ridge, IL 60068, USA

R. P. Dutton (✉)
American Society of Anesthesiologists, 520 N. Northwest Highway, Park Ridge, IL 60068, USA
e-mail: r.dutton@asahq.org

R. P. Dutton
Department of Anesthesia and Critical Care, University of Chicago, Chicago, IL, USA

Introduction

During a complicated endoscopic retrograde cholangiopancreatic (ERCP) procedure under general anesthesia, the patient—a 70-year-old man—experiences the sudden onset of cardiovascular collapse. Non-perfusing tachycardia is accompanied by a decline in end-tidal carbon dioxide to less than 10 cm H_2O. The procedure is halted. Cardiac compressions are initiated and intravenous epinephrine administered. Spontaneous circulation returns after 10 min. Subsequent transesophageal echocardiography demonstrates residual air in the right ventricle and in the venous circulation of the liver.

This short vignette describes an unusual, and potentially lethal, complication of anesthesia for a very common procedure. In the author's experience, many anesthesiologists do not know that air embolus can occur during ERCP, and only a few have seen or heard of a case in their own practice. The incidence of this event is so small that attempts to study it prospectively will never succeed, yet with hundreds of thousands of ERCPs performed each year, there will be hundreds of patients potentially harmed. As dramatic as such an event is, the provider who experiences it is unlikely to forget the possibility during future cases. Yet how do we share this learning with others? How do we make it so that all of us can learn from the experience of one of us?

The answer is the incident report, a short description of the patient, the situation and the event that can be shared with other providers who might someday see the same thing. Humans learn well from story-telling—maybe better than from scientific process—and reading the narrative may be sufficient for a provider to prevent a future occurrence or treat the next one in a more timely fashion. Further, the report of this event can be combined with the

records of others—in the same institution or around the world—to identify trends and commonalities. The event above, for example, is a consequence of advancing capabilities in gastroenterology. It has been reported a dozen times in the GI literature, but only recently in an anesthesia publication. An incident report that captures this event will be critical to improving the care of future patients.

Incident reporting in anesthesia has a long and distinguished history [1–4, 5•]. From our specialty have grown a number of multispecialty, national systems [6–9], as well as subspecialty systems devoted to pediatric and regional anesthesia [10••, 11]. Many of these systems are based on incident capture systems in disciplines outside of medicine, especially aviation [12–14]. There is a wealth of knowledge available about how to analyze and learn from adverse events, fueled in recent years by the ability of rapid, worldwide digital communications to gather and disseminate information. This article will discuss basic principles of incident reporting in anesthesia, including techniques for gathering cases and thoughts about how to work with the results.

Collecting Incidents

The anesthesiologist involved in this case first completed resuscitation of the patient—fortunately without any sequelae—and then used a computer to record details of the event in a nationwide, anesthesia-specific incident-reporting system for adverse events and near misses.

Incident reports are no more or less than medical short stories that describe unusual events and patients [15]. In the past, incident reports were typically hand-written by an observer of the event and sent on paper to a department or hospital officer. Institutional forms were developed to prompt the recall of specific details of the event, but the core of the report was the narrative itself. These forms were typically kept separate from the medical record and maintained in a highly confidential fashion (i.e., not copied and not distributed). In most enlightened jurisdictions, the contents of incident reports are not discoverable by the legal system, both to encourage open reporting and because they may include speculations as well as facts [16].

In the information age, the traditional incident report is moving to digital technology. The first step was transcription by institutional abstractors into an electronic archive, often with inclusion of important structured data elements culled from the medical record. More recently, the digital 'front end' has been moved to the bedside and the incident reporter encouraged to record the event directly into the incident report system. With this support, it is now possible to build incident capture systems that cover more territory than single hospitals—up to and including national systems for the entirety of healthcare. Examples are listed in Table 1.

Table 1 Representative national Anesthesia Incident Reporting Systems

Australia/ New Zealand	Web-based Anesthesia Incident Reporting System (WebAIRS)	http://www.anzca.edu.au/about-anzca/Committees/australia-and-new-zealand-tripartite-anaesthesia.html
Europe	Critical Incidents Reporting System (CIRS)	http://www.anaesthesie.ch/cirs/
Great Britain	Safe Anaesthesia Liaison Group (SALG)	https://www.eforms.nrls.nhs.uk/asbreport/
United States	Anesthesia Incident Reporting System (AIRS)	www.aqiairs.org

These are all anesthesia-specific systems. Many other nations have general medical incident reporting systems

While electronic record-keeping has made it easier to archive and analyze large numbers of incident reports, and somewhat easier to enter them in the first place, this solution has created problems of its own. It is now much easier to copy and widely distribute incident reports, with a greater potential for loss of confidentiality. This has led facilities to request segregation of incident reports from the electronic health record (EHR), even when the same computer terminal is being used to enter both clinical data and the incident itself [17]. A requirement to log out of one system and into another creates a new barrier for incident reporting for overworked clinicians, so there is still room for improvement in the ease of reporting.

In the future, it may be possible to derive detailed incident narratives directly from the electronic medical record (e.g., through automated reconstruction of vital signs and medications), but at present the most useful reports come from experienced human observers. Because their value is based in the specificity of detail presented, the best reporters are the practitioners themselves, who are the peers of the intended audience [18, 19]. Anesthesiologists create the best incident reports for other anesthesiologists, because they share the same language and the same perspective on a given clinical event. The further removed the reporter is from the incident itself—whether in time or distance or mindset—the less specific the incident report will be. This is one reason that global incident capture systems covering large geographic regions and multiple medical disciplines have proven less useful at improving care than facility-specific and specialty-specific efforts [20].

Characteristics of an effective incident reporting system are shown in Table 2. The goal is to make it as easy as possible for a busy clinician to make a report, while

Table 2 Characteristics of an effective incident report system, which must both encourage reporting and capture enough information to enable useful decision making

Easy to find
One-button access from EHR for local systems
Common web-site address for national systems
Easy to enter case information
Prepopulated data from EHR (local systems)
Intuitive flow of data entry
Menu-driven checkmark entry of structured data
Reactive logic, to hide irrelevant fields
Single text box to collect narrative
No mandatory elements
Data elements and definitions created by consensus process
Use of available national and international data standards
Readily available data dictionary
Assured confidentiality
Legal disclaimer at front (national systems)
Transparency about who will see report
Option for anonymous data entry
Collection into appropriately structured database
Transparent schema, allowing for sorting under multiple classification systems
Search capability for finding and reviewing free text items
Visible use of the data to improve patient safety
Publication of (de-identified) case reports and narratives
Publication of aggregated reports and trends
Sharing of aggregate data with outside stakeholders: government and manufacturers

capturing enough detail to enable analysis. Structured fields populated by radio buttons can speed submission; 'reactive logic' can be used to hide or reveal options based on earlier responses. For example, details about post-gestational age, weight at birth and mode of delivery would not appear for any patient with age >1. Fields should be presented to match the normal flow of an anesthetic: details of the facility and patient, followed by the procedure itself, the complication, the after effects, and reporter introspection on potential causes and preventability. Free-text fields are generally less desirable—and will deter reporting—but at least one should be included to capture the narrative of the event. If the incident system is linked to an EHR or other patient tracking system, many structured fields can be pre-populated; providers will generally be put off by the need for redundant data entry of things that should be obvious to the computer, such as patient identifiers, age, time of day, and facility.

Researchers analyzing the incident system database will be aggravated by missing or empty structured data fields, and will lobby for 'hard stops' in the reporting system that prevent an incomplete incident report from being submitted. The temptation to limit reporting in this way should be avoided, however, as it is extremely frustrating to the clinicians trying to use the system. The system proprietor should operate on the principle that some data are better than none. In critical cases, an incomplete report can signal the need for a focused review of the record; in less critical cases, an incomplete report can still indicate a trend. More value will derive from a system that accepts all data than from one with built-in limitations; it is easy enough for the quality management professional who is reviewing reports to separate the wheat from the chaff. This is especially true with systems that rely on human reporters. At best, they will never capture more than the tip of the iceberg of potential cases [21]. In a similar vein, duplicated incident reports from two witnesses to the same event should not be discouraged. They can be combined for analysis when positively matched, but otherwise tolerated. It is better to have too many records of the same patient safety event than none at all.

The national incident systems listed in Table 1, above, are each built in accordance with these principles. They are inherently somewhat 'bulkier' than institutional systems that can link to an EHR for demographic information, but share the advantage of aggregating much larger numbers of cases than are likely to be found in a single department of anesthesia. The Australia-New Zealand system and the American Anesthesia Incident Reporting System (AIRS) share common roots in the pre-digital Australian national anesthesia incident system and are built with a common taxonomy in mind. Since launching in 2011, each system has recorded about 1,000 cases, and each leadership group has harvested their collection for educational examples of emerging patient safety risks. A summary of shared findings is in preparation at this time.

Development of an online reporting tool for incident reporting has the added advantage that the same basic infrastructure can be used to create granular case report forms for other purposes. Research targeting specific patient populations—e.g., anesthesia patients with a history of malignant hyperthermia—can be facilitated by development of online case report forms. As with random incident reports, users can be referred to these forms directly from the EHR, with some fields already pre-populated. This sort of methodology is already lowering the cost and increasing the precision of a variety of clinical effectiveness and prospective observational research trials.

The EHR systems of the future will not simply enable reporting of unusual events, but will increasingly identify them independently (for example, by ongoing analysis of variability in the vital signs). Registries of outlier cases will be populated automatically, without a requirement for human self-reporting. This will greatly increase the numbers of cases available for analysis, although the human

touch will still be required for separating artifacts from reality and for identification of new and unique events.

Turning Data into Knowledge

The incident report from this case is selected by the Quality Management Committee for presentation at the next M & M conference, with the gastroenterologists invited to attend. The events are presented in chronological order, and a robust discussion occurs, focused on the possibility that impending cardiac arrest might have been recognized in time to prevent it. The case presentation concludes with a review of previously reported serious adverse events arising from ERCP, including several isolated examples that were likely also caused by air embolus. One paper notes the potential for GI surgeons to reduce the chance of this event occurring by switching their insufflating case from air to CO_2, which is much more rapidly cleared from the circulation. This suggestion leads to a new institutional policy.

The case report is aggregated with others like it in the national incident capture system, and the case series is published. This is accompanied by an alert to all anesthesiologists through the national society, with a recommendation for increased clinical vigilance and consideration of universal change to CO_2 for insufflation during ERCP. The case report is also used as the basis for a new simulator exercise in the national curriculum.

The most important use of incident reports is at the local level. This is where changes in education, policy, and patient care philosophy can be most rapidly and most effectively implemented. A department's own cases will have the greatest resonance as drivers for change in policy or practice. The first step in this process is peer review by some form of quality management committee. The purpose is twofold. First, unusual cases that illustrate important points for staff education should be set aside for presentation and discussion. Second, trends in adverse events should be identified and considered for focused review and changes in department or institutional policy [22, 23•].

Cases selected for presentation are the fuel for the traditional Morbidity and Mortality (M & M) conference. Done best, this conference presents the clinical course of the case in a narrative form, beginning with surgical scheduling and preoperative assessment. The specific providers involved are not identified—unless they volunteer to be—as the purpose of the presentation is not blame or shame, but rather the dissemination of important educational material and the solicitation of changes in policy or systematic practice that could prevent a recurrence. The narrator is typically the practice's Quality Management Officer. The presentation is chronological and should pause for discussion as interesting or controversial points are uncovered. In teaching programs, this may lead to an interactive, Socratic dialogue between the faculty and the residents and students. In private practice, the presentation is usually more condensed and the discussion focused directly on inter-provider variations in care and on potential changes in policy. Once consensus on each point has been reached (or it has been established that no consensus exists), the narrative is continued. In this way, the key cognitive events of the case are gradually unfolded, in an environment free from the stress and time pressure of the actual event. The conclusion of the case presentation is often a deeper dive into a relevant segment of the scientific literature—finding and citing specific research papers and clinical guidelines—as a means of bringing outside thinking into the group.

While the purpose of the M & M discussion is to educate providers and heighten awareness, increased vigilance by itself is a poor long-term approach to mitigation. Humans, while flexible and creative in their thinking, are not perfectly reliable at repetitive processing [24]. For this reason, a good M & M discussion will seek changes in systematic practice with the potential to more routinely prevent the adverse event in question. Changing the system through innovations such as procedural checklists, equipment modifications, and template order sets is more likely to have an enduring impact [25•]. Further, by making systemic changes in response to adverse events, a culture of safety develops that will make future staff engagement in the incident reporting system more likely [26].

At the national and international level, incident reporting systems are the 'trip wire' for identification of new threats to patient safety. An example would be the emergence in the 1990s of postoperative visual loss (POVL) as a serious adverse complication of prolonged spine surgery in the prone position. A rare event in any case, POVL occurred at such a low incidence that by the end of the decade most anesthesiologists had heard of a single occurrence, but few providers had experienced more than one. It was not until a series of cases had been collected and published by the American Society of Anesthesiologists Closed Claims Project [27•] that POVL was considered a recurrent risk with known antecedents, which could be systematically studied and addressed. While too early for a definitive statement at this time, it is likely that increased attention to this complication has decreased its incidence in the past decade.

The tragedy in the POVL story, however, is that an aggregation of events did not occur until enough cases had accumulated in the US malpractice system—a lag of 5–10 years from the individual events themselves. One of the motivations for national incident reporting systems is to shorten the recognition and response loop for new threats

to anesthesia patient safety. Themes emerging at present in the US Anesthesia Incident Reporting System (AIRS) include adverse events related to minimally invasive and robotic surgery, new hazards created by electronic healthcare records, and the increased risk of adverse events in non-operating room anesthesia. Each of these has already been the subject of an AIRS case presentation in the ASA Newsletter, distributed to 50,000 US anesthesiologists and shared with collaborators in other national societies. Each has also been reported to ASA's Education Department as a 'knowledge gap' to prompt creation of new educational materials.

One theme frequently emphasized in reports from AIRS, from the British national system, and from the Australia–New Zealand program is the importance of human factors thinking in reacting to serious adverse events. Recognizing the limits of human cognition is one such example; others include intuitive design of monitors and EHRs, the organization of procedure rooms and anesthesia work spaces, and standardization of medication doses and syringe labels. The lesson is that passive changes to the operating environment, taken in accordance with an understanding of what risks can occur, can produce important long-term gains in patient safety. This in turn will free those who care for sick patients undergoing new and more complex procedures to do what humans do best: innovate and problem solve.

Conclusion

The information age has given anesthesiologists the ability to share their unique experiences with their colleagues, their national society and the international community. Web-based incident reporting systems at the local and national level can facilitate easy and intuitive reporting of unusual patients, serious adverse events and near misses. Digital records can be easily aggregated and analyzed for common factors, then stored for later consideration.

Incident reporting systems fuel peer review of anesthesia cases at the local level by capturing important cases in a format that can be easily reviewed and managed by the Quality Management Officer. Sentinel cases can be presented in M & M conferences and used as the basis for simulation-based training. At the national level, aggregation of incident reports will identify emerging threats to patient safety associated with new procedures and technologies [28]. Used correctly—with an eye to systems-based analysis that is sensitive to human factors—aggregated incident reports can lead to new national safety guidelines, proactive modification of equipment and medication, and specialty-wide awareness of appropriate threat mediation. Every anesthesia provider should understand the resources available for incident reporting and should assume the professional obligation to submit cases with potential implications for other patients and providers.

Compliance with Ethics Guidelines

Conflict of Interest Richard P. Dutton declares that he has no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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