Perioperative quality of care and patient safety

Koers, L.

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Chapter 2
Safety in the operating theatre

“Medicine used to be simple, ineffective, and relatively safe. It is now complex, effective and potentially dangerous.”
BMJ. Sir Cyrill Chantler 1998

Koers L, Schlack WS, Preckel B.
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The developments in science and technology that have enabled care for very sick and fragile patients, have also led to a substantial increase in the complexity of modern medicine. And it is not just the technical aspect of medicine that has become more complex, the organisation of care around an increasingly aging and sick patient population is not without challenge as well. Frequently multiple specialities per patient are involved. Creating a safe perioperative environment is a complex task and depends on both human and system factors. In the last twenty years, strategies used by the aviation and nuclear industries have served as models for patient safety initiatives in medicine. Increasingly, the medical community is aware of the important role of “human factors” in patient care.

Definition of safety
Safety is defined as a condition in which the possibility of damage to persons, matter or the environment is reduced and maintained at, or below an acceptable level. This is a continuous process of risk inventory and management. However, it does not mean that the chance of damage is completely absent, it means that the number of avoidable errors will be reduced towards nil.

Errors
In order to create a safe perioperative environment it is critical to reduce the number of errors, as well as the damage that these errors can cause. There are several characteristics of the perioperative environment that contribute to the occurrence of errors.¹
- Both time and production pressure in the operating theatre can cause mistakes.
- The patient is sedated or locally anaesthetised and is therefore often unable to advocate for his own safety (e.g. reporting of chest pain).
- The people working in an operating theatre do not always function as a team.
- Communication is often suboptimal; examples are lack of closed loop communication and communication that gets lost in the noisy environment of the operating theatre.
As the operating theatre is a technically complex environment, theatre staff can lose situational awareness while they are focused on a complex task. Finally, a lack of involvement from the Executive Board or hospital management can negatively affect safety as poor policymaking can facilitate the occurrence of errors.

Analyses show that the cause of incidents can be widespread, at different levels within the planning and execution of care and can even happen in a considerable time frame prior to the incident. In order to effectively target errors, active errors must be distinguished from latent factors. Active errors have immediately noticeable detrimental effects whereas latent factors can only cause an incident in combination with another provoking factor.2

**Active errors**

Active errors can happen either unconsciously (figure 2.1) or they are deliberate violations of existing rules. Unconscious errors are caused by failures in the execution of a correct action by inattention, forgetfulness or clumsiness. For instance, a drug error can happen because a nurse gets distracted during preparation. Unconscious errors can also occur when a problem is solved in the wrong way. These errors are called failures. Failures occur because of lack of knowledge or because rules are not applied correctly. An example of this is a patient who is withheld the best treatment because the doctor is unaware of this treatment method. Although the treatment the patient receives is well executed, it is not the right or optimal one for this patient. A patient that is given a standard treatment when he has a contraindication is another example of a failure. Poor organisation and planning further contribute to active failures as they cause situations in which solutions need to be improvised. Reducing errors that are secondary to mistakes, inattention and forgetfulness must be done at system level. Rules, such as not disturbing a healthcare provider who is preparing medication and double-checking while preparing medication can reduce the incidence of medication errors.


Rules can also be deliberately violated. Various factors have been described in the literature that contribute to the active failure of safety barriers through deliberate violations of rules.3 Individuals might feel that their level of personal skill, experience or hierarchical status justifies breaking the rules. Moreover, it can be a cultural expectation within an organisation that rules must be broken to get things done. Normalisation of deviant behaviour is a
process that consciously deviates from “best practice.” This is done because the violation of a rule was without consequences in the past. This behaviour is often copied in a group. The problem with this behaviour is that the risk of a bad outcome for the patient doesn’t change because the patient isn’t harmed (i.e. driving through a red traffic light). However, the healthcare provider perceives the risk as less serious because there was no previous patient harm associated with breaking the rule. Healthcare staff needs to understand the risks arising from this behaviour. Organisations can reduce the incidence of deliberate violations by addressing cultural expectations and changing rules that are irrelevant. It is possible that doing something in a better and faster way is a violation of an existing rule. In this case, an overhaul of the existing agreements or protocols should take place. The rules must always facilitate best practice.

**Latent conditions**

Latent conditions are holes in a system that promote the occurrence of incidents. Examples of latent conditions in an organisation are excessive production pressure, shortage of staff, structural fatigue of staff due to a disproportionate workload or inadequate equipment. All of these examples can lead to reduced signalling of potential risks and must be targeted in order to increase patient safety. Sufficient staffing and rotas that prevent exhaustion of staff provide a safer environment for staff and the patient. The cultural beliefs and rules of an organisation are other examples of latent conditions. A hierarchical culture for example, can lower the safety level as an anaesthesia practitioner* might find it difficult to address an intimidating doctor that violates the rules. If unsafe situations, violations or errors are observed, all team members must feel safe to speak up and to report this.

Within an organisation effectiveness and thoroughness must be balanced. This is also known as the Efficiency-Thoroughness Trade-Off (ETTO) principle. The ETTO principle describes the choice that organisations make between prioritising resources on thorough preparation of the process (i.e. making the process as safe as possible) and the execution of the process. If the production pressure is high, more resources (such as time, money) will be spent on the execution of the process; i.e. making the production process more efficient, until the productivity targets are reached. Conversely, if there is a lot of pressure to increase safety, resources will be spent on improving safety (in preparation of the production process) until the safety targets are reached.

**Safety barriers**

An error can be prevented or compensated by safety barriers. As in Reason’s Swiss cheese model it is usually a combination of latent factors and the failing of safety barriers that is required to cause patient harm. Examples of safety barriers in the operating theatre include

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* In the Netherlands anaesthesia practitioners assist Anaesthesiologists in the provision of Anaesthesia.
double checking of medication and the preoperative time-out checklist.\textsuperscript{6,7} However, it should be emphasised that more rules (as safety barriers) does not equal increased patient safety. An organisation that has more rules than can be followed will come to a standstill. Moreover, a rule that might prevent one incident could actually cause a potential danger in another situation. It is therefore extremely important to make sure that all safety barriers that are incorporated within the healthcare organisation are effective and essential.

\textit{Organisational culture}

The prevailing culture within an organisation plays a major role in the safety that this organisation can guarantee for its patients. We currently know three important organisational cultures. First, there is the blame culture, in which one care provider is given full responsibility for the incident. In many industries, including healthcare, this way of dealing with incidents has proven to be ineffective in reducing further incidents. It actually results in decreased reporting of incidents.\textsuperscript{8} In a “blameless” culture, it is assumed that mistakes are caused by the system in which the healthcare provider operates. This strategy is also ineffective in increasing patient safety because there is no consequence for violating the rules. The “Just culture” is a culture that is the balance between the blameless and the blame culture. Within the just culture, the individual caregiver is not blamed if the underlying system or process is the cause of the incident, but violating the rules will not be tolerated. This does not necessarily mean that the care provider is directly sanctioned, but he will be held accountable for his behaviour. This organisational culture improves patient safety by actively identifying mistakes and weaknesses within the organisation as employees feel save to report problems and incidents.

\textit{Risk assessment, incident analysis and audit}

It is pivotal to continuously collect prospective data in order to get an accurate picture of areas of improvement within the process of care provision, especially because many caregivers involved in the chain of care often do not see the implications their actions have on the patient’s further trajectory. Clinical audit is measuring the quality of care and comparing it against a relevant standard. An audit can provide insight into the reason why a standard is not met within a department. Based on the audit, priorities can be set for the improvement of care. Audit is a cyclical process (figure 2.2) and should be part of the quality policy of departments.
Figure 2.2 The audit cycle

Collection of data on anaesthetic and critical care practices has been tremendously facilitated by the development of electronic databases. For instance, a prototype of a scorecard has been developed that can provide feedback on the efficiency and other points of improvement (postoperative patient nausea, pain etc.) for individual anaesthesiologist. This instrument contributes to the continuous professional improvement of anaesthesiologists.

Incident reporting of both incidents and near misses is essential to increase patient safety, because it can provide insight into the reasons for failures in care. There are different methods for analysing incidents. The classic model of the Root Cause Analysis (RCA) looks for the cause of an incident at system level of a process. Although an RCA identifies hazards that can cause patient harm, it is reactionary. Another method for analysing incidents is the use of “Safety factor maps”: these are conceptual representations of an event on the basis of the incident report. Although this method might be better in identifying potential hazards, a more predictive method for preventing and analysing errors is the “Task Analysis” and “Threat and Error Management” (TEM) method. TEM depicts current practice in a systematic way and predicts the occurrence of problem through this. TEM assumes that most incidents can be described by the risks in an operational environment and by the actions of personnel in this environment, who can oppose or exacerbate this danger. By identifying risks, they can be targeted and staff can be trained in actions to minimise or eliminate these risks. TEM is widely used in other risk industries such as aviation. Resilience engineering is a new concept within the risk analysis and system safety discussions. Resilience is the ability of a healthcare system to respond to an unexpected request for help, while the normal tasks can be continued, or resumed in the short term. Resilient organisations or departments can effectively adapt their practice to a varying demand for care whilst maintaining safety barriers. The operating theatre and the Intensive Care are examples of systems in which resilience can be developed.
Communication

About a third of conversations in the operating theatre does not achieve its purpose. A structured form of communication, as is also used in aviation, facilitates clear and correct communication in routine and emergency cases. An example of this is the SBAR method. The abbreviation SBAR stands for: “Situation, Background, Assessment, Recommendation.” This method starts with stating the situation: (“the patient is very hypotensive”), followed by the background (“the patient has an allergy to penicillin”), assessment (“I think the patient has an anaphylactic reaction to the cefazoline”), and recommendation (“we have to put the patient in the Trendelenburg position and administer fluid and adrenaline”). Although the effectiveness of this technique in the operating theatre has not yet been clearly studied, there is evidence that this technique improves communication in other places in healthcare. Briefing prior to a case with the entire team, or debriefing after a case, can also lead to improved patient outcomes. A 2-minute preoperative briefing has been shown to improve team communication, cause fewer disruptions during the operation, improve the compliance with protocols for the administration of prophylactic antibiotics and deep vein thrombosis prophylaxis and improve the general perception of patient safety.

Decision making

Errors in thought processes and bias are important factors in making wrong decisions in medicine. A bias is having a certain preference for managing certain situations or solving problems. It may be that this preference is not necessarily based on any evidence, but on the personal experience of a healthcare provider. For example, “loss aversion” describes a phenomenon where the negative associations with a loss or unpleasant experience are a stronger motivator than a positive association with an equal positive experience in making a decision. Subsequent management is not always meant to maximise profit, but to avoid losses. Because these thinking errors occur mainly in our subconscious mind, it can be difficult to recognise them by ourselves or by incident analysis techniques. Awareness of these human factors by healthcare providers themselves and the management of a healthcare organisation is thus important to improve patient safety.

Non-technical skills

Psychological factors and non-technical skills have a major impact on clinical performance. Non-technical skills can be defined as ‘the ability to solve problems and the cognitive and social skills’ of an individual that contribute to the safe and efficient performance of tasks that complement the technical skills of that individual. The non-technical skills of the multidisciplinary operation team have a significant impact on perioperative safety. For instance, failing to notice important signs or symptoms by either poor situational awareness or tunnel vision are the most common causes of incidents for both surgeons and anaesthesiologists. Poor communication and lack of teamwork also significantly increase the risk of intra-operative
incidents. The capacity to work in a team or to manage a team is one of the most important features for an anaesthesiologist in preventing or effectively managing an incident.\textsuperscript{16}

\textit{Simulation training}
Research shows that the most important factor in retaining certain knowledge and skills is the frequency with which care providers are exposed to situations requiring this knowledge and skillset.\textsuperscript{21} Especially in infrequent emergency situations there is a danger that healthcare providers do not act effectively which can cause preventable patient harm. Studies show that clinicians forget about 20-50\% of critical management steps in high-pressure emergency situations.\textsuperscript{22-26} By regularly exposing staff to these situations through simulation training, they retain the necessary knowledge and skills for these situations better. Simulation training also improves multidisciplinary teamwork by gaining knowledge of each other’s strengths and weaknesses, understanding each other’s priorities and improving team communication.\textsuperscript{27} These training courses are associated with a reduction in perioperative mortality.\textsuperscript{28} High fidelity simulation can also reveal problems with logistics and equipment. For example, it can become clear that certain equipment is not suitable for, or not available in specific circumstances and measures can be taken to improve this. Crisis Resource Management and team training are thus crucial components in improving patient safety.\textsuperscript{29}

\textit{Standardisation}
There is overwhelming evidence that a standardised approach, especially in the complex environment of perioperative medicine, increases patient safety. Whether it concerns pre-operative checks such as the WHO Surgical Safety Checklist\textsuperscript{6} and the SURPASS checklist,\textsuperscript{7} the execution of technical skills such as the prevention of central line-related infections when inserting a central venous catheter,\textsuperscript{30} the prevention of a regional anaesthesia technique on the wrong body part; the “stop before you block” campaign,\textsuperscript{31} or carrying out hand overs.\textsuperscript{32,33} All have been shown to improve patient safety through a standardised approach. Even the management of emergency situations can be improved through the use of checklists.\textsuperscript{22-25} Several cognitive aids for the treatment of intraoperative emergency situations are available.\textsuperscript{22-25,34,35} These crisis checklists help theatre staff to take the right treatment steps, in the right order and to not omit critical steps during an emergency. As a result, the chance of mistakes or missed steps is reduced and the speed of management can be increased. It is important to identify barriers within organisations that could lead to failure to follow best practice guidelines or protocols. Potential barriers for failing to adhere to best practice are poor quality of, unfamiliarity with, or incorrect or unjustifiable deviation of guidelines or protocols. The importance of drawing up good quality protocols, adapted to the local situation, and following these protocols cannot be emphasised enough. However, a protocol is a means to a safe patient environment and must not become the ultimate goal in itself. Protocols should be limited to the ones that actually make a difference in patient outcome
and should not be there for the sake of having a protocol for every thinkable condition or situation. This will create “protocol fatigue” and will increase the risk of not adhering to important protocols.

**Handover**

Patient handover is defined as the transfer of information and the transfer of professional responsibility and liability for some or all aspects of care for an individual patient or group of patients, to another person or profession on a temporary or permanent basis. Handovers are one of the most error-prone episodes in patient care. Mistakes in handovers are common and can lead to complications by delaying diagnostics and, or therapy. The post-operative transfer to the post anaesthetic care unit (PACU) or Intensive Care Unit (ICU) is particular challenging for care providers in the delivering and the receiving team. The surgical team transports the patient with monitoring, all the necessary equipment and infusion pumps, whilst simultaneously monitoring the vital functions and possibly ventilating the patient and, or adjusting pharmacological therapy. Upon arrival at the ICU, equipment, infusion pumps and monitoring must be transferred, and the handover must be done in an often busy and chaotic environment. The receiving team is unfamiliar with the patient, but (subconsciously) assesses the patient immediately and starts to prepare a management plan. This can distract from the actual handover. To ensure that the whole team focuses on the handover, it is recommended that urgent tasks, such as transferring infusion pumps and monitoring, are completed before the actual oral information handover. This is to create a “sterile” environment in which all communication should be about the care of the patient during handover. Every relevant team member must be present, and everyone should have the opportunity to ask questions during handover. People involved in the handover have different backgrounds (specialities) and different levels of experience so that information can be interpreted differently. Training in communication, teamwork and handover improves handover. In addition, studies show that handovers on the basis of a standardised transfer checklist are more complete. There are more handovers during the day because of working directives in medicine, i.e. shorter shifts. This further increases the need to reduce errors during handover. With an increasing number of care providers, it is furthermore essential that the whole care system in the department is responsible for the continuity of care of a patient (or patient group) and not just an individual care provider. All multidisciplinary team members must have a consistent and accurate level of knowledge about the patient and his treatment. Tables 2.1 and 2.2 provide a summary of the recommendations for the post-operative transfer handover. There are additions to this list, such as the preoperative level of consciousness, language that the patient speaks and contact information for the patient’s relatives. Every hospital should define a minimal dataset for the handover that is considered essential for the continuity of care.
### Table 2.1 Methods for safe handover

<table>
<thead>
<tr>
<th>Methods for a safe and effective handover</th>
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<tr>
<td>Make sure that the (alarms of the) monitors, IV pumps and medication, ventilator and its appropriate setting and other necessary equipment is ready before the patient arrives</td>
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<tr>
<td>Urgent tasks, such as transferring patient to another bed and ventilator, transferring infusion pumps and monitoring, should be done before the handover</td>
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<td>The anaesthesiologist that brings the patient (still responsible) must be happy with the condition of the patient before handover</td>
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<td>All relevant members of the surgical team and receiving team should be present during handover</td>
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<td>Ensure enough time for the handover. One person speaks at a time with minimal distractions or interruptions</td>
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<tr>
<td>Only the patient is discussed during the handover</td>
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<tr>
<td>Make sure the structure of the handover allows room for a dedicated time to ask questions or clarifications</td>
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<td>Utilise supportive documents such as the anaesthetic and surgical notes and current laboratory values</td>
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<tr>
<td>Use protocols, checklists or other methods of standardisation to not forget important information</td>
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<tr>
<td>Document the handover</td>
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<td>Train handover and teamwork</td>
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### Table 2.2 Recommended information for handover

<table>
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<th>Recommended information for the handover</th>
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<tbody>
<tr>
<td><strong>Patient information</strong></td>
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<tr>
<td>- Name</td>
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<tr>
<td>- Date of birth, age</td>
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<tr>
<td>- Weight</td>
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<tr>
<td>- Allergies</td>
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<tr>
<td>- Indication for operation</td>
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<tr>
<td>- Performed operation</td>
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<tr>
<td>- Past medical history</td>
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<tr>
<td><strong>Surgical information</strong></td>
</tr>
<tr>
<td>- Performed operation</td>
</tr>
<tr>
<td>- Surgical complications and interventions</td>
</tr>
<tr>
<td>- Estimated blood loss</td>
</tr>
<tr>
<td>- Information about surgical wound, drains, stomas, bandages and stitches</td>
</tr>
<tr>
<td>- Cardiopulmonary bypass run, problems with weaning off bypass</td>
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<tr>
<td>- Ischemic/ clamp-time</td>
</tr>
<tr>
<td><strong>Anaesthetic information</strong></td>
</tr>
<tr>
<td>- Type of anaesthesia</td>
</tr>
<tr>
<td>- Anaesthetic complications</td>
</tr>
<tr>
<td>- Lines ([central] venous, arterial, epidural, peripheral nerve blocks and urine catheter)</td>
</tr>
<tr>
<td>- Intraoperative drugs</td>
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<tr>
<td>- Administered IV- fluids</td>
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Table 2.2 Recommended information for handover (continued)

Recommended information for the handover

- Blood products (type and amount)
- Intraoperative investigations (i.e. arterial blood gases, transoesophageal/ transthoracic echo)

Current condition (Anaesthesiologist)
- Respiratory and haemodynamic support
- Other supportive therapy
- Sedatives and analgesia

Postoperative plan
- Problems to be anticipated
- Surgical postoperative plan (i.e. position, feeding, alerts for drain output, GCS-scores etc.)
- Postoperative orders and investigations to be performed (x-rays, labs etc.)
- Duration and intensity of monitoring and targets for vital signs
- Postoperative plan for pain relief and sedation
- Postoperative plan IV-infusions, antibiotics, changes to current medication, anticoagulation

Task shifting

For some years, tasks that were previously only done by anaesthesiologists, such as preoperative screening (POS) and providing moderate-to-deep sedation for low risk patients have been delegated to specially trained physician assistants, POS employees or sedation practice specialists (SPS) in the Netherlands. This has potential benefits, such as the freeing up an anaesthesiologist to provide care to a high-risk, complex patient in the operation room. It is nonetheless important to investigate the impact of task shifting on outcomes on system level (i.e. postponing or cancellations operations and last-minute changes in anaesthetic plan because of inadequate preassessment) and at patient level (i.e. perioperative complications and satisfaction). A review into this practice concluded there was insufficient evidence to prove the safety of anaesthetic task shifting. Further research into this practice is therefore necessary. With regard to sedation, the Dutch Board for Quality in Healthcare issued a guideline in 2009 which stated that healthcare staff that provide deep sedation must also be able to deal with patients going into a state of general anaesthesia. In addition, there must be someone in the room qualified in advanced life support skills. There are studies describing the safety of sedation by non-anaesthetic physician assistants. However, it appears that the introduction of sedations by SPS under indirect supervision of an anaesthesiologist significantly reduced the number of sedation-related events, in comparison with sedations performed by a trained nurse supervised by a gastroenterologist. The development of a sedation protocol under supervision of an anaesthesiologist is the cornerstone of safe sedation practice. This protocol must contain clear agreements about the intensity of monitoring, the administration of drugs and oxygen, and situations in which help must be requested. More outcome-related patient data should be collected to prove that the sedation care provided
by the sedation practice specialist is safe. Chapter 6 of this thesis is a prospective national study into the safety of sedation provided by sedation practitioners.

After the Post-Anaesthetic Care Unit

After patients leave the recovery room, PACU or are transferred to the ICU, the anaesthesiologist no longer plays a significant role (other than in pain management) in the treatment of patients in many hospitals. Nevertheless, a case could be made for the involvement of anaesthesiologists in the post-operative care for high-risk patients. Nowadays most complications do not occur during the operation but in the first postoperative days as anaesthesia for these high-risk patients is often carefully planned, with optimisation of the patient prior to the operation. For example, 3 days postoperatively when the initial Systemic Inflammatory Response Syndrome (SIRS) response resolves, oedema caused by previous capillary leak will move back into the bloodstream and patients with a poor cardiac function will be at risk of developing heart failure at this point. However, the patient is no longer on the PACU or intensive care unit at this point, but in the ward, where there is less monitoring of physiological parameters and a much higher patient-to-care provider ratio. Several studies have shown that the difference in mortality rate between hospitals is not caused by a difference in the occurrence of complications, but by the effective management of these complications. Anaesthesiologists could play an important role in the early recognition and management of deteriorating high-risk surgical patients. This will have to be investigated in the future. Additionally, cognitive aids can also reduce failure to rescue in deteriorating surgical patients as they have the potential to decrease the number of omitted critical management steps. This is outlined in chapter 10 of this thesis.

Discussion and conclusion

Optimising perioperative safety is a complex task that requires effort and responsibility from all levels within the hospital organisation involved in the perioperative process. The impact of the organisational culture, safety management, risk assessments and management, incident analysis, audits, good quality protocols and human factors can’t be emphasised enough and should be managed on both system and individual level. It is important to realise that safety initiatives that are implemented without sound scientific evidence can also harm patients and waste time, effort and resources. Future research will have to shed light on the many facets of optimising patient safety. Finally, as Winston Churchill said, “the price of greatness is responsibility.” So in order to improve the safety of our patients, we, as doctors, have to take our responsibility in making sure our practice is as safe as possible, every day.
References


31. ESRA Stop before you block campaign http://esraeurope.org/stop-before-you-block-campaign/