‘Skating on thin ice’?

Consultant surgeon’s contemporary experience of adverse surgical events

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Abstract

Concerns about patient safety have prompted studies of adverse surgical events (ASEs) but descriptive classification of errors and malpractice claims have overshadowed qualitative investigations into the *processes* that lead to expert errors and their solutions. We studied consultant surgeon's perspectives on *how* and *why* events occurred through semi-structured interviews about general and specific events. The sample contained heterogeneous cross-section of ages, gender and specialism, with > 2 years consultant status and working within a 25 mile radius. Overarching findings included (i) pressures to work harder, faster and beyond capability within a blaming culture; (ii) optimism bias from over-confidence and complacency; (iii) multiple pressures to 'finish' an operation or list, resulting in completion bias. Seven high order themes were identified on the healthcare system, adverse event types, contributing factors, emotions, cognitive processes, error detection, and strategies, solutions and barriers. The process of classifying event types guided solution selection, and the decision about whether to formally report it. How serious consequences were for patients and their temporal effects, defined an adversity continuum. Minor events arose routinely i.e. technical discrepancies, side-effects. More problematic were sub-optimal outcomes and avoidable events. Despite their expertise, consultants were vulnerable to unavoidable, uncontrollable events which were major concerns. Most serious were near-misses, errors and mistakes. However major errors did not inevitably lead to a catastrophe and minor errors could be extremely serious. A 'cascade' of minor events exacerbated by negative emotions can precipitate major events, and interception methods need investigation. Consultants felt powerless and helpless to change environmental, organizational and systemic problems; new communication and action channels are desirable. Confidence building in team leadership would promote 'flatter' hierarchies, facilitating appropriate warnings. Although implementing

the WHO Checklist averts important problems, social, environmental and organizational contributing factors are largely overlooked here and in existing models.

Keywords: surgeon, consultant, adverse event, qualitative, error, process

From 17 million surgical procedures completed annually in NHS hospitals (Hospital Episode Statistics, 2007), adverse surgical events (ASEs) constitute 5% (850,000 pa). Similar figures exist for malpractice claims (Greenberg et al, 2007; Griffen et al, 2007; Morris et al, 2003; Rogers et al, 2006). Consequences from ASEs vary in seriousness from slight/temporary to death (Brennan et al, 1991). Fifty-two % of surgical errors (rather than errors in patient care) are technical, being manual (65%), judgement (9%), or both (26%) (Regenbogen et al 2007). More importantly, two-thirds of technical errors are made by experienced surgeons, and 84% of these during routine procedures (Regenbogen et al 2007). This contrasts with research linking insufficient experience, low volume and highly complex operations to errors (Sosa et al, 1998; Porter et al, 1998; Prystowsky, 2005; Wilkiemeyer et al, 2005). Unexpected patient factors like difficult anatomy; human factors such as decision-making, and system-complicating problems e.g. equipment, also contribute (Regenbogen et al, 2007). Decision-making studies show that 86% of incidents arise from cognitive factors e.g. vigilance (Gawande et al, 2003), affecting 65% of malpractice claims (Rogers et al, 2006).

However, cognitive factors only partly explain how events occur; they combine with factors like communication breakdown (Williams, Silverman, Schwind et al, 2007), inadequate supervision and technology failures. Despite longstanding research on cognitive processes (Reason, 1990), they have only recently been applied to surgery (Vincent, et al 2001; Sarker and Vincent, 2005). Other psychological processes are infrequently investigated. Building on previous research, we aim to further investigate these processes because in practice, they could be intercepted.

Recently the NHS implemented routine use of a World Health Organisation (WHO) Checklist during operations (Gawande et al, 2003; World Alliance for Patient Safety, 2008). This warns about wrong patient or body site operations, incorrect anaesthesia/resuscitation, infection risk and ineffective teamwork. Physical and functional actions in the Checklist are partially

commensurate with cognitive models, but emotional, social, organisational and structural mechanisms remain largely overlooked. Furthermore, qualitative approaches are rarely used to gain detailed access to surgeon's perspectives, as quantitative research is preferred. Statistics offer rare and partial insights into *how* and *why* contributory factors affect ASEs, showing only that they do. Little is known about the recent experience of experts in surgical practice, as trainees are typically studied. We hypothesised that qualitative techniques would better elicit information about complex behaviours and interactions than quantitative methods. The study aim was therefore to find out how expert consultant surgeons view ASEs.

Method

Sampling: Sixty-one consultant surgeons from two NHS hospitals (south-west England) were identified within a 25 mile radius from the Dr Foster website (compendium of medical experts). This pool was large as limited response was anticipated. We planned to recruit a heterogeneous cross-section of specialists, age and gender groups. The exclusion criterion was consultant status <2 years. Although not representative, this self-selected group have more interest/insight into ASEs; small numbers are acceptable for in-depth techniques. Surgeons were recruited until no new themes emerged i.e. saturation (Smith, Jarman and Osborne, 1999; Silverman, 2006).

Procedure: Following ethical approval (local NHS Research & Development) a written invitation to a face-to-face interview about surgical errors, slips, and 'near misses' was followed by a phone call to arrange it. Participants were assured of anonymity and confidentiality, and could withdraw at any time. These conditions were vital to accessing information on this very sensitive topic. Semi-structured questions explored general, then specific event(s) covering errors, decisions, warnings and contributory factors. An open-ended technique then flexibly explored remaining issues (Smith, et al, 1999). Audio-tapes

were transcribed. To protect identity, personal details, specialism, procedures, body parts and medical conditions were coded.

Analysis: Following Smith, et al (1999), themes in the first transcript structured coding and connections. These were extended and changed by subsequent transcripts. Quotations supported theme clusters, super-ordinate concepts and sub-themes (Elliott, Fischer & Rennie, 1999). New issues were highlighted. Themes shared by participants represent the higher order themes reported. Reliability was established by an independent recoding of transcripts; discrepancies were negotiated.

Results

Sample: Eleven consultant surgeons (10 men; 1 woman) were interviewed (2007). None withdrew. As the 11th interview added no new themes, sampling was concluded. The mean interview time was 37 minutes (range 17-64).

Interviews were obtained from a rich cross-section of participants aged 42-56 years; 10 were British, one overseas. They had been consultants for 7-20 years, practiced surgery for >13 years, and specialised in orthopaedics, obstetrics, otolaryngology, urology, vascular or general surgery.

Themes: Seven important new higher order themes frame the analysis: (i) healthcare system, (ii) factors contributing to error, (iii) ASE types, (iv) cognitive processes, (v) detecting errors, (vi) emotions, (vii) strategies, solutions and barriers to action (Table 1). As expected, themes on errors, decision-making, warnings and contributory factors largely confirmed or informed known cognitive processes.

INSERT TABLE 1 HERE

(i) Healthcare System

The context of operations was very important in influencing working practices, how ASEs occurred, and whether they were reported (Table 2).

National Political Context: Policy influenced practice, and undue focus on targets affected it adversely, by increasing pressure e.g. adding patients to lists, increasing risks. Such processes were barely apparent from 'outside'.

The Government has forced us to squeeze through vast numbers of operations in a system that may have been working below capacity but was then forced to work above capacity. It's not the right way to do it! I don't think too many people have died or suffered as a result but it was a hazardous thing to do (A19).

Increased use of performance tables/rankings biased patient selection. Surgeons adapted to this pressure in self-protective ways by selecting 'low risk' patients to ensure acceptable mortality rates.

If you do an average operation on a patient who is going to do well, they'll probably do well. Whereas if you do a technically fantastic operation on a patient whose going to do badly, they'll do badly, and so measuring your outcome has as much to do with who you pick to do it on, which is why crude measures of death rates …are not very good (A20.)

Limited experience of junior surgeons due to legal reductions in working hours affected rates.

(Trainee surgeon have had) huge reductions in hours and…are now trying to train in about a third of the time that we trained in. And is that okay… to let them out onto the general public at that stage? Well, probably most of the time, yes…but occasionally, maybe critically, no (A20).

Local Political and Managerial Context. How consultants worked was heavily influenced by the hospital organisation (Table 2), and management were seen as responsible for providing adequate working conditions.

You need to know that the hospital does look (at whether) the theatre is working, and the kit works and is reliable, and there's an adequate supply of beds (A17)

Poor management reduced performance and increased error rates through pressures of insufficient time to do the job properly and to 'cut corners'.

You don't want to have people...counting how long you are taking…and feeling that the organisation is pressurising you to do things…technically…that you don't want to do, or in terms of time (A17).

We sometimes start an operation or...list, knowing that (certain) conditions should be fulfilled... to produce the ideal environment. We know sometimes that we are ***'skating on thin ice'****. Either we've done a list that is ridiculously silly, or we've got a team that is not up to the task (A19).*

The seeming inability of NHS administrators to schedule established teams to work together was a major criticism. This made ASEs more likely and inhibited their detection. New teams were less co-ordinated and unacquainted with each other's strengths and weaknesses. This could be crucial in a crisis.

Sometimes surgeons were pressurised to conduct operations they were not competent to perform, so where ASEs occurred, the system was often implicated.

What we are dealing with...is whether the right surgeon is dealing with the right procedure...That's an endemic festering sore in the NHS but it is the nature of a system where junior staff are being taught how to do things. Occasionally they will be doing things in the middle of the night which would have been better (done by) a more experienced person. But that's not the way the system works…it's not staffed to deal with it (A19).

It was believed that national and local "Politics" had sought and achieved disempowerment of consultant surgeons, allowing standards to slip and increasing risks.

INSERT TABLE 2 HERE

(ii) Factors contributing to Adverse Surgical Events

Table 2 identifies factors contributing to ASEs. Environmental factors including the organisation and culture of health care were major concerns that were largely controllable by management. Arrangements necessary for optimal outcomes could be absent and hard to remedy e.g. no intensive care beds.

But these details were not new. Of note was that few ideas were expressed about how to correct organisational, social and environmental factors. Surgeons felt powerless to make changes outside their immediate remit of practice i.e. physical treatment of individuals. Consultants acknowledged their personal role in ASEs, and accounts often revealed intense self-criticism and self-blame. Task and ergonomic factors played key roles but these were potentially controllable and correctable through retraining. Being unable to anticipate a minefield of largely uncontrollable patient factors was perplexing e.g. obesity, inflammation, temperature; and these were common impediments. Team communications could be dysfunctional occurring too often, insufficiently or inappropriately. Processes involving some of these factors are exemplified below.

(iii) Types of Adverse Surgical Events.

Adverse surgical events were conceptualised in seven distinct types (see Table 3) ranging along a continuum of seriousness, tempered by frequency of occurrence.

Technical discrepancies were small, simple things that went wrong but were correctable during surgery. They occurred too often and routinely to be classified as near misses.

It is a technical thing...um...a knot might come undone or slip. That probably happens in most procedures (A17).

Side-effects. Some events were side-effects of the procedure, being an inherent part of the operation, not an error.

We remove an organ and adjacent to that will be some nerve structures. We know that the… technique by which the operation is done will lead to nerve damage in 20% of cases say, so risk is inherent in the operation. So…there is no way of avoiding that risk (A24).

Complications This term was used in a generic and euphemistic sense to describe *all* types of error. Specifically it described events arising from sheer biological variability, even when no mistakes had apparently been made. This was common in technically difficult operations e.g. neurology, and with unexpected/unknown patient factors e.g. tight skin.

If you are operating...very near the brain all the time you would expect to have more complications (A17).

Sub-optimal outcomes. Many surgeons saw sub-optimal outcomes as ASEs.

I would say that the outcome could be described as um...potentially better, in between 5 to 10% of cases (A19).

However, standards of acceptability were determined by individual consultants, and were therefore variable.

…But is his decision-making good? Well, he's decided he's not going to spend another 10 minutes doing it perfectly. I just wished I could put the breaks on this bloke and get him to slow down and do it just a little more carefully because people would do so much better if he'd do it like that (A20).

Avoidable and unavoidable events were highly elaborated. Known complications could be anticipated, avoided or controlled but unavoidable events were caused by unexpected, uncontrollable factors; some were only detected post-operatively.

Well there are errors that you foresee are going to happen because the case may be complicated, so you can often avoid those. There are other cases where you've got no control over who is on your list (and) whose assisting you, and....you find (something) in the

operation that you weren't expecting. Then there are those cases that you think have gone completely well, and it's only when the patient wakes up you find…a problem. (A22)

INSERT TABLE 3 HERE

Near-misses and errors or mistakes (below) often involved known cognitive processes. These were usually reported as an evaluation/interpretation mistake (Reason, 1990) e.g. bleeding from a failed stitch, a wrong side operation, or an action/execution mistake or slip e.g. missing swab, retractor failure. Perception slips/mistakes were rare (Table 3).

Sometimes a supervised near-miss was used in a controlled way to teach trainees. This did not normally result in an ASE.

Errors and mistakes mainly resulted from mistaken judgement and flawed practice. They were identified by the size and seriousness of consequences for patients. Outcomes ranged from very minor e.g. temporary leakage, to major e.g. death, permanent disability, supplementary operation or hospitalisation. Paradoxically, small errors might cause catastrophic problems; conversely few (or no) ill effects could result from major errors. Defining an error was important as it strongly influenced whether it was officially reported and the likelihood of professional consequences.

Error and near-miss reporting...depends on…individual surgeons or...teams, and what their criteria are; what level they set as to what constitutes a near-miss (A30).

Where multiple errors contributed to events an action/execution mistake/slip was often compounded by an evaluation/interpretation mistake/slip in a 'cascade' of errors.

There is a sort of cascade...when there has been an accumulation of small events…although often each individual part is relatively small. Somebody is called away unexpectedly, or people are off sick, and then you know you're (definitely) more stretched and the difficulty is in knowing when to say 'Actually it's not safe to go on'. (It's fine to) go on if things proceed smoothly but then...you get on that slippery slope leading to errors (A23).

This was not an all encompassing classification but rather a series of overlapping ideas each with its own contribution to understanding and classifying error. In particular, different terms reflected both different errors in different specialities, and different responses to the same error.

(iv) Cognitive Processes

These themes differed in richness of responding. Accounts of shifts in decision-making were unforthcoming as participants had difficulty recalling thinking stages. Like other work, surgeons saw that automatic thinking reduced work strain. It guarded against problems occurring, through subconscious error checks and subtle adjustments. However it was negatively implicated in ASEs. They recognised that expectations and confirmation bias also had a role.

The new insight was about completion bias (Reason, 1990). Operations cannot usually be left incomplete. Unlike other work, the surgeon (performer) cannot start again another day. Moreover the working day finishes when operations (work) are complete, not a set time like a. shift, so there is intense pressure to finish, as that is the short-term measure of success.

…once you say 'That's good enough' then you can start to finish. You…can close the wound up. The end is in sight once you can say 'Yes, that's good enough (A15).

Pressure increased when co-workers e.g. nurses, perceived a risk, or actual over-run of a list or case. As they must work to the end of shift, they have a vested interest in completion. Moreover they do not see outcomes of operations so for them, completion is the end-point and yardstick of success, unless plainly marred by error.

(v) Error Detection

Cues to detection. Checks and adjustments are self-monitoring processes that resolve minor problems throughout most operations and detect errors. Routine checks provided cues e.g. patient markings. By overlooking small factors this could cue major errors e.g. marking

absent leading to a wrong side operation. Detection often occurred when errors became visible during surgery e.g. bleeding. However, many errors remained undetected by surgeons until later, and completely undetected by other theatre staff. Biases of completion and optimism that the operation had 'gone well' interfered with error detection.

Warnings by others. Warnings about rising pulse rate (anaesthetist), missed swab (scrub nurse) and wrong body side (registrar) were described, but had variable success in detecting errors. Contemporary theatre professionals were less experienced and knowledgeable about what was correct, so less aware of what was wrong. They had less seniority than formerly, and seemed less empowered to question surgeons. Finally, senior attitudes affected whether warnings were given. Many saw that the vertical hierarchy inhibited questioning. However some surgeons did not heed warnings, viewing advice as deficient or unhelpful.

Not always necessarily a good thing if...er…a leader of the team is constantly doing what...um (tail off)...or has a lot of people saying 'Do you think this is as it should be?' You then become indecisive (A17).

(vi) Emotions

Few participants described emotions and. accounts were poorly elaborated and often played down. However emotions were acknowledged as important detrimental influences on decision-making. Some surgeons dissipated negative emotions by actively remaining calm or '*reengaging the logical side of the brain*'. Extreme fear, anxiety and panic functioned as important cues to seeking help. Impulsiveness, demoralisation and surprise were reported.

…Oh shit! This is going completely pear-shaped. And you know, your bottom falls out...and that's the time when you actually need somebody else to come in who's not been involved; who's completely …able to...go back to the beginning and....help you out. (A17)

Different feelings were reported at particular stages of the operation. Anticipation anxiety or a '*sense of foreboding*' before surgery; irritation with small accumulated events during surgery;

regret, annoyance or anger afterwards. Feelings about external events e.g. home stress, distracted surgeons from their task.

INSERT TABLE 4 HERE

(vii) Solutions, Strategies and Barriers.

A striking lack of consensus was found: 96 strategies and solutions were offered covering 47 types (Table 4). Consultants accumulated idiosyncratic repertoires of actions from experience which formed a resource or '*safety net'*. Diverse personal solutions probably arose from lack of training in addressing errors, and stress. Only one advocated standardising procedures. Different strategies were necessasry at particular stages of surgery (Table 4). Many were pre-operative and precautionary providing useful training material. During surgery, well-used personal strategies involved known cognitive processes.

Some creative strategies demonstrated good practice:

I…write on the board the list of what I am going to do in the theatre before I start and…the series of steps that I'm planning to take, and… possible alternatives, and then ask them to get out the equipment they are going to need for any of those alternatives. We review…all...X-rays every morning, and all the cases (from) the day before...in a meeting (A20).

Another described how in a crisis he made the patient safe, then removed his surgical gloves. As this required him to scrub again, valuable time was gained rethinking the operating plan away from the table.

Barriers were inextricably and paradoxically intertwined with activating solutions. Although assistance could be requested, some consultants found this humiliating. Whether help was summoned depended on the technical problem, the surgeon's personality and speciality. The main barriers were '*defensive*' reporting system and the '*blame culture*'.

The balance between the decisiveness of the leader of the team and him being able to take on board messages from the others...it's not an easy dynamic (A17).

Discussion

The study investigated consultant surgeon's accounts about *how* and *why* ASEs occur within contemporary surgery. This qualitative investigation of processes contrasts with descriptive, quantitative previous research (e.g. Williams, et al, 2007). Pressure from government and management to work faster, harder, and beyond capacity, contextualises the increased potential for errors. Many surgeons reported the intensity of these pressures to operate on more patients, and '*finish*' an operation or list, demonstrating *completion bias*. Greater awareness about biases should be built into surgical and management training with strategies to combat them. Structurally, targets and standards are achieved by selecting easier patients which also reduce ASE risks. However, this tactic may increase health inequalities; another focus of concern.

Within a culture of individual blame for ASEs, environmental factors are downplayed. Management failure to organise smooth operating schedules and optimal theatre conditions arose from how the system works. Furthermore, management sometimes lacked empathy with the surgeon's psychological state when pressing them to complete a list after a patient death. Such working environments damage performance, wasted time, resources and good will, and promote risky short cuts. Risks also increased if team competence was lacking due to eroded training and support and where teams were strangers. Pre-operative introductions are now required by the WHO Checklist.

Seven ASE types indicated complex conceptualisation of this area. Definitions were tied to the seriousness of consequences, their persistence, and to decisions about reporting them. This classification provided a 'rule of thumb' for assessing consequences and a framework for understanding *how* and *why* events occurred. 'Complication' euphemistically embraces most ASEs but when specifically used, it referred to biological variations. Technical discrepancies and side-effects inherent to a particular operation were normal and therefore less significant.

Sub-optimal outcomes arising from competence/judgement flaws were more problematic but infrequent. Events avoidable through preparation contrasted with unavoidable events from unexpected/unknown factors. Uncontrollable factors caused widespread anxiety and were more serious. Despite extensive expertise, consultants were never invulnerable during routine procedures. These slips, mistakes and lapses occurred at skills- and rules-based performance levels, partly explaining Regenbogen et al's (2007) findings. Where faults were correctable, potentially serious near-misses could have positive outcomes. Technically, these serious errors were detected just before a disaster. Real errors and mistakes often had extremely serious consequences. However paradoxically, small errors might have '*catastrophic*' consequences and major errors trivial outcomes. How an ASE was interpreted was influenced by anticipated consequences for professionals; a mechanism representing the '*blame culture'*. Error risk mounted when a '*cascade*' of possibly trivial events occurred. As this sequence progressed, consultants knew they were '***skating on thin ice*'**. This process was exacerbated by negative emotions e.g. irritation. Optimally intercepting this process deserves further investigation. Single error events e.g. severing a nerve, could also be serious if, as commonly happened, no warning signs occurred. As these events are harder to anticipate, improvements to practice are problematic. While automatic thinking aided rapid routines and reduced strain by providing subconscious checks/adjustments to prevent later problems, it generated important errors from overconfidence and complacency as *optimism bias*.

Some problems in dealing with errors were social. Although team responsibilities included warning others, '*speaking out*' was inhibited when viewed as inappropriate or interfering, especially for inexperienced staff. Summoning assistance depended on the surgeon's speciality, seniority, personality, acceptability standards and hierarchy. Although team members sometimes identified their own errors e.g. missed checks, close attention to their

task meant they infrequently noticed others errors. Error rates increased under pressure to '*finish*' an operation, and during this period tasks overlapped and role boundaries blurred.

Although emotions play a role in ASEs, surgeons could recall little about how these functioned, possible due to attrition over time. Cultural pressure against articulating emotions is integral to training and enables surgeons to continue functioning. After ASEs, new strategies were added to a surgeon's repertoire, providing a resource and 'safety net'. Replacing retrospective procedures with real-time or short-term methodology in the future could improve access to fleeting emotions, and data quality.

Important environmental, organisational and systemic factors contributed to ASEs but lack incorporation within existing models. Consultants felt disempowered to influence these factors; uncharacteristic features of a profession who typically assume high control levels. Prolonged uncontrollability causes helplessness depression (Abramson, Seligman et al, 1981). To increase controllability and improve mental health, Trusts should provide surgeons with communication channels to a speciality safety team who can rapidly rectify problems.

Although the Checklist is now used routinely to prevent errors throughout NHS hospitals only some factors important to expert surgeons are included; environmental, organisational and social issues are substantially overlooked. Checklist use could offer secondary benefits to management-surgeon relations through working together towards mutually important goals of reducing ASEs.

As strategies for dealing with ASEs were diverse, pragmatic and highly idiosyncratic, introducing standard guidelines could prove unacceptable. Surveys of professional bodies could further investigate consensus about 'best' practice. Environmental explanations for ASE volunteered by Trusts could dispel the personal blame culture. Good leadership within this new organisational atmosphere would promote situational solutions. Furthermore, professional development surrounding help-seeking would reframe these actions positively.

More self-confident leadership could transform vertical hierarchies into horizontal ones, promoting appropriate warnings and enhancing team spirit. While organisational change can be slow, reducing the human and financial costs of ASEs is pressing.

Acknowledgements: We are indebted to the consultant surgeons who gave valuable time to participate in this research. The field work was conducted by Joanne Langdon, as part of an MSc in Health Psychology awarded by Univ. of Bath.

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Table 1: Summary of Themes offered by Consultant Surgeons about Adverse Surgical Events

(i) Healthcare system	Political context
	Professional responsibility
(ii) Contributing factors	Organisation and culture of health care
	Ergonomic factors
	Environmental factors
	Task factors
	Team factors
	Surgeon factors
	Patient factors
(iii) Types of adverse surgical events	Technical discrepancies
	Complications
	Side-effects
	Sub-optimal outcomes
	(Un)avoidable events
	Near misses
	Errors and mistakes
(iv) Cognitive processes	Automatic thoughts
	Decision-making
(v) Error detection	Cues to detection
	Warnings by others
(vi) Emotions	Before, during & after
(vii) Implementation	Strategies and solutions for different stages
	Barriers: personality, conflict, hierarchy

Table 2: Factors Contributing to Adverse Surgical Events

Categories	Factors
Organisational & culture of health care	Overburdened lists
	Inadequate training
	Poorly staffed teams
	Poor match: team to procedure.
	Inadequate beds, hospital chaos
	Stressful environment
	Pressure to meet Government targets
	Pressure to compromise personal standards
	Fatigue/exhaustion: workload or work stress
	Not following safety procedures
	Costs & limits to resources
Ergonomic factors	Patient's position slipped
	Incorrect incision position
	Drapes incorrectly positioned
Environmental factors	Interruption during operation
	Inappropriate music/noise
	Inappropriate lighting
	Theatre temperature
	Incorrect instruments/kit
	Unfamiliar environment
Task factors	Unprepared change to procedures
	Changing the order of the theatre list
	Complexity of procedure: inherent risks
	Poor execution of procedure
	Taking over from fellow surgeon
Team factors	Poor communication
	Lack of knowledge of others: no cohesion
	Irrelevant chatter: distraction
	Incompetence of individual team members
	Team members not concentrating
	Fatigue or exhaustion due to personal life
	Lack of knowledge of procedure
	Unfamiliarity with equipment
	Lack of supervisory support
Surgeon factors	Lack of pre-operative planning
	Lack of technical skills/experience of procedure
	Personality of surgeon & effect on team dynamics
	Personality of surgeon: acceptable standards
	Overconfident
	Insufficient pre-op. investigation/tests
	Out of practice e.g. returning from leave
	Rushing/omitting steps or safety procedures/checks
	Not seeing patient pre-op; not marking patient
	Stressed
	Lack of concentration
Patient factors	Obesity
	Previous surgical history present
	Children as patients
	Not well; tissues poor quality/inflamed
	Combination of pathology
	Patient selection (unlikely to do well)
	Access to organs problematic; unusual anatomy

Table 3: Specific Adverse Events reported by Consultant Surgeons

Typology of error	Description of event	Description of error or near-miss	Outcome for patient
1. Evaluation mistake	Surgical outcome sub-optimal	Ignored evidence: sub-optimal outcome	Subsequent operation to correct error
2. Perception slip Evaluation slip	Patient had stabbed self	Emergency: no pre-op investigation. Extent of damage misunderstood. Beyond surgeons experience	Unknown. Surgeon with relevant speciality called to deal with operation
3. Evaluation mistake Action Execution slip	Patient very ill: high temperature	No pre-op investigation. Unexpected pathology & pneumonia. Inflammation: stitch failed. Bleeding	Near miss. Bleeding discovered. Subsequent operation to repair failed stitch
4. Action Execution mistake	Difficult operation with participant assisting. Consultant 'gung-ho'	Consultant wrongly cut (body part). Tried to fix cut but did not know how	Serious adverse outcome: patient died
5. Action Execution slip	Consultant took over routine operation from colleague. Wrong position uncorrected	Consultant drilled too deep	Permanent adverse outcome. Patient lost function area of body
6. Action Execution slip Action Evaluation slip	Overseeing operation by registrar	Registrar pulled clamp and tore skin. Consultant repaired tear, but left undetected hole	Temporary adverse outcome. Patient suffered leakage. Required further operation & 3 months hospital stay
7. Evaluation Interpretation mistake	Consultant began operation on wrong side: nurse incorrectly prepared & draped patient. Registrar, who had spoken to patient, left room to operate elsewhere: staff shortage	Consultant assumed checks had been made. Began operating on wrong side	Near miss. Registrar returned & voiced error. Consultant repaired wrong side & continued on correct side
8. Action Execution mistake Action Evaluation slip	Changed operation procedure during surgery. Correct sized swabs not available. Small swabs used to pack open wound	Unanticipated change in procedure so correct swabs not available. Nurse did swab count: one short. Swab left inside patient	Near miss Swab count picked up error. Surgeon reopened & removed missing swab
9. Action Execution slip	Retractor lever slipped and the (body part) of patient subsequently moved during operation	Mechanical failure of retractor. Surgeon had not completed necessary check before procedure	Near miss Surgeon corrected patient position & corrected retractor
10. Evaluation Interpretation slip & Action Execution mistake	Temporary implant rod cut through patient (body part)	Surgeon initially missed information that became known just before operation. Required changed procedure: suboptimal	Patient required another operation
11. Action execution slip Evaluation & Interpretation mistake	Emergency. Surgeon called to operation; rest of team dealt with patient	Emergency. Anaesthetist intubated oesophagus not trachea. Assumed machinery readings were wrong & that problem was linked to patient injuries	Patient died

Table 4: Strategies to avoid Adverse Surgical Events

Type of Strategy	Strategy
	During operation
Personal	Shift thought processes to problem-solving Call for help from colleagues Focus: ignore irrelevant events and stresses Recognise that situation is beyond experience Be receptive to problems occurring Keep calm Make checks and if necessary, retrace steps Do not act impulsively; check evidence Take a short break
Team-related	Interact with team to identify or solve problem Team know each other, including abilities. Communication between team members Senior specialists e.g. anaesthetists, offer supervision to juniors Assistant concentrate & work hard to support surgeon Anaesthetist offer encouragement Supervision given to junior surgeons Operate with fellow consultant
Task-related	Display, identify, simplify & isolate problem Make site safe, then stop Make physical adjustments to correct small problems Accurate transfer of information when swapping staff Use safety checklist during operation Use X-rays
	Prior to operation
Organisation	Match operation with surgeon's ability Provide suitable operating environment Match team's expertise to procedure
Personal	Do not undertake (a) unnecessarily dangerous operations or (b) those beyond own experience or (c) if feeling stressed. Pre-plan action; also alternatives in event of problem Make checks: patient marking, patient diagnosis Practice & prepare for procedure Change lists around or cancel if full team not available Agree department safety standards: follow them Theatre lists must take account of leave Talk to patient Plan for appropriate after-care Set & maintain predetermined outcomes/standards
Task-related	Juniors learn from near misses: controlled conditions Learn operations as step-wise procedures Ensure familiarity with machinery/equipment
	After Operation
Organisation / System	More open and less defensive reporting system More investment/resources put into reporting systems Incorporate errors into training
Personal	Self-audit work: undertake training if necessary. Talk to patient & make post–op. checks
Team-related	Review operations next day in team meeting, discuss outcome & make changes.