The World Health Organization Surgical Safety Checklist

The World Health Organization produced the Surgical Safety Checklist to improve patient safety. This review examines the supporting evidence, the results of a study of its worldwide trial and discusses the possible mechanisms of its effects.

It has been long recognized that operative procedures carry inherent risk, with perioperative mortality in industrialized countries of up to 0.8%, and major morbidity of 3–17% (Gawande et al, 1999; Kable et al, 2002). The Institute of Medicine published *To Err is Human* in 1999, where it was claimed that as many as 44 000–98 000 lives a year are lost in the USA from medical errors, and leaving aside the personal cost of such errors, the financial cost is upwards of $29 billion per year (Kohn et al, 2000). The Agency for Healthcare Research and Quality in the USA reported that 32 000 people die each year from 18 common types of medical injuries (Zhan and Miller, 2003). Up to 48% of all adverse events occur in surgery, and are claimed to be preventable 74% of the time (Brennan et al, 1991). It has been suggested that 54% of surgical errors were preventable (Gawande et al, 1999). In the context of an estimated 234 million operations performed yearly, worldwide, it is important from a humanitarian and financial point of view that preventable errors should be minimized.

Patients develop complications following surgery for many reasons. Strategies to decrease such adverse events have been extensively investigated over the years. The main areas of research are discussed below.

Surgical site infections

For many operations prophylactic antibiotics decrease postoperative infection. However, surgical site infections, which account for 20% of all health-care-associated infections, still complicate at least 5% of patients undergoing surgery (Smyth et al, 2008). Administering antibiotics within the first 2 hours of starting surgery results in significantly fewer surgical site infections than if given 2–24 hours pre-incision or postoperatively (Classen et al, 1992). Despite there being numerous guidelines around which antibiotics to use, and when to administer them, adherence is poor. There has also been work that suggests that maintaining normal body temperature and glucose levels during the operative phase contributes to decreased rates of surgical site infection. Additionally avoiding hair removal, or using clippers rather than razors, decreases wound infection rates.

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Venous thromboembolism

Venous thromboembolism is the major cause of post-surgical morbidity and mortality. Without prophylaxis 10–40% of medical and general surgical patients and 40–60% of patients after major orthopaedic procedures suffer venous thromboembolism. Approximately 10% of all hospital deaths are attributed to pulmonary embolism. Appropriate prophylaxis cuts these rates dramatically and has been subjected to many reviews and guidelines (Geerts et al, 2008). However, it is still one of the commonest causes of preventable death. Appropriate use of venous thromboembolism prophylaxis gives the highest increase in safety of all common interventions.

Wrong site surgery and retained objects

Wrong site surgery, which is thankfully rare, is catastrophic to the patient and the whole team involved. The National Patient Safety Agency's self-reporting system revealing 16 such cases in 2007 in England and Wales. Retained objects, despite the scrub teams routinely declaring 'swabs, needles, instruments correct' at the end of surgery, accounted for 779 incidents in the same year (National Patient Safety Agency, 2009). These facts, in part, led to the National Patient Safety Agency 'Correct Site Surgery' alert, mandating who, how and where patients should be marked before induction of anaesthesia.

Communication and teamwork

As illustrated above there is a large knowledge base on how to improve surgical morbidity and mortality. Many national and international bodies have produced guidelines to promote best practice. However, preventable harm continues to happen to patients. It has been recognized in other highly complex industries, such as the airline and nuclear industries, that effective communication and teamwork are pivotal to minimizing preventable mishaps. The importance of these skills within the health-care setting is also being increasingly recognized.

Teamwork is central to a culture of effective communication in the operating room and is a surrogate marker for patient safety. Communication failure has been identified as a leading cause of wrong site surgery (Joint Commission on Accreditation of Healthcare Organizations, 1998).

Senior medical staff often perceive that they have good communication skills. In one study 85% of surgeons ranked the communication skills of their surgical colleagues as high, while nurses agreed that surgical communication was good only 48% of the time (Makary et al, 2006). Physicians fare no better, with three quarters of intensive care unit physicians believing physician–nurse communication was good, whereas only one third of nurses felt that communication was effective (Thomas et al, 2003). This may, in part, explain the resistance of senior clinical staff to initiatives to improve communication. It has also been shown that ineffective communication can affect patient outcome. Nurses' perception of good communication among team members correlated with patient outcomes across three intensive care units in New York. Lower mortality has been noted in intensive care units with staff that felt they functioned effectively as a team (Baggs et al, 1999).

Surgical Safety Checklist

The Safe Surgery Saves Lives Study Group studied the effect, on complications and death, of the introduction of a 19-point surgical checklist (*Figure 1*) (Haynes et al, 2009). The checklist was based on World Health Organization guidelines, which identified practices that helped to ensure the safety of surgical patients worldwide (World Alliance for Patient Safety, 2008). The checklist was used three times during the patient journey through theatre. Before the induction of anaesthesia the 'sign in' included confirmation of patient identity, the proposed procedure, the surgical site and that appropriate consent had been given. The 'time out' occurred immediately before incision and included a team introduction, reconfirmation of patient identity, a discussion of potential problems and adherence to a surgical site infection bundle. The 'sign out' happened at the end of the operation before the patient left the operating room. Correct needle, swab and instrument count was confirmed and any postoperative concerns mentioned.

Eight institutions from high- and low-income countries were chosen to participate, in order to reflect the diverse socioeconomic environments in which surgery is performed. The end points were major complications as defined by the American College of Surgeons' National Surgical Quality Improvement Program. These include unplanned return to theatre, acute renal failure, myocardial infarction, transfusion requirement of greater than three units of red cells within 72 hours after surgery, acute renal failure, deep vein thrombosis and death.

Before the introduction of the checklist, 3733 patients were enrolled. Patient characteristics, type of surgery and

Figure 1. World Health Organization Surgical Safety Checklist. From World Health Organization (2009).

complications up to hospital discharge or 30 days post-surgery were collected. After each centre had enrolled approximately 500 patients, the checklist was introduced over 1 week to 1 month. Local teams used lectures, written materials and direct guidance. Following the introduction of the checklist, a further 3955 patients were recruited.

The overall complication rate at all sites fell from 11.0% to 7.0% (P<0.001), the surgical site infection rate dropped from 6.2% to 3.4% (P<0.001) and the in-hospital death rate decreased from 1.5% to 0.8% (P=0.003). These changes were not accounted for solely from the low-income sites; the overall complication rate fell from 10.3% to 7.1% (P<0.001) in the high-income sites, with the death rate falling from 0.9% to 0.6% (P=0.18). It should be noted that at one high-income site the death rate increased from 0.8% to 1.4% following the introduction of the checklist. Although no single site was responsible for the overall effect, the intervention was more strongly felt at some sites than at others. Reduction in the overall complication rate was significant in one high-income and two low-income sites.

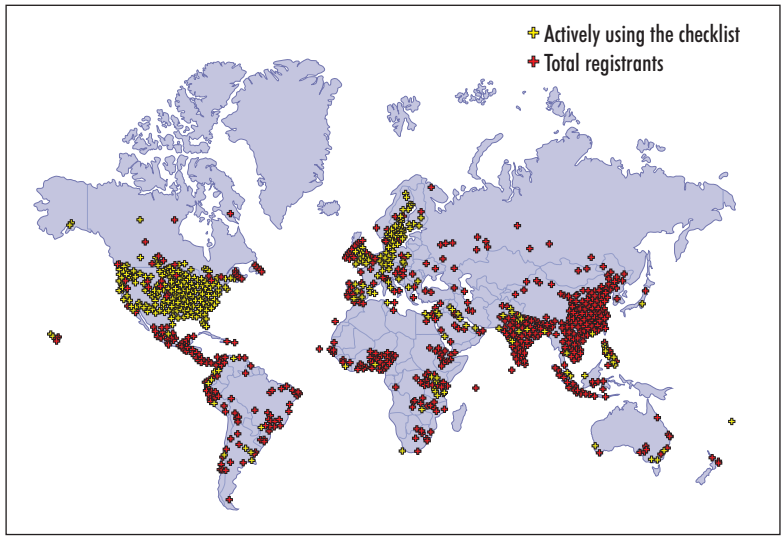
The study has a number of flaws, many of which are commented on by the authors. Interestingly, despite there being 19 points on the checklist, adherence to only six was assessed. These were:

1. Objective evaluation and documentation of the airway before induction of anaesthesia
2. Use of pulse oximetry before induction of anaesthesia
3. The presence of at least two peripheral intravenous catheters or a central venous catheter before incision in cases involving an estimated blood loss of greater than 500 ml
4. The administration of prophylactic antibiotics within 60 minutes before incision when indicated
5. Oral confirmation immediately before incision of the patient's identity, operative site and the intended procedure
6. The completion of a sponge count at the end of any procedure if an incision had been made.

Overall there was fairly poor adherence to the use of all six safety indicators, performance from all sites improving from 34.2% to 56.7% (P>0.001). One site, which demonstrated an overall complication rate decline from 21.4% to 5.5%, never performed all six safety indicators before or after the introduction of the checklist. At that site antibiotic prophylaxis rose from 29.8% to 96.2% over the course of the study.

The authors acknowledged that the exact mechanism of improvement was unknown. The intervention of confirming the correct timing of prophylactic antibiotics during the time out contributed to the improvement in surgical outcomes. They also suggested that the improved safety processes including time for team introductions and briefings were important factors. It was felt that the checklist improved communication and teamwork within theatre. They concluded that the introduction of a surgical checklist was associated with a significant decrease in complications and death from surgery in a diverse group of institutions around the world.

Figure 2. Location of hospitals using a safer surgical checklist in January 2010. From www.safesurg.org/registermap.html (accessed 23 April 2010).



Discussion

The introduction of such a checklist, which was poorly adhered to at the study sites, requires a considerable change in attitudes and behaviour within theatre teams, many of whom may question its value. However, the positive findings have led to the drive, orchestrated by the World Health Organization, to see it adopted across the world. It has been implemented in many countries and more than 1500 hospitals (*Figure 2*). In England and Wales the National Patient Safety Agency mandated that locally adapted versions of the World Health Organization Surgical Safety Checklist be implemented in all NHS hospitals by February 2010.

It would appear reasonable to assume that increasing the adherence to surgical site infection and venous thromboembolism prophylaxis protocols would account for improvement in surgical outcomes. Is it reasonable to suggest that improved teamwork and communication further improved patient safety?

A similar checklist was introduced in 2004 in the USA leading to reduced wrong site surgery, improved patient safety, reduced case delays and cancellations (DeFontes and Surbida, 2004). There is evidence from obstetric and general surgery that improving teamwork decreases complications (Nielsen et al, 2007; McCulloch et al, 2009). The effect of simple interventions, which included a checklist of actions, significantly decreased catheter-related bloodstream infections in the USA and lead to the current 'Matching Michigan' campaign (Pronovost et al, 2006).

There are lessons learnt by the airline industry that can be transferred to the hospital environment. Investigations have revealed that in many accidents attributable to pilot error, another member of the team in the cockpit was aware of, but unable to communicate the imminent danger as a result of the hierarchical structure within the cockpit. There has been extensive work on how to improve the way teams communicate and work together. The aviation industry sees the pilot as the leader of a team, who actively seeks input from all team members. This model is sometimes called crew resource management. This team strategy has many facets, one being the use of multiple checklists to ensure strict adherence to safety protocols. These also apply to emergencies, where the quick reference handbook has algorithms to guide pilots through hazardous situations.

It can be disingenuous to directly compare a multi-billion pound industry that accepts a less than one in a million error rate with another multi-billion pound industry that accepts a 5–10% error rate. There are significant differences: the pilot has one employer and is regulated directly by the Civil Aviation Authority, whereas the doctor is semi-independent and is answerable to many competing regulatory bodies, e.g. the General Medical Council, local trust, National Patient Safety Agency, Royal colleges and Department of Health. All of the techniques used in the airline industry cannot be directly applied to health care. However, it is hard to imagine anyone sitting in an aeroplane being happy to trust the inherent professionalism and training of the pilot when about to embark on a flight. Yet many doctors feel that this is acceptable for patients.

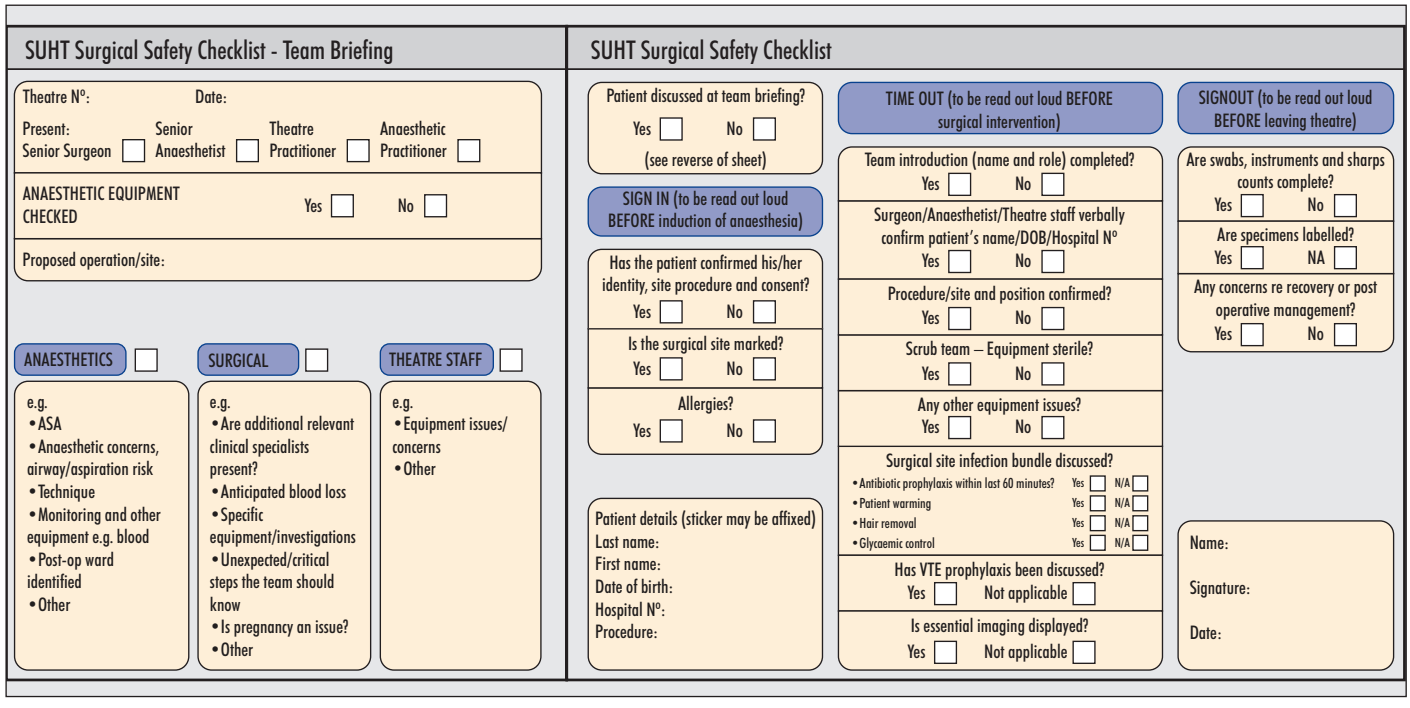
Southampton's experience

Southampton University Hospital Trust is a large teaching hospital with 29 operating theatres in five locations performing specialized complex surgery. As with all acute hospitals there have been cases of wrong site surgery and near misses. A number of interested clinicians and managers agreed to formulate a plan to introduce a locally adapted Surgical Safety Checklist (*Figure 3*) into the Trust before the February 2010 deadline.

It was decided that communication between the surgeon, anaesthetist, operating department practitioner and theatre team should happen before the induction of anaesthesia. This has been termed the 'team briefing' where all the cases are discussed. Anaesthetic and surgical requirements and potential problems are outlined. Antibiotic and venous thromboembolism prophylaxis are also agreed on. The rest of the checklist is essentially the same as the World Health Organization document. It was agreed that there should be one checklist across the Trust to minimize confusion. Individual teams were encouraged take ownership of the checklist and adapt its delivery as they saw fit.

The checklist was piloted over 3 months in a small number of theatres. A number of changes were made, and team satisfaction was investigated. Although all found the checklist to be useful, many senior clinicians felt that such communication already took place informally, and that more paperwork would not add to safety. This mirrors the experience found by other workers attempting to introduce airline-style crew resource management techniques to the UK health-care environment (McCulloch et al, 2009).

Figure 3. Locally adapted surgical checklist used in Southampton. ASA = American Society of Anesthesiologists; SUHT = Southampton University Hospitals NHS Trust; VTE = venous thromboembolism.



Following extensive educational support and training of all theatre users the Southampton University Hospital Trust Surgical Safety Checklist was rolled out in November 2009.

The Surgical Safety Checklist will only be truly effective if clinical teams do not view it as yet another set of boxes to tick. When asked individually nearly all clinical staff agree, in principle, with the idea of a checklist. However, changing attitudes and behaviours is notoriously difficult. There has been some resistance to all of the senior team attending the team briefing. The team introduction or 'group hug' feels very uncomfortable for many people. In the authors' Trust the checklist must be signed to document that it has been completed. This has led to the fear that legal colleagues will apportion blame to those who have signed the checklist when complications occur.

Most theatre teams have engaged with the checklist, and most report improved communication and teamwork in theatre. An audit of over 250 cases in February 2010 revealed that team briefings occurred on 77% of occasions, and a time out happened in 86% of cases. Inability of all staff to attend the team briefing is the main obstacle at present in the authors' theatres.

Conclusions

Significant avoidable harm occurs to patients everyday throughout the world. This ranges from catastrophic errors such as wrong site surgery to the failure to follow antibiotic and venous thromboembolism prophylaxis guidelines. Poor teamwork and communication are often found when errors are analysed. There is evidence from health care and other industries that improving communication enhances outcomes and safety.

The Safe Surgery Saves Lives Study Group offers robust evidence that the introduction of a surgical checklist improves surgical outcomes, although the methodology can be questioned. It should be welcomed by clinical staff and patients. Further investigation into which elements of the checklist actually enhance safety would be welcome. Also work on how to implement the behavioural and attitudinal changes required for such a checklist to be truly successful would be very valuable. **BJHM**

KEY POINTS

- The overall risk of surgery is up to 0.8% for mortality and between 3 and 17% for major complications.
- Poor teamwork and communication are implicated in many adverse events, including wrong site surgery.
- Improving teamwork and communication has improved safety in other complex, high-risk organizations such as the airline and nuclear industries.
- The World Health Organization Surgical Safety Checklist decreased overall complications from 11.0% to 7.0% and mortality from 1.5% to 0.8% in eight hospitals across the globe.
- The National Patient Safety Agency has mandated all NHS hospitals to implement a locally adapted surgical safety checklist by February 2010.

Figures 1 *and* 2 *are reproduced by kind permission of the World Health Organization.*

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