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Compliance and quality in administration of a surgical safety checklist in a tertiary New Zealand hospital

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Abstract

Aim Recent studies have demonstrated a reduction in perioperative complications if a surgical safety checklist is utilised. In our institution an adaptation of the WHO Surgical Safety Checklist is administered in 3 "domains": on arrival of the patient in the operating room (Sign In); before surgical incision (Time Out) and before the patients leaves the operating room (Sign Out). Since incomplete administration or staff disengagement could diminish any safety benefit we evaluated administration of this checklist.

Method 100 adult surgical cases were observed. Compliance with administration of the Sign In, Time Out, and Sign Out domains and their component checklist items was recorded. The timing of the checklist administration, and engagement of operating room teams were also assessed.

Results The rate (per 100 cases) of the checklist domain administration was: 99 for Sign In; 94 for Time Out; and 2 for Sign Out. The mean (range) checklist item compliance was 56% (27–100%) for Sign In, 69% (33–100%) for Time Out, and 40% for Sign Out. Checklist items related to patient identity and surgical procedure were administered in 100% of Sign In administrations. Timing of the checklist administration was appropriate in over 80% of cases. Engagement by theatre teams was frequently incomplete.

Conclusion The Sign Out domain was almost always omitted, which may increase the risk of important omissions in postoperative care. Most other aspects of checklist administration could also be improved. This will require strong leadership from senior clinicians in all relevant teams.

The incidence of preventable adverse events in the operating room (OR) is well documented.[1–4] Globally, more than 200,000,000 operative procedures are estimated to take place per year and it follows that the impact of surgery-related adverse events is substantial.[5]

The World Health Organization (WHO) Safe Surgery Saves Lives Challenge began in 2006 with the aim of developing global guidelines to promote patient safety in the OR and following operative procedures.[6] From these guidelines, the *WHO Surgical Safety Checklist* was developed to address preventable adverse events in the OR setting.

Safety checklists are already in use in the medical setting,[7] and are well established in other high risk professions; aviation is a clear example. However, the WHO Surgical Safety Checklist advances standard perioperative checklist practices in several key ways. First, it is administered in the OR, not in the preoperative area as has often been the case. Second, it is administered at three strategic points: on patient arrival but

before any intervention ("Sign In"); immediately before surgical incision ("Time Out"); and before team members or the patient leaves the OR ("Sign Out"). Finally, it is specifically designed to promote communication and teamwork within the OR.

A multi-centre international study comparing patient outcomes before and after implementation of the WHO Surgical Safety Checklist showed a significant overall reduction in postoperative complications and mortality.[8] These findings were replicated in a recent multicentre prospective trial of an analogous system to improve surgical safety in the Netherlands.[9]

Auckland City Hospital was one of the study sites in the initial WHO Surgical Safety Checklist study,[8] and an adapted form of the checklist has since been part of standard OR practice (Figure 1). However, checklist use and compliance has not been evaluated in the two years since the study.

Appropriate use of the WHO Surgical Safety Checklist constitutes more than item verbalisation; it requires verification of the listed items by various OR team members, correct timing of domain administration and the involvement and attention of all team members throughout. Incomplete or inconsistent checklist administration may diminish the potential for improvement in patient safety identified by the relevant studies.[8,9]

In institutions where the WHO Surgical Safety Checklist is employed, future studies of preventable patient harm following operative procedures should be interpreted in the context of the quality of checklist administration. The aim of this study was to determine the contemporary quality of administration of our institutions' adaptation of the WHO Surgical Safety Checklist in ORs at Auckland City Hospital.

Methods

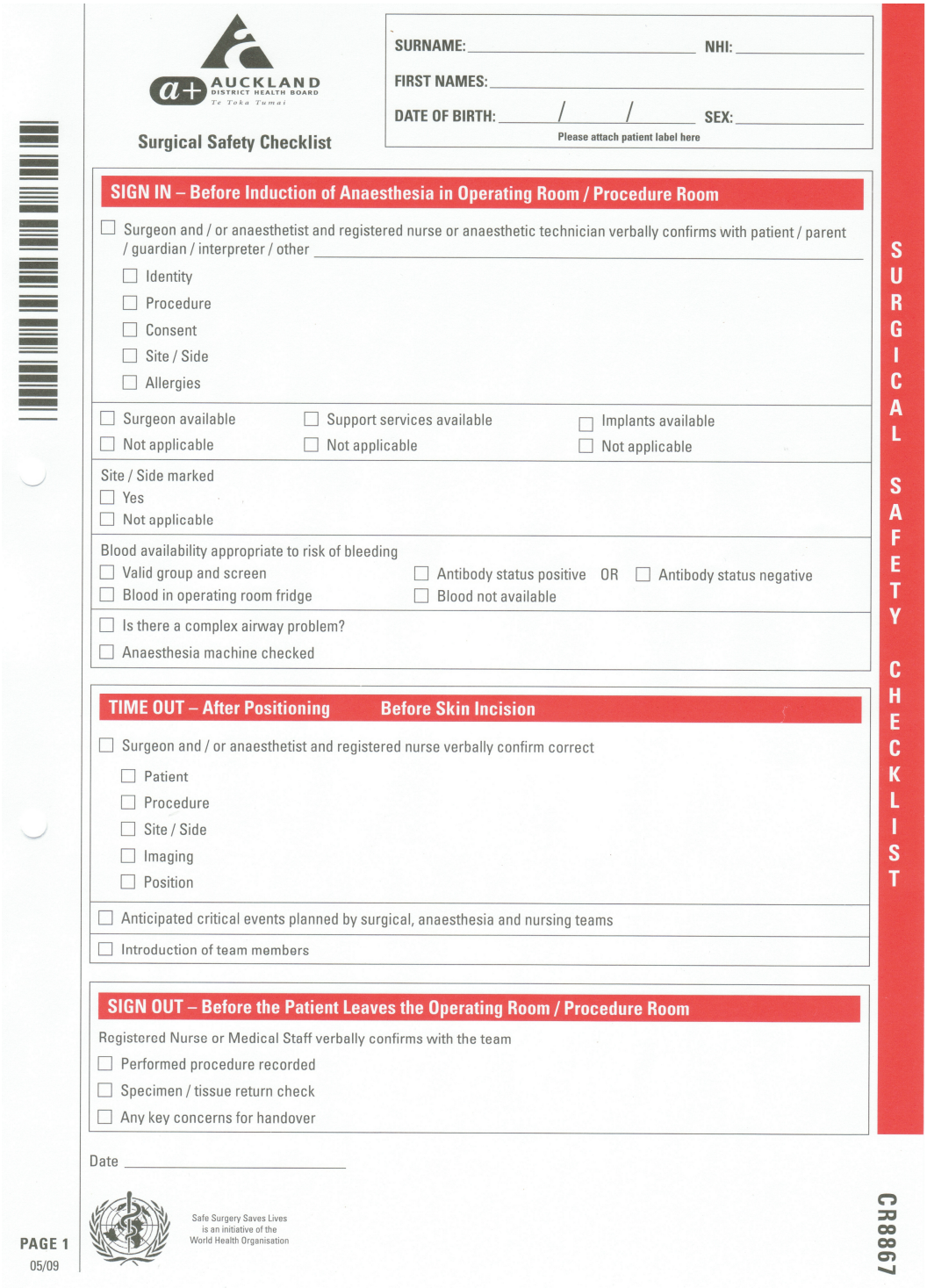
Study design—The study was approved by the Northern Y Regional Ethics Committee (ref: NTY/10/EXP/077) and was listed with the Australian New Zealand Clinical Trials Registry (ref: ACTRN12610001070022). The study was also discussed with and approved by senior OR management, and announced to a general meeting of OR staff in advance. This was a prospective investigation of current practices in the administration of the adapted version of the WHO Surgical Safety Checklist at Auckland City Hospital, undertaken during November and December 2010. One hundred adult surgical procedures were directly observed. At the start of each study day, the observer was allocated to an OR by the attending Anaesthetic Coordinator. Where operating lists finished early, observation was transferred to a second OR. Observations took place during weekday shifts and all acute and elective procedures were eligible.

Data collection—The observer (NV) attended operating lists primarily as a medical student with the agreement of the attending anaesthetist. This ensured observation was discrete and reduced potential for changes in theatre staff behaviour as a result of the observation itself. Surgical specialty and operative procedure were documented, but no identifying information relating to patients, theatre staff or OR was collected. Data were recorded using a standardised WHO Surgical Safety Checklist compliance assessment tool (Appendix 1), which was developed from the adapted version of the WHO Surgical Safety Checklist currently used in all theatres at Auckland City Hospital (Figure 1). The compliance assessment tool also includes items from the original WHO Surgical Safety Checklist that are not included in the current Auckland City Hospital version. This was intentional, so that the tool could be adopted for use in institutions that use this original version. Any redundant items in the tool were ignored by the observer in the present study.

The compliance assessment tool is divided into three domains (Sign In, Time Out and Sign Out) corresponding to those of the WHO Surgical Safety Checklist. Compliance (or non-compliance) with administration of individual items of the checklist was recorded. Compliance was defined as verbal communication of the item by the checklist administrator (commonly a circulating theatre nurse in our

institution) or by other members of the OR team during administration of the checklist. Items of the checklist that were performed or communicated between team members outside of checklist administration did not constitute compliance with that item.

Figure 1. Adapted WHO Surgical Safety Checklist in current use at Auckland City Hospital



AUCKLAND DISTRICT HEALTH BOARD
Te Toka Tumai

Surgical Safety Checklist

SURNAME: _____ NHI: _____

FIRST NAMES: _____

DATE OF BIRTH: ___/___/___ SEX: _____

Please attach patient label here

SIGN IN – Before Induction of Anaesthesia in Operating Room / Procedure Room

☐ Surgeon and / or anaesthetist and registered nurse or anaesthetic technician verbally confirms with patient / parent / guardian / interpreter / other _____

- ☐ Identity
- ☐ Procedure
- ☐ Consent
- ☐ Site / Side
- ☐ Allergies

☐ Surgeon available ☐ Not applicable

☐ Support services available ☐ Not applicable

☐ Implants available ☐ Not applicable

Site / Side marked
☐ Yes
☐ Not applicable

Blood availability appropriate to risk of bleeding
☐ Valid group and screen
☐ Blood in operating room fridge
☐ Antibody status positive OR ☐ Antibody status negative
☐ Blood not available

☐ Is there a complex airway problem?
☐ Anaesthesia machine checked

TIME OUT – After Positioning Before Skin Incision

☐ Surgeon and / or anaesthetist and registered nurse verbally confirm correct

- ☐ Patient
- ☐ Procedure
- ☐ Site / Side
- ☐ Imaging
- ☐ Position

☐ Anticipated critical events planned by surgical, anaesthesia and nursing teams

☐ Introduction of team members

SIGN OUT – Before the Patient Leaves the Operating Room / Procedure Room

Registered Nurse or Medical Staff verbally confirms with the team

☐ Performed procedure recorded
☐ Specimen / tissue return check
☐ Any key concerns for handover

Date _____

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SURGICAL SAFETY CHECKLIST

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In addition to compliance with individual items, the timing of administration and the engagement of team members were recorded for each domain. Engagement was defined as the cessation of all other activities and conversation, with focus on communicating the checklist. Engagement was scored according to the number of the three theatre teams (surgical, nursing and anaesthesia) that were engaged in checklist administration: engagement of at least one team member constituted team engagement. If a team was not present for administration of a checklist domain, this was recorded as non-engagement but any expected absences are qualified in the results.

Data quality—The observer received training during a 2-week setup phase immediately prior to study commencement and completed the compliance assessment tool for four operating lists during this period. Throughout the data collection phase, one operating list per week was attended by a second observer (JH) who independently observed the same cases for assessment of inter-observer reliability. In ten percent of cases, the completed compliance assessment tool was randomly allocated for re-entry to assess data entry accuracy.

Analysis—The primary outcome was the administration rate (per 100 cases) of the three domains (Sign In, Time Out and Sign Out) and the percentage of cases, by domain, in which its individual checklist items (Figure 1) was administered. Any items that were not applicable to a particular case were excluded from the analysis. Secondary outcomes were engagement of team members during domain administration and timing of domain administration. Domain item compliance was calculated as the proportion of completed individual domain items to the total number of items in that domain. Domain item compliance was expressed as a percentage for each case, and the mean (range) across all audited cases.

Results

Forty-six acute cases and 54 elective cases were audited during the study period. The casemix of surgical specialities audited is given in Table 1.

Table 1. Surgical specialty casemix for the 100 study cases

Surgical specialty	Number of cases
Colorectal	8
Gastroenterology	1
General	23
Head Neck and Breast	11
Orthopaedic	13
Upper gastrointestinal (GI)	11
Urology	23
Vascular	10
Total	**100**

Primary outcomes—The rate (per 100 cases) of checklist domain administration was: 99 for Sign In; 94 for Time Out; and two for Sign Out. The mean (range) domain item compliance was 56% (27–100%) for Sign In, 69% (33–100%) for Time Out, and 40% for Sign Out. Compliance with individual domain items is given in Table 2. There was 100% compliance with statement of patient identity and, although not specified by the checklist, this was confirmed by inspection of patient wristband in 98% of cases.

Communication with patients to confirm their identity occurred in 30% of cases. High compliance scores were also achieved for the checklist items pertaining to operative procedure type (99%), verification of patient consent (96%) and statement of patient

allergies (95%). The item pertaining to patient allergies prompted acknowledgement from the anaesthetic team in 23% of these cases; acknowledgment by members of the surgical team did not occur in any of the 17% of cases for which they were present during completion of this item.

The checklist item stating availability of blood products was acknowledged by the anaesthetist in 38% of the cases in which it was completed. In those cases where Time Out was completed, 74% involved some form of team member introductions. Of these: 1% involved full introduction of members by name and role; 72% involved naming of team members only; and 27% involved verbal acknowledgement by the checklist administrator that the team already knew each other.

Table 2. Compliance with administration of items of the Auckland Hospital adaptation of the WHO Safe Surgical Checklist

SIGN IN (n=99)	**Compliance**
Patient's identity stated and agreed	100%
Patient's surgical site stated and agreed	94%
The surgical site marking is checked if applicable	33%
The patient's procedure stated and agreed	99%
Patient's consent stated and verified	96%
Presence or absence of allergy stated	95%
Availability of surgeon verified	23%
Blood availability stated	81%
Question about complex airway problem asked and anaesthetist responds	26%
Question about anaesthetic machine asked and anaesthetist responds	20%
TIME OUT (n=94)	
Introduction of team members	74%
Patient's identity stated and agreed	100%
Patient's surgical site stated and agreed	96%
Patient's procedure stated and agreed	100%
Appropriateness of positioning confirmed	77%
Presence of correct imaging confirmed	16%
Surgeon enumerates or denies any anticipated critical events	90%
Anaesthetist enumerates or denies any anticipated critical events	78%
Nursing staff enumerate or deny any anticipated critical events	3%
SIGN OUT (n=2)	
Name of procedure is stated as recorded	50%
Confirmation that the specimen (if any) is correctly labelled	50%
Surgeon enumerates or denies any key concerns for the recovery and care of the patient	50%
Anaesthetist enumerates or denies any key concerns for the recovery and care of the patient	0%
Nursing staff enumerate or deny any key concerns for the recovery and care of the patient	0%

Secondary outcomes—OR team engagement during Sign In consisted of all three teams (surgical, nursing and anaesthesia) in 3% of cases, two teams in 52% and one team in 45%. Interpretation of these data must take account of the frequent and accepted absence of the surgical team at Sign In. They were present in only in 17% of cases.

Engagement during Time Out consisted of the entire theatre team in 15% of cases, at least one member of all three teams in 38% of cases, two teams in 35% and one team in 12%. In one of the two cases where Sign Out administration was observed, two

teams were engaged and in the other, one team was engaged. Sign In was performed before drug intervention in 79% of cases, and Time Out was performed before skin incision in 90% of cases. Both instances of Sign Out domain completion occurred before the surgical team left the OR.

Data quality—Eighteen cases were assessed by two independent observers to measure inter-observer reliability. This produced 657 assessable data points, of which 96% were concordant. Re-entry of 10% of cases to evaluate data entry quality produced 100% accuracy for the resultant 450 data points.

Discussion

This study, conducted in a major adult surgical operating room suite, found that the prescribed checklist was invariably utilised but often incompletely. There was a high rate of administration of the Sign In and Time Out domains within which the best compliance was with items relating to patient identity, procedure, consent and, where valid, side or site of operation. These are arguably amongst the most important checks present on the list as they target wrong-side, wrong-patient, wrong-procedure errors all of which are capable of causing serious harm and are entirely preventable.[10]

In contrast, Sign Out was rarely performed. This omission appears to be accepted as standard in the ORs included in this study. A potential reason for the poor compliance with this domain is confusion around its proper timing. The correct timing is defined as 'before the surgeons leave the OR' and therefore, unlike the other domains, it is not linked to a specific event in patient management. Furthermore, in our institution the checklist is primarily performed by the nursing team whose members have a number of responsibilities at the end of a surgical procedure, such as completion of final instrument count. This may also interfere with Sign Out administration. The components of the Sign Out, such as concerns for handover of the patient, represent an important part of the theatre dialogue which may not occur when this domain is omitted.

These findings are consistent with a recent study in British hospitals which found that Sign Out was completed less commonly than the other domains.[11] It also found that overall administration of checklist items declined dramatically after the initial observed introduction period. The potential causes of less rigorous checklist administration are multiple. The routine nature of the checklist's use may result in indifference towards it and thus less thorough administration. This may be compounded by the multiple protocols already present in the OR – leading to 'checklist fatigue'. Furthermore, the time-pressured nature of the OR environment may lead to superficial or hurried safety checks.

It must be acknowledged that failure to administer an item during administration of the checklist does not invariably mean that an equivalent safety check was not conducted. For example, communication of the availability of the surgeon prior to induction occurred almost universally during this audit despite poor rates of administration of this item during Sign In (Table 2). However, the role of the checklist is to standardise checks and it should not be replaced by these practices but rather supplement and formalise them.

A key objective of the WHO Surgical Safety Checklist is improvement of team communication, which corresponds to one of the ten objectives of the WHO guidelines for safe surgery.[6] The role of checklists in promoting communication in the OR has been documented.[12] The WHO Surgical Safety Checklist is designed to actively promote such communication; all domains are administered in the OR while the patient is present, and Time Out includes the introduction of all team members by name and role.

The findings of this study relating to team communication and the checklist were interesting. The introduction of team members' names, arguably the most important communication-enabling measure, was appropriately undertaken in many theatres. Nevertheless, communication was often poor around other items. For example, while checklist items involving statement of allergy and blood availability were administered in a high proportion of cases (Table 2), an acknowledgement from the anaesthesia and surgical team was uncommon.

Moreover, despite the emphasis on communication, some items specifically framed as questions rather than statements in order to promote response were often either not administered, not acknowledged, or only grudgingly acknowledged. For example, the least performed items in Sign In were the questions directed at the anaesthesia team regarding the potential for a complex airway and whether anaesthetic machine checks had been completed. The observer noted that, when administered, these items often resulted in abrupt answers or no acknowledgement from the anaesthesia team.

One explanation for this may lie in the possibility that checklists can evoke animosity where health professionals feel their individual clinical judgement is threatened or that use of a checklist implies inadequate memory or skill.[7] Such emotions would be likely in the OR suite audited here. It is served by highly qualified anaesthesia technicians for whom highly detailed anaesthetic machine checks are culturally ingrained, and airway evaluation is similarly embedded in anaesthetic practice. Whatever the cause of antipathy to these questions, repeated unsatisfactory responses would make checklist administrators more inclined to ignore the item leading to the low compliance we measured here.

Engagement of the OR teams, which involved cessation of activity and focus on the checklist, was another indicator of team communication. The failure of team members to pay attention to the checklist has multiple potential consequences. It can result in the failure of communication of important case-specific information and may propagate disregard for the checklist itself, particularly if team leaders are disengaged. Simultaneous engagement of all three teams infrequently occurred for Sign In, primarily due to the usual absence of the surgical team at this time.

Three team engagement at Time Out (when all teams were invariably present) was observed in just over 50% of cases. Failures in this regard were usually due to preoccupation with other tasks on the part of the surgical and anaesthetic teams. This is clearly an area where improvement could be made. Leadership by senior team members is important. In addition, the assertiveness of the checklist administrator strongly influenced team engagement; if the administrator demanded team attention before commencing administering the checklist higher rates of engagement were achieved.

There are several limitations to this study. Allocation of the observer to operating theatres was not randomised as originally intended. This proved impractical because allocation to low throughput theatres would have resulted in failure to finish the study within the period of the observer's availability. High-turnover theatres were given preference and this means that specialties such as neurosurgery which have a predominance of longer cases were not represented in the audit. Additionally, the period of observation was limited to two months and thus results may be affected by seasonal or annual variation.

Although an attempt was made to keep the observation process discreet by using a medical student expected to be in the OR for educational purposes, the presence of an observer in the theatre may have altered performance. It is most likely this would have biased the behaviour of staff toward more thorough application of the checklist. Finally, the effects of discrepancies in administration of the checklist on patient safety were not examined in this study but would be important in confirming the significance of our findings.

In conclusion, since its introduction to Auckland City Hospital the local adaptation of the WHO Surgical Safety Checklist has become almost universally adopted. However, the Sign Out domain is virtually always omitted. Moreover, not all items of the checklist are performed with equal frequency, with checks around patient identity and procedure occurring most often, and checks around complex airway issues and anaesthetic machine preparation occurring least often. Inadequacies have also been identified in the timing of checks and in engagement of team members.

These findings are important as it is plausible that imperfect administration of the checklist will result in a loss of the patient safety benefit previously shown to be accrued from its use. It is recommended that regular references to quality of administration of the checklist be made at in-service education meetings for all OR teams, that the checklist be administered by a senior nurse in the OR, and that senior members of all related departments be urged to recognise the crucial leadership role they play in ensuring high quality practice; without their example, poor practices will inevitably become prevalent.

Competing interests: AFM was the anaesthesia lead in the WHO Safe Surgery Saves Lives initiative, and is Chair of the Board of the Health Quality and Safety Commission.

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Appendix 1. The checklist compliance and quality assessment tool

SIGN IN
Patient's identity stated and agreed – Patient's wristband checked – Communication with patient regarding identity if they are alert
Patient's surgical site stated and agreed
The surgical site marking is checked or site marking is not applicable
The patient's procedure stated and agreed
Patient's consent stated and verified
Presence or absence of allergy stated – Anaesthetist acknowledges presence or absence of allergy – Surgeon acknowledges presence or absence of allergy
Availability of surgeon verified
If a prosthesis or special equipment is required, it has been checked and presence confirmed
Blood availability stated – Anaesthetist responds appropriately to statement about blood availability
Question about complex airway problem asked and anaesthetist responds
Question about anaesthetic machine asked and a member of the anaesthetic team responds
Presence of functioning pulse oximeter verified
Timing – Administered on arrival in OR before any drug intervention – Administered in OR before induction but preceded by drug intervention – Not administered in OR
Engagement – Entire theatre team present and engaged – At least one member of each of the surgical, anaesthetic and nursing teams engaged – Two of the three (surgical, anaesthetic and nursing) teams engaged^ – One of the three (surgical, anaesthetic and nursing) teams engaged
TIME OUT
Introduction: – All team members introduced by name and role – Team members introduced by name only – No introduction – Administrator acknowledges that the team already knows each other
Patient's identity stated and agreed
Patient's wristband checked
Communication with patient regarding identity if they are alert
Patient's surgical site stated and agreed
The surgical site marking is checked or site marking is not applicable
Patient's procedure stated and agreed
Appropriateness of positioning confirmed
Presence of correct imaging confirmed
Confirmation that prophylactic antibiotics have been administered ≤ 60 before incision or that antibiotics are not indicated
Confirmation that post-operative thrombo-prophylaxis has been ordered if appropriate
Anticipated critical events reviewed: – Surgeon enumerates or denies – Anaesthetist enumerates or denies any anticipated critical events – Nursing staff enumerates or denies any anticipated critical events

Timing – Administered prior to knife - to - skin – Administered after to knife - to - skin – Not administered
Engagement – Entire theatre team present and engaged – At least one member of each of the surgical, anaesthetic and nursing teams engaged – Two of the three (surgical, anaesthetic and nursing) teams engaged – One of the three (surgical, anaesthetic and nursing) teams engaged
SIGN OUT
Name of procedure is stated as recorded
Confirmation that the specimen (if any) is correctly labelled
Correct count verified
Key concerns for the recovery and care of the patient reviewed: – Surgeon enumerates or denies (any key concerns) – Anaesthetist enumerates or denies (any key concerns) – Nursing staff enumerates or denies (any key concerns)
Problems with equipment discussed
Timing – Administered at the end of surgery before the surgical team has left the theatre – Administered at end of surgery, but surgeons have left the theatre – Not administered in OR
Engagement – Entire theatre team present and engaged – At least one member of each of the surgical, anaesthetic and nursing teams engaged – Two of the three (surgical, anaesthetic and nursing) teams engaged – One of the three (surgical, anaesthetic and nursing) teams engaged