Preventing Surgical Mishaps
Using Surgical Checklists

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KEYWORDS

• Surgery • Checklist • Complications • Mortality • Morbidity

KEY POINTS

- Surgical checklists decreases complications and saves lives.
- The use of a checklist improves surgical culture.

BACKGROUND: CHECKLISTS STARTED IN THE AERONAUTIC INDUSTRY

In the summer of 1934, the US Army Air Corps circulated a proposal for a new long-range bomber to replace the 2-engined B-10, which was currently in use. Prospective builders were instructed to have multiengined aircraft ready for a competition in October 1935. The candidate aircraft had to be able to fly at least 1640 km (1020 miles) and preferably 3540 km (2200 miles). They had to be able to carry a 900-kg (2000-pound) bomb load and to be able to reach a speed of at least 320 kph (200 mph), although 400 kph (250 mph) was considered desirable.

Working in secrecy, Boeing produced a prototype, the Model 299. When a Seattle newspaperman saw the prototype, he named it a "flying fortress"; the name stuck. The Model 299 had 4 engines, rather than 2 or 3; retractable landing gear; electric trim tabs on its control surfaces; a hydraulically operated constant-speed propeller; and positions on the fuselage for gun turrets. It was a more complicated plane than the B-10 and was the first 4-engined plane ever built.

After a short period of testing the 299 was delivered to Wright Field, Ohio, for testing against a Martin design, an upgraded B-10, and a DC-2 Douglas converted into a bomber, the DB-1. Both were good designs, but were 2-engined aircraft. Boeing's 299 Flying Fortress was in a class by itself. It could carry 5 tons of bombs, depending on the fuel load, which was far more than its 2-engined competitors; the 299 carried its load higher, faster, and nearly twice as far as its competitors.

On October 30, 1935, the Fortress prototype taxied out for takeoff at Wright Field. A crowd gathered to watch. At the controls was the Air Corps' chief test pilot, Major Ployer P. Hill. His copilot was First Lt. Donald L. Putt. Also aboard were an engineer, a mechanic (both were in the rear) and Leslie R. Tower, the Boeing test pilot, who was standing in the cockpit behind the two pilots.

The aircraft roared down the runway and took off. It then climbed steeply-too steeply. It rose to an altitude of about 90 m (300 ft), where it stalled, rolled to the side, crashed back onto the airfield and exploded. Putt and Tower stumbled out of the wreckage dazed and bleeding. The two mechanics went out the back, largely unscathed. Hill was unconscious and trapped in the cockpit. He was evacuated from the wreckage but died the next day. Tower, who had been standing behind the pilots as an observer, blamed himself for the accident. Although he did not seem to be seriously injured, he died not long afterward.

Investigators determined that the Fortress crashed because the elevator and rudder controls

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were locked; the pilot could not lower the nose, so the aircraft quickly stalled. The locking mechanism was controlled from inside the cockpit, but no one remembered to disengage it before takeoff. Tower apparently noticed that the control lock was still engaged as the aircraft moved up to stall, but was unable to get to it in time to prevent a crash. More familiar with the 299 than anyone else, this oversight on his part is why he blamed himself for the disaster. Because the Boeing prototype had crashed, the Corps declared the winner to be the Douglas DB-1, later designated the B-18 Bolo.

Air Corps leaders tried to place an order for 65 of the revolutionary Fortresses, but War Department General Staff, who controlled Air Corps finances, refused. The General Staff advanced the view that, because the Boeing airplane had crashed, it must have been too complex for anyone to handle safely. Acting on the misguided principle that quantity was more important than quality, the Army promptly ordered 133 of the new Bolos.

A group of test pilots thought that the Flying Fortress, although complex, was flyable. They came up with a checklist for pilots to use before take off, while taxiing, during flight, and landing, to ensure that some simple but crucial step, such as unlocking the elevator and rudder controls, had not been forgotten. Through a legal loophole, the Air Corps was eventually able to purchase 13 Flying Fortresses, enough to equip 1 squadron. These planes were designated YB-17s. Using the checklists, Air Corps pilots logged more than 9200 flying hours on their YB-17s without experiencing a serious major accident.

When World War II broke out in Europe in September 1939, the Army Air Corps had barely 24 of the new B-17s. In September 1940, the number was up to only 49 bombers. The United States needed to increase production, but things still moved at a glacial pace. At the time of Japan's attack on Pearl Harbor on December 7, 1941, the Air Corps had fewer than 200 B-17s in the inventory. Not until early 1944 would the US military have enough Fortresses to have a decisive impact on the bombing campaign against Germany. The Army eventually purchased about 13,000 Flying Fortresses. Three-hundred and fifty Bolos were purchased. They proved unsatisfactory in combat and were relegated to coastal patrols and navigational training.

The 1935 crash did produce one notable benefit. Airmen realized that aircraft were becoming too complex to fly safely without standardized procedures. Moreover, these procedures were too numerous and complicated to commit entirely to memory. Checklists were developed that spelled out specific tasks that were to be accomplished by each crew member at various times throughout the flight and also while on the ground. Such a checklist, performed while taxiing out for takeoff, would probably have revealed that the 299's elevator locks were still engaged. Today, such detailed checklists are mandatory for all aircraft.[1]

LESSONS OF THE AERONAUTIC INDUSTRY EXTENDED TO HEALTH CARE: A CHECKLIST AND BLOODSTREAM INFECTIONS

It may seem strange to try to adapt techniques devised to make flying complicated aircraft safe to the practice of medicine, but, in 2001, a physician at Johns Hopkins Hospital, Peter Pronovost, PhD, MD, decided to try to put one together to decrease the rate of complications of one of the tasks that physicians do daily in most hospitals: placement of central lines.

In 2006 it was reported that 36 million patients were admitted to hospitals in the United States, staying for 164 million hospital days. Eleven percent of those hospital days are spent in intensive care units (ICUs), or 9.7 million days; for 54% of the days (9.7 million), central venous catheters remain in place to infuse medicine and fluids.[2] At that time there were 48,600 catheter-related bloodstream infections resulting in deaths estimated from 17,000[2] to 28,000 per year.[3] The median rate of catheter-related bloodstream infections in ICUs ranged from 1.8 to 5.2 per 1000 catheter days.[4]

The intervention used evidence-based procedures recommended by the Communicable Disease Center as having the greatest effect on decreasing the rate of catheter-related bloodstream infection. These procedures were that physicians wash their hands before the catheter placement; full barrier protection is placed on the patient before insertion of the catheter; the physician wears sterile gloves, mask, hat and gown; the skin of the patient is scrubbed with chlorhexidine; the femoral site should be avoided, if possible; and unnecessary catheters should be removed as soon as possible. Dr Pronovost devised a 1-page checklist to ensure that these tasks were performed. Nurses stopped providers in nonemergency situations from proceeding with catheter placement if the steps were not followed.

This checklist was tried out at Johns Hopkins Hospital; results were dramatic: the 10-day infection rate went from 11% to 0%. Pronovost then devised checklists to ensure that nurses observed patients for pain at least once every 4 hours, which reduced the likelihood of patients enduring pain from 41% to 3%. Another checklist ensured

that patients on mechanical ventilators received antacid medication and that the head of the bed was propped up to at least 30°.

The percentage of patients not receiving antacids went from 70% to 4%; the incidence of pneumonia decreased about 25%. Checklists helped with memory recall, established the minimum necessary steps in a process, and established a higher standard of baseline performance.[5,6]

The checklist to reduce catheter-induced infections was introduced in most of the ICUs in Michigan as part of a statewide safety initiative known as the Michigan Health and Hospital Association (MHA) Patient Safety and Quality Keystone Center ICU project. The project also introduced a daily goals sheet to improve clinician-to-clinician communication within the ICU, an intervention to reduce ventilator-assisted pneumonia, and a comprehensive unit-based safety program to improve safety culture. The project involved 67 hospitals, of which 52% were teaching facilities and included 85% of all of the ICU beds in Michigan.[3]

Data were collected from 103 ICUs for 1981 ICU months and 375,757 catheter days. Using the checklists, the overall median rate of catheter-related bloodstream infection decreased from 2.7 (mean 7.7) infections per 1000 catheter days at baseline to 0 (mean 2.3) at 0 to 3 months after implementation of the study intervention, and was sustained at 0 (mean 1.4) during 18 months of follow-up. Teaching and nonteaching hospitals realized similar improvements.[3]

These data were published in the *New England Journal of Medicine*. An editorial in the same issue discussing this article stated that "the story is compelling and the costs and efforts so relatively minor that the five components of the intervention should be widely adopted. We can no longer accept the variations in safety culture, behavior or systems of practice that have plagued medical care for decades. Imagine the effect if all 6000 acute care hospitals in the United States were to show a similar commitment and discipline."[2]

DEVELOPMENT OF THE WORLD HEALTH ORGANIZATION CHECKLIST

In an article published in 2008, Weiser and colleagues,[7] reported that the World Health Organization (WHO) had collected demographic, economic, and health data from the 192 WHO member states. WHO estimated that 232 million major surgical procedures are performed each year. The article concluded that "Worldwide volume of surgery is large. In view of the high death and complication rates of major surgical procedures, surgical safety should now be a substantial global public-health concern. The disproportionate scarcity of surgical access in low-income settings suggests a large unaddressed disease burden worldwide. Public-health efforts and surveillance in surgery should be established."

In January 2007 in Geneva, Switzerland, the first meeting of Safe Surgery Saves Lives convened for a 2-day conference, bringing together surgeons, anesthesiologists, nurses, hospital administrators, and others to improve the safety of surgery worldwide and to obtain better information on the nature of surgical services in different countries and in different health systems.

The group concluded that a surgical checklist should be developed. The checklist should ensure that proper antibiotics were given before incising the skin and that monitored anesthesia was administered. The checklist would emphasize teamwork and be occupied with measures that promote safety. It should include a preoperative briefing to address surgical team issues and also be a team training process. The checklist should facilitate teamwork. Members at the conference in Geneva recognized that different countries and different specialties would have different needs; the checklist should therefore provide latitude for additions and tailoring based on local factors and environment.[7] The checklist that was developed as a product of this conference and working sessions that followed is available at www.safesurgery.org and www.who.int/patientsafety/safesurgery/tools.

The WHO checklist contained 19 items to be noted before and after surgery: that patients confirmed their identity, surgical site, and procedure, and that a consent was signed; if applicable, the surgical site was marked; a pulse oximeter was present and functioning; members of the team were aware if the patient had a drug allergy; airway had been evaluated; and, if blood loss of at least 500 mL was expected, blood and fluids were available.[8] The goal was to create a tool that supported clinical practice without substituting a rigid algorithm for professional judgment. Following the aviation lesson, the checklist was to focus on items that are recognized to either be deadly if missed or, if not deadly, then high risk and known to be recurrently overlooked or missed.[9]

In the WHO checklist, a time-out is performed before skin incision. The patient's name, surgical site, and procedure are reviewed. All team members are identified by name and role; surgical, anesthesia, and nursing staff review the anticipated events and confirm that preoperative antibiotics have been administered. All imaging studies for the correct patient are displayed in the operating room, if necessary. Following surgery, the

nurse reviews the name of the procedure and that needle, sponge, and instrument counts were correct. Any specimen, if necessary, has been labeled. Issues with equipment are addressed.

Between October 2007 and September 2008 8 hospitals in 8 cities (Toronto, Canada; New Delhi, India; Amman, Jordan; Auckland, New Zealand; Manila, Philippines; Ifakara, Tanzania; London, United Kingdom; and Seattle, WA) participated in the WHO's Safe Surgery Saves Lives program. Selection of these cities purposely included places with different economic circumstances and different populations. The checklist was introduced into these hospitals, each of which had a full-time investigator for the project with no other clinical responsibilities. Each hospital identified 1 to 4 operating rooms to serve as study rooms. Patients who were 16 years of age or older and were undergoing noncardiac surgery were consecutively enrolled in the study. After noting the practices at that time in each institution, all were asked to correct policies not consistent with the 19-item WHO safe-surgery checklist and to implement the checklist in the designated rooms. Part of the data was collected by observers in the operating room and part by clinical teams involved in surgical care.

During the baseline period 3733 patients were enrolled; 3955 patients were enrolled after the checklist was implemented. The rate of complications decreased from 11% at baseline to 7% after the checklist was introduced. The total in-hospital rate of death decreased from 1.5% to 0.8%. These decreases were of about 36%. Similar declines in complications were observed in high-income and in low-income sites. It was noted that, "The rates of reduction in rates of death and complications suggest that the checklist program can improve the safety of surgical patients in diverse clinical and economic environments."[8]

There have been some legitimate questions raised about the findings of the 8-hospital WHO study. Martin and colleagues[10] thought that a 30% reduction in death was unlikely to be achieved in the United Kingdom because rates of death in some hospitals in the WHO exceeded the published normal range of 0.4% to 0.8%. McCambridge and colleagues[11] noted that clinical teams were aware that they were being observed and that some of the improved outcomes may have been influenced by alterations in behavior. Sanders and Jameson[12] thought it was possible that antibiotics and pulse oximetry may have accounted for the survival advantage in the sites in cities of low income. In response to these doubts, Haynes and Gwande[13] pointed out that the case mix varied widely among hospitals and that the hospitals had enormous diversity. Rate of postoperative death is unknown for the mix of cases in this international group of hospitals and comparison of these hospitals with those in developed countries is invalid. WHO recommends that the use of an oximeter and antibiotics are minimum standards for safe surgery. Haynes and Gwande[13] found no effect of an observer in the operating rooms.

Many of the findings of the WHO Safe Surgery Saves Lives study were confirmed in a tertiary university hospital in Utrecht, the Netherlands.[14]

EXPERIENCE WITH CHECKLISTS IN THE US VETERANS HEALTH ADMINISTRATION

The US Veterans Health Administration (VHA) is the largest national integrated health care system in the United States, with 153 hospitals of which 130 provide surgical services. In 2006, the VHA implemented a team training program for operating room personnel on a national level that included 2 months of preparation, a 1-day conference, and 1 year of quarterly coaching interviews. It involved briefing and debriefing in the operating room and included checklists as an integral part of the process. Data were collected from 2006, 2007, and 2008, and compared mortality before and after team training and checklists were implemented. Baseline mortality for the 42 facilities that received training in 2007 was their 2006 rate; baseline mortality for the 32 that underwent training in 2008 was their 2007 rate. Thirty-four facilities did not receive training in those 3 years.

After controlling for variables, the 74 trained facilities observed an 18% reduction in mortality. For every quarter of training that the facilities received there was measurable decrease in mortality. The dose-response relationship between the training programs with inclusion of the control of the previous year's statistics supports the conclusion that training caused the reduction in mortality rather than other influences that may have occurred.[15]

DUTCH EXPERIENCE WITH THE SURGICAL PATIENT SAFETY SYSTEM CHECKLIST

In 2010, a Dutch group published results of a study to reduce complications in surgical patients.[16] Starting with the WHO checklist, the group developed the Surgical Patient Safety System (SURPASS) checklist. The pathway was subdivided into admission to the ward, operating room, recovery/ICU, ward, and discharge. This checklist was multidisciplinary: ward doctor, surgeon, anesthesiologist, operating room assistant,

and nurses were responsible for completion of parts of the checklist.[17] The checklist was designed to provide a comprehensive pathway, minimize information loss during transfers from one stage of the pathway, and to promote interdisciplinary communication. The nearly 100 items on the checklist required that 11 forms be completed and documented.[18]

The checklist was used in 6 academic or tertiary teaching hospitals. Five academic or tertiary teaching hospitals were used as controls. Ninety percent of procedures observed in each group of hospitals were procedures that required surgical intervention in less than 24 hours, gastrointestinal procedures, trauma, vascular, renal or amputation surgery, abdominal wall procedures, breast surgery, and endocrine surgery. In a comparison of 3760 patients observed before implementation of the checklist with 3820 patients observed after implementation of the checklist, complications per 100 patients decreased from 27.3 to 16.7. The proportion of patients with 1 or more complications decreased from 15.4% to 10.2%. In-hospital mortality decreased from 1.5% to 0.8%. Outcomes did not change in the control hospitals.[16] Use of the checklist also optimized timing of antibiotic prophylaxis.[19]

The study from the Netherlands documented a positive relationship between checklist compliance and outcomes. Patients with incomplete checklists had more complications than those for whom checklists were completed. It is not clear whether similar benefits would have been realized with fewer items. The WHO study achieved similar reductions in morbidity and mortality with a simpler checklist focused on the operating room alone.[18]

THE CHECKLIST TRIAL IN SOUTH CAROLINA

Following the development of the WHO checklist, 2 members of the Safe Surgery Saves Lives program decided to implement checklists in a trial state in the United States. Atul Gwande, MD, MPH, is a general and endocrine surgeon at the Brigham and Women's Hospital in Boston. He is an associate professor at Harvard Medical School and the Harvard School of Public Health and leads the Safe Surgery Saves Lives program for the WHO. William Berry, MD, is a former cardiac surgeon and chief scientist for Safe Surgery Saves Lives. Dr Berry is a professor in the School of Public Health of Harvard University.

Dr Gwande and Dr Berry chose South Carolina as the first state to implement surgical checklists. South Carolina was chosen because it is a small state: it is 24th in population and 40th in size. The South Carolina Hospital Association (SCHA) has a history of working closely with South Carolina hospitals and had successfully introduced several safety initiatives, including getting patients into a catheterization laboratory within 90 minutes of a myocardial infarction and the formation of rapid response teams. The association between the SCHA and the Harvard School of Public Health was announced on September 18, 2010.

All of the hospitals in South Carolina committed to putting the checklist into routine use in their operating rooms by the end of 2013. Successful implementation and proper use of the checklist is expected to save more than 500 lives per year in South Carolina. The experiences of South Carolina hospitals will serve as a model to improve patient safety and change the face of surgery across the United States. The program is named safesurgery2015 (www.safesurgery2015.org).[20]

There are about 400,000 inpatient operations per year in South Carolina and about 60,000 outpatient surgical procedures. The program started in South Carolina involved 60 of 65 hospitals in the state. The checklist was not introduced to all 60 hospitals at once. The first wave included 23 hospitals and ran from April to November 2011. The second wave ran from November 2011 to April 2012 and the third wave targeted 29 hospitals and ran from April to October 2012. The goal was to decrease the death rate to less than 1%, which would be lower than the death rate in any state. The first year involved more than 1300 people, 140,000 hours of work, and 1600 hours of webinars and telecommunication. People in the program traveled 2400 miles in state and the CEOs of all of the hospitals were involved.[21]

Greenville Hospital System University Medical Center is a research institution nationally known for advanced technology and comprehensive services and staff. It is one of the largest health systems in the southeast and the largest in South Carolina. It is the only academic medical center in the upstate area with 746 beds. Greenville Memorial Hospital is the state's largest acute care hospital.

Christopher Wright, MD, is a cardiovascular surgeon in the Greenville Hospital System and is one of the physician champions in introducing the checklist to South Carolina. I interviewed him in Greenville and again at the SCHA meeting on October 17, 2012. The interviews indicate some of the practical problems in implementing the checklist statewide.

Newkirk: "What is the background of the checklist in South Carolina?"

Wright: "What we decided to do in Safe Surgery 2015 was to see if we could get a safety

checklist based on the WHO checklist in every hospital and every operating room by 2014. Dr Gwandi and Dr Berry introduced the idea about 3 years ago to get people on board. Thereafter we put together a leadership team of Dr Berry and myself. Dr Barry and his team [at the Harvard School of Public Health] did most of the process thinking and gave it to us to run with it. They asked me to go back to my hospital and set up a leadership team. That team took the World Health Organization checklist and used it or modified it, based on the hospital's needs. We also had webinars weekly. Anyone involved could view those webinars and have weekly office calls [to Harvard School of Public Health]. Dr Berry has the results to the surveys that were taken which included, 'Would you want to be operated in this operating room?' Dr Berry has the results to these surveys."

Newkirk: "What is the present situation in introducing the checklist in South Carolina?"

Wright: "We have some work to do on some smaller hospitals that are not on board. The biggest problem is getting people to use it and total commitment from the leadership. We are part of a project now to collect data to make sure the checklist is being used properly. We want to find a tool to measure that the checklist is being used appropriately.

We are using the same checklist in general surgery and cardiac surgery. We are looking to make different checklists, but the basic checklist will still be there.

I think communication within the health care system is crucial. One thing that I have learned is 75% of errors are committed by people, meaning only 25% of error is by the process. Most of the errors committed by people are based on a breakdown of communication. If we have any tool that can help communication among team members it will help and the check list will certainly do that. We don't really call it the checklist anymore we call it the 'surgery briefing and debriefing.' We are actively trying to get the mindset [in this hospital] that this isn't a checklist; this is a tool to make sure that all resources and information are at the point of care and that everyone in the room is communicating with each other. We need to be able to communicate on an equal basis and the checklist will allow is to do that. Each person has a role and by acknowledging that, it gets people communicating and talking. It makes people feel that they can talk and speak up. I have given the staff [in this hospital] the ability to speak out. When you announce who you are and what your role is at the beginning of an operation, you are more likely to speak up if you see a problem because you have already spoken up. What goes hand in hand with this is you have to develop an adjusted culture and what I mean by that is if someone speaks up and they are wrong you need to guide them instead of biting their head off. The checklist helps foster this idea and puts people on an equal basis."

Newkirk: "Have the physicians been amenable to the introduction of the checklist?"

Wright: "For the most part, yes. At least 90% of the doctors here are on board. I think what you really need is a couple of strong physician leaders who really believe in it to lead this project. Done right and done correctly it is well worth the time. Once you use it for a significant amount of time you will begin to change the culture in the room and [eventually] in health care globally. We are excited about it though we know there is a still a lot of work to be done. Not only does it make the one case safer, it is a vehicle for the institution as a whole to go toward quality improvement and communication improvement.

Newkirk: "How much of the WHO checklist did you change or modify?"

Wright: "Not too much. We made a surgeon component, nurse component, and an anesthesiologist component. For example, we do not dictate how every physician in the hospital does it. As long as you hit all the key points of the checklist the process does not matter. The key is that everyone introduces themselves and has the opportunity to speak up. Debriefing occurs at the end.

Newkirk: Tell me about the debriefing.

Wright: "Debriefing occurs at the end of the case. I will say 'does anyone have any concerns about this case?' If there are no concerns at the time the case is over. But if there are concerns we address them. Everything is discussed at the debriefing such as equipment problems or concerns about the patients that need to be documented for the next team taking over. We want our staff to function like a NASCAR pit crew. The checklist is one of those tools that can make

Before Induction of Anesthesia

Nurse and Anesthesia Provider review:
- ❑ Patient identification (name and DOB)
- ❑ Surgical site
- ❑ Surgical Procedure to be performed matches the consent
- ❑ The site has been marked
- ❑ Known allergies
- ❑ The anesthesia safety check has been completed

Anesthesia Provider discusses patient specific information with the team:
- ❑ **Anticipated airway or aspiration risk**
- ❑ **Risk of significant blood loss**
  - Two IVs/central access and fluids planned
  - Type and crossmatch/screen
  - Blood availability
- ❑ **Risk of hypothermia - operation >1h**
  - Warmer in place
- ❑ **Risk of venous thromboembolism**
  - Boots and/or anticoagulants in place

Before Skin Incision

Surgeon, Nurse, and Anesthesia Provider perform the Time Out:
- ❑ Patient's name
- ❑ Surgical procedure to be performed
- ❑ Surgical site
- ❑ Patient Positioning
- ❑ Essential imaging available

- ❑ **Has antibiotic prophylaxis been given within the last 60 minutes?**
  - Plan for redosing discussed

Briefing

- ❑ **Everyone please state your name and role.**

Surgeon discusses:
- ❑ Operative plan and possible difficulties
- ❑ Expected duration of procedure
- ❑ Anticipated blood loss
- ❑ Implants or special equipment needed

Anesthesia Provider discusses:
- ❑ Anesthetic plan
- ❑ Airway or other concerns

Nursing team discusses:
- ❑ Sterility, including indicator results
- ❑ Any equipment issues or other concerns

Surgeon states:
"Does anybody have any concerns? If you see something that concerns you during this case, please speak up."

Before Patient Leaves Room

Nurse reviews with team:
- ❑ Instrument, sponge and needle counts are correct
- ❑ Name of the procedure performed
- ❑ Specimen labeling
  - Read back specimen labeling including patient's name

Debriefing

Surgical Team Discusses:
- ❑ Equipment problems that need to be addressed.
- ❑ Key concerns for patient recovery and management
- ❑ If anything could have been done to make this case safer or more efficient

Fig. 1. South Carolina surgical safety checklist template. (*Adapted from* WHO Surgical Safety Checklist. Available at: http://www.who.int/patientsafety/safesurgery/en. © World Health Organization 2008. All rights reserved.)

BEFORE INDUCTION OF ANESTHESIA

Sign In

Anesthesia Safety Check Completed

Anesthesiologist Reviews (CRNAs may perform on IV Anesthesia cases)

Patient is confirmed as to:

Identity
Procedure
Site
Surgeon
Consent (Obtained & Signed)
Site Marked (if applicable)

Risk of hypothermia (operation >1 hour). If yes, warmer in place.

Does patient have Allergies?

Does patient take beta blockers?

Is surgeon available to begin once Anesthesia has been induced?

Has airway been assessed and special equipment available for anticipated airway issues?

Nursing Team Reviews

SCD's in place
Sterility Confirmed
Is essential imaging displayed?
Implants available?
Other patient concerns

BEFORE SKIN INCISION

Time Out

Everyone stop what they are doing…

Surgeon Reviews

Team members introduce themselves by name and role

To follow cases with same staff – no introductions necessary. Whenever a change in staff occurs, introductions must be repeated.

Surgeon verbally confirms with the surgical team:
- Patient
- Site
- Procedure
- Position
- Risk of > 500 ml blood loss (7ml/kg in children) If yes, adequate intravenous access and fluids planned
- Does patient have allergies?

Anticipated Critical Events

Surgeon Reviews

Brief overall description of procedure and any anticipated difficulties
- Expected duration of procedure
- Single operative field vs. multiple operative fields
- Need for instruments/supplies beyond those normally used for the procedure.

Surgeon confirms with Anesthesia Team

Have antibiotics been given in the last 60 minutes?
Antibiotic redosing plan in place (not applicable <3 hrs)?
Beta Blocker given?
Glucose checked for Diabetics?

Surgeon confirms with Nursing Team

- *Sterility Confirmed?*
- *Is essential imaging displayed?*
- *Implants available?*
- Other patient concerns?

BEFORE SURGEON LEAVES OR

Sign Out

Surgeon verbally confirms with the team.
- Did we do all the procedures on the consent?
- The name of the procedure recorded
- That instrument, sponge and needle counts are correct (or not applicable)
- How the specimen is labeled (including patient name)
- Whether there are any equipment/problems to be addressed
- Neutral zone used? Any exposures?

All members of the surgical team review the key concerns for recovery and management of this patient.

Fig. 2. Surgical safety checklist used in the Greenville hospital system.

us a team that functions and communicates at an efficient level. I have seen how much teamwork can make a difference."

The South Carolina Checklist Template is shown in **Fig. 1**. This template was given to all of the hospitals involved in the introduction of checklists and was modified as needed.

The checklist used in the Greenville Hospital System is shown in **Fig. 2**. In contrast with the WHO checklist, checklists in the United States include items recommended in the Surgical Care

A

UPON ENTERING THE OPERATING ROOM
(RN, ST, CRNA)

- ✓ **Confirm patient identification**
  -Name and date of birth
- ✓ **Do the procedure and consent agree?**
- ✓ **Are the posted equipment needs and outside providers available?**
- ✓ **Confirm the surgical site**
  -What does the consent say?
  -Does the patient agree?
  -Is the site marked?
- ✓ **Does the patient have any known allergies?**
- ✓ **Does the patient have any contact or blood precautions?**
- ✓ **Is a difficult airway anticipated?**
  -Are there alternative plans?
  -Is the appropriate equipment available?
  -Is there an increased risk for aspiration?
- ✓ **Are antibiotics on hand and begun?**
- ✓ **Was a beta blocker given?**
- ✓ **Is DVT prophylaxis indicated?**
- ✓ **Is the room warm enough?**
- ✓ **Anesthesia safety check**
  -Machine
  -Circuit
  -Drugs
  -Devices

B

PRE-OP BRIEFING AND TIME OUT
(ENTIRE TEAM)

- ✓ **Do we all know each other?**
  -Each person introduce yourself at the beginning of day and with relief
  -Record names on white board
- ✓ **Surgeon confirms:**
  -Patient name
  -Procedure
  -Site
  -Position
  -Imaging
  -Operative plan and potential difficulties
  -Expected duration of procedure
  -OP vs. admission
  -Implants or special equipment
  -Fire safety risk
    Alcohol containing preps dried (ChloraPrep)
    Head/neck procedures
    Open source of oxygen
  -Anticipated blood loss
    If over 10%, anesthesia discusses IV access
    Is blood available and on hand
    Beginning Hgb/Hct
- ✓ **Anesthesia providers review:**
  -Allergies
  -Antibiotics
  -Beta blocker
  -DVT prophylaxis
  -Temperature regulation
  -Any post-op concerns
    Airway issues
    Analgesia
    ICU/specialty bed
    Isolation, blood precautions

"Does anyone have any concerns?
If you see something that concerns you during this case, please speak up."

C

END OF CASE DEBRIEFING
(ENTIRE TEAM)

- ✓ **Are the counts correct?**
- ✓ **What is the name of the procedure that was performed?**
  -What is the post-op diagnosis?
  -Is the post-op diagnosis the same as the pre-op diagnosis?
  -Did the wound class change?
- ✓ **Read back specimen labels**
- ✓ **Surgical team discusses:**
  -Any changes to plans for recovery?
  -Are antibiotics to be continued?
  -Should beta blockers be continued?
  -Are there equipment issues to be addressed?
- ✓ **Could anything have been done to make this case safer or more efficient?**

Fig. 3. Palmetto Health surgical safety checklist. DVT, deep venous thrombosis; Hct, hematocrit; Hgb, hemoglobin. (*Adapted from* WHO Surgical Safety Checklist. Available at: http://www.who.int/patientsafety/safesurgery/en. © World Health Organization 2008. All rights reserved.)

Improvement Project (SCIP): antibiotics given within 60 minutes of skin incision, patient warmer in place for operations longer than 1 hour, deep venous thrombosis prophylaxis.

Fig. 3 shows the checklist presently used in the Palmetto Health System, composed of 2 hospitals in Columbia: Palmetto Health Richland and Palmetto Health Baptist. Palmetto Heath Richland is

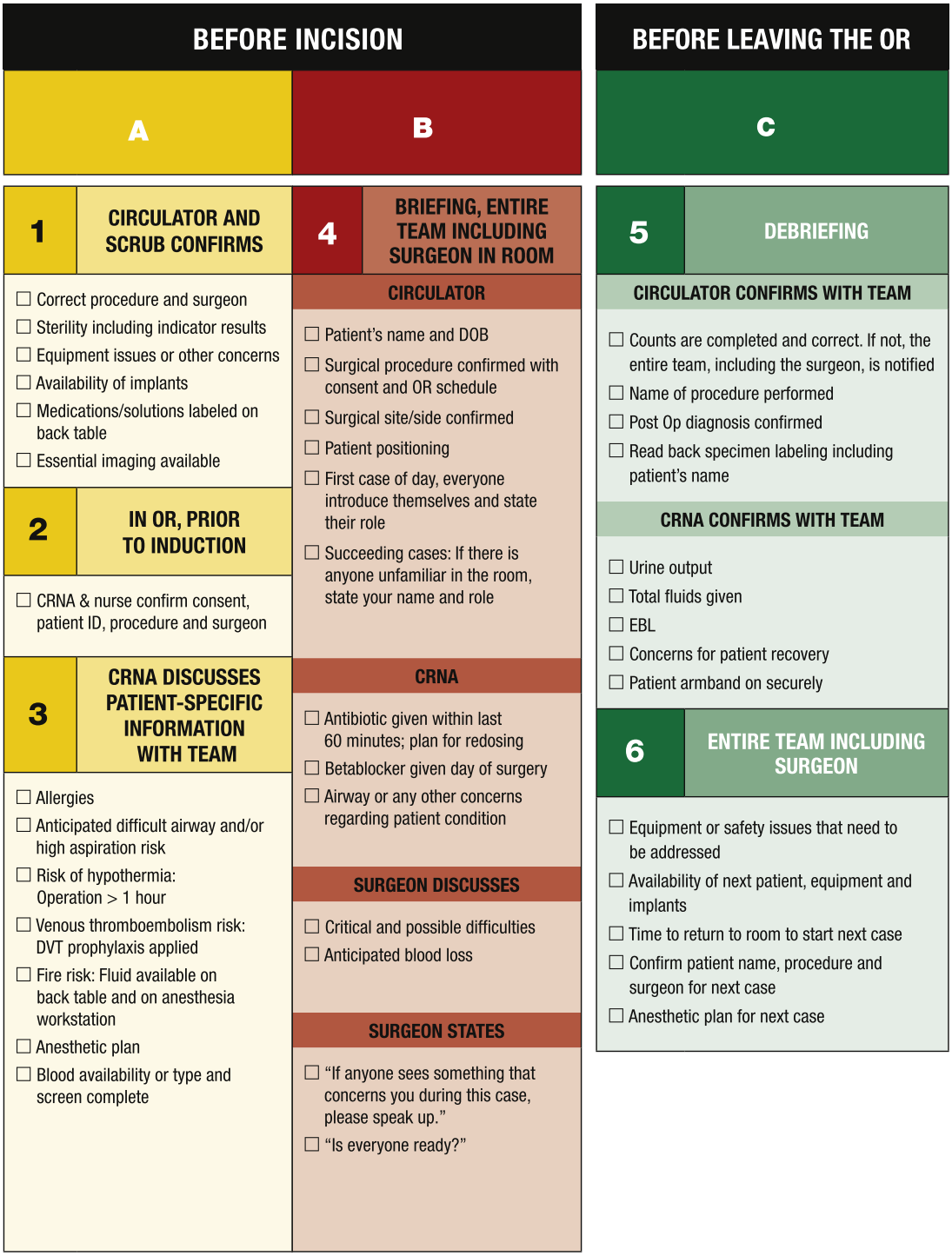

Fig. 4. Lexington Medical Center surgical safety checklist. (*Courtesy of* Lexington Medical Center, Lexington, SC; with permission.)

A

Before Induction of Anesthesia in OR	Before Skin Incision/Procedure	Before Patient Leaves OR
SIGN IN-INITIATED BY CIRCULATOR	**TIME OUT-INITIATED BY SURGEON**	**SIGN OUT-INITIATED BY SURGEON**
VERIFICATION STEPS VERBALIZED OUT LOUD FOR ALL TEAM MEMBERS TO REVIEW:		
ANESTHESIOLOGIST & CIRCULATOR VERIFIES: 1. Patient Identification • *Matching 2 identifiers with name band* • *Engage parents and patient (when applicable)* 2. Procedure & Site/Side • *Engage parents and patient (when applicable)* 3. Site marked by surgeon performing procedure 4. Weight and Allergies **WHEN CLINICALLY INDICATED:** 5. Compression boots used for DVT prophylaxis 6. Warmers in place to prevent hypothermia	**ALL TEAM MEMBERS** 1. Introduce self by name and role **SURGEON VERIFIES:** 1. Patient/Procedure/Site/Side & Position 2. Critical Steps/Anticipated Risks/EBL/Duration 3. Special Equipment/Implants needed 4. Imaging, labs, and other relevant preoperative tests reviewed and available **ANESTHESIOLOGIST VERIFIES:** 1. Antibiotics given within 60 min of incision 2. IV access appropriate for anticipated EBL 3. Blood(or cross- match) available if needed **CIRCULATING/SCRUB NURSE VERIFIES:** 1. Consent matches verbalized procedure 2. Site marking visible in prepped field 3. Special Equipment/Implants available 4. Medications/Solutions labeled on field **STOP!** **ANY QUESTIONS FROM TEAM?**	**SURGEON VERIFIES:** 1. Name of procedure to be recorded **CIRCULATOR/SCRUB VERIFIES:** 1. Final counts (sponge/instrument/needles) 2. Correct labeling of specimens 3. Equipment problems to be addressed **ALL TEAM MEMBERS DISCUSS:** 1. Key concerns for postoperative period 2. Airway concerns during recovery 3. EBL and likelihood of ongoing blood loss 4. Need and timing for post-op labs/imaging 5. Plan for communicating key recovery issues to accepting team (safe hand-off)

B

SIGN IN	PROCEDURAL TIME OUT	WOUND CLOSURE TIME OUT
ANESTHESIOLOGIST & CIRCULATOR VERIFY: • Patient identification • Procedure(s) to be performed • Surgical site marked by surgeon • Weight • Medication allergies **WHEN CLINICALLY INDICATED:** • DVT prophylaxis / Compression boots • Warming devices in place	**TEAM MEMBERS INTRODUCE NAME & ROLE** **SURGEON & CIRCULATOR VERIFY:** • Correct Patient/Procedure/Site/Positioning • Consent matches procedure(s) • Site marking visible in surgical field • Special equipment / Implants available • Equipment settings (e.g. cautery/insufflation) **SURGEON VERIFIES:** • Critical steps of case reviewed with team • Relevant imaging and labs reviewed **ANESTHESIOLOGIST & SURGEON VERIFIES:** • Antibiotic indication / Given within 1hr • Re-dosing plan if duration >4hrs • Blood (or cross-match) available if needed **CIRCULATOR & SCRUB PERSONNEL VERIFY:** • Medications / Solutions labeled on field **STOP!** **ANY CONCERNS WITH PROCEEDING?**	**STOP!** **CLOSING TIME OUT ANNOUNCED** • Wound exploration performed • Counts completed audibly by both members of nursing team viewing counted items • Team acknowledges closing count status • Team initiates SIGN-OUT during or following wound closure **SIGN OUT** **SURGEON VERIFIES:** • Name of procedure to be recorded • Equipment problems to be addressed **ANESTHESIOLOGIST & SURGEON VERIFIES:** • Airway concerns during recovery • EBL and likelihood of ongoing blood loss • Fluids / Blood products administered • Need and timing of post-op labs / Imaging • Disposition and hand-off plans **CIRCULATOR VERIFIES:** • Final count (sponges/instruments/needles) • Disposition/Correct labeling of all specimens

Fig. 5. Children's Hospital Boston pediatric surgical safety checklist. (*Adapted from* WHO Surgical Safety Checklist. Available at: http://www.who.int/patientsafety/safesurgery/en. © World Health Organization 2008. All rights reserved.)

C

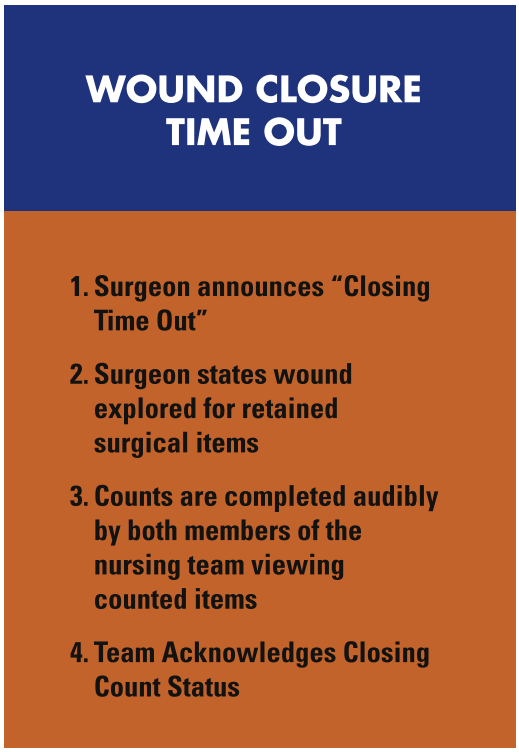

Fig. 5. (*continued*)

the teaching hospital of the University of South Carolina School of Medicine. Composed of 3 pages, most of the checklist items on the first page are reviewed in the preoperative holding area before the patient enters the operating room.

Fig. 4 shows the checklist presently used at Lexington Medical Center (LMC) in Columbia, South Carolina, and includes the SCIP recommendations. LMC is a 414-bed community hospital in West Columbia, South Carolina, with more than 600 affiliated physicians. It offers a complete range of surgical services, including cardiac and neurosurgery. The same checklist is used in all of the operating rooms.

Pediatric patients are usually not able to participate in identifying the site of surgery. As a result, Boston Children's Hospital developed a surgical checklist specific for the pediatric population, which is shown in **Fig. 5**. Norton and Rangl[22] reviewed the introduction of the checklist at Boston Children's Hospital and found that it improved teamwork, communication, and adherences to processes. Checklists were also developed in other areas of the hospital where invasive procedures were performed. This article also includes pediatric procedural and pediatric bedside safety checklists.

Another useful checklist is depicted on the Web site of the Association of Perioperative Registered Nurses (www.aorn.org). This checklist includes color-coded items that indicate their origin: WHO, Joint Commission, universal protocols, and both Joint Commission and WHO.

EXTENSION OF THE SURGICAL CHECKLIST TO OUTPATIENT SURGERY

The Center for Medicare and Medicaid Service (CMS) has indicated that, in 2013, ambulatory surgical centers (ASCs) will be required to go to the CMS Quality Net Web site between July 1 and August 15 and report whether they used a safe-surgery checklist at any time between January 1, 2012, and December 31, 2012, for all patients, not just those covered by Medicare.

ASCs are required to report safe surgery practices during each of the 3 critical perioperative periods. Because CMS is not dictating that ASCs use a particular checklist, ASCs are free to select a checklist (or multiple checklists) that meets their need. Although CMS uses the name safe surgery checklist, the measure applies to all ASC procedures, including those that are generally considered to be diagnostic and pain management procedures (eg, certain endoscopies and injections for controlling pain).[23,24]

I frequently operate at Parkridge Surgery Center (PSC), an ambulatory surgical center that was the first ASC in South Carolina to adopt the checklist. One of the physician champions is Chad Rubin, MD, a general surgeon in Columbia. I spoke to Dr Rubin about the changes between PSCs checklist and the other checklists in use in inpatient facilities. This checklist is shown in **Fig. 6**.

Newkirk: "How was the surgical checklist now used at Parkridge Surgery Center developed?"

Rubin: "Parkridge Surgery Center was the first ASC to adopt a checklist in South Carolina. We took the checklist that we thought was most applicable to outpatient surgery and modified it. It has the key items that are important for us to know. [We do a lot of plastic surgery and ophthalmology at the surgicenter] so we included a part on whether or not we needed implants and are they available. We dropped the portion related to administration of blood.

I think that's what's even more important is that everybody identifies themselves; they tell who they are and what their role is. This often occurs when you are gowning and gloving and takes very little time. The

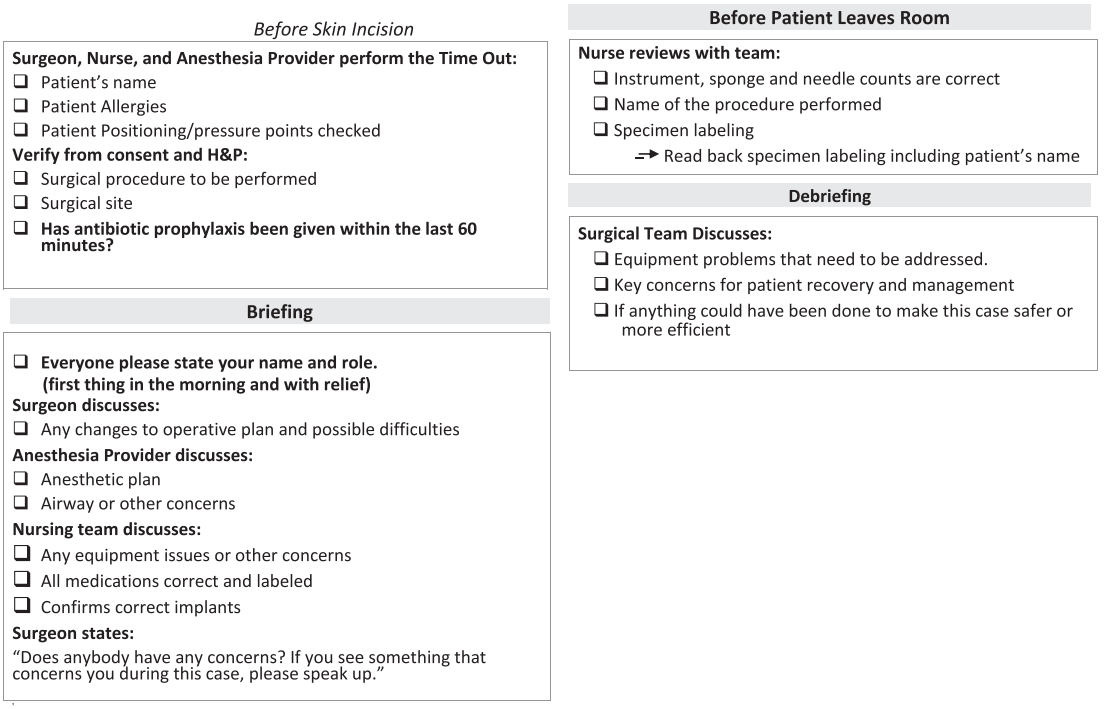

Fig. 6. South Carolina surgical safety checklist template. (*Courtesy of* Palmetto Health, Columbia, SC; with permission.)

anesthetist introduces herself and you ask what are you using as an anesthetic? Do you think we are going to have problems?

Then you go to the circulating nurse, whose role is giving the time out, do we have the right patient? Are we doing the right procedure? Then you bring the techs in: do we have the right equipment? Do we have the right anesthetic on the field? You have everybody involved.

The most important question is you ask is, 'Does anyone have any concerns?' Ninety-nine point nine percent of the time nobody has any concerns, but it changes the atmosphere in the entire operating room, I am absolutely convinced it brings more of a team approach: [As a team member] I'm not afraid to speak up."

Newkirk: "Has the use of the checklist prevented any mishaps?"

Rubin: "I keep going back to this example, but it's an incredible example. We went through the checklist, and this was fairly early on at the outpatient surgery center. I was doing a left inguinal hernia repair. The patient had had previous surgery. The consent said that we are doing a recurrent left inguinal hernia repair, and the tech spoke up and said, 'But Dr Rubin, the scar is on the right.' I said, 'Whoa, let's stop, let's go back and go through the chart.' As it turns out, the patient had had bilateral inguinal hernia repairs and the recurrence was on the left but, amazingly, you couldn't see the scar on the left, but you could see it on the right. That's the kind of culture that you want to have: it was the tech that spoke up, who probably wouldn't have spoken up if we didn't have this kind of atmosphere."

SUMMARY

It is clear that the use of surgical checklists decreases complications and saves lives. After reviewing the literature I have concluded that that the use of a checklist causes a major positive improvement in surgical culture. This improvement will benefit patients and physicians. The American Association for Ambulatory Surgical Facilities, Inc, now mandates that a surgical checklist be used prior to surgical procedures using sedation or general anesthesia.

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