WHO Cares About Safety in the Operating Room

by John H. Dirckx, M.D.

Segnar sette e tagliar uno.
(Measure seven times and cut once.)
—Benvenuto Cellini,
16th-century sculptor,
Autobiography

The pre-flight checklist has been a standard feature of aviation since before any of us were born. No U.S. commercial plane takes off without a minimum flight crew of three, any one of whom is qualified to fly that plane. Before the engines are started, the crew members together run through a formal, detailed, and rigorously complete review of instrument readings (more than 100), confirm that all controls are functioning properly, and make numerous other checks to ensure safety in the air.

In contrast, the great majority of surgical procedures performed around the world today are initiated with no more elaborate advance precautions against errors of omission or commission than a poker game or a stroll in the park.

Checklists as a reinforcement of memory and a defense against human fallibility are nearly universal features of modern life. From enormously complex projects like the construction of a skyscraper or a communications satellite to simple everyday activities such as a trip out of town or even just to the grocery store, common sense and centuries of accumulated experience dictate advance planning and some way of confirming that certain steps or operations are carried out in proper sequence and that essential materials, whether a ton of steel rivets or a quart of milk, are on hand at the appropriate time and place.

Although preliminary checklists for anesthesia and for at least some surgical procedures have been standard practice in some areas for years, it is only since the beginning of the present century that, under the sponsorship of the United Nations World Health Organization (WHO), real progress has been made toward universal implementation of an evidence-based and officially recognized set of safety checks in the operating room.

In the context of modern medicine, performing a surgical operation is often clearly preferable to allowing a disease process to continue causing chronic pain, dysfunction, or disability, or to advance to a lethal stage. According to one study, in 2002 an estimated 164 million disability-adjusted life-years, representing 11% of the entire disease burden, were due to surgically treatable conditions. Some 234 million operations are performed annually around the world, a figure exceeding the number of childbirths.

But the lesser of two evils is still an evil. Virtually all surgery involves injury or damage to healthy tissue, with irreversible changes in anatomy and often permanent impairment of critical functions. In addition, even minor surgical procedures carry a risk of adverse effects, including death, arising from human error or from accidental or unforeseen problems occurring during or after the operation.

Studies in industrialized nations have shown a perioperative death rate associated with inpatient surgery of 0.4 to 0.8% and a major complication rate of 3 to 17%. In this country, perioperative adverse events of all kinds are thought to affect as many as one half of all surgical patients, resulting in excess costs of approximately $25 billion. In a prospective study of colon cancer operations, the mortality rate for elective cases was 3.5% and the complication rate 24%, as compared with 10% mortality and a 38% complication rate in emergency procedures. In the developing world, postoperative complication rates are even higher.

In analyzing these statistics and seeking ways to improve them, it is essential to distinguish between preventable and nonpreventable adverse events. Negative outcomes of surgery can be divided into three classes:

1. A **sequela** is an expected negative result of surgery, a consequence that is inherent in the procedure itself. For example, hysterectomy precludes future childbearing, and hypophysectomy (removal of the pituitary gland) induces panhypopituitarism (lack of all pituitary hormones).

2. **Failure to cure** indicates that the operation performed was in some degree unsuccessful in achieving its purpose. For example, the surgeon may have been unable to excise all malignant tissue without compromising vital structures, or a disease process or previous surgery may have caused scarring or deformity that renders the intended procedure technically impossible.

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3. A surgical **complication** is any deviation from the normal conduct or consequences of a procedure or from the expected postoperative course. This heading includes adverse events occurring during surgery (accidental injury to nerves, blood vessels, or organs adjacent to the operative site, shock or death from excessive blood loss) as well as those following it (wound infection, pulmonary embolism, graft rejection). Efforts to improve surgical outcomes naturally focus on this third category.

The role of human error looms large in the causation of surgical complications. Clearly only crass neglect of elementary precautions can lead to the unspeakable horror of having the wrong leg amputated or of undergoing the removal of one's only remaining kidney. Most errors, like these, are errors of omission, resulting from inadequate planning, lack of foresight, or lapses of memory or attention.

Common sources of trouble are improper practices for identifying patients, inadequate preoperative evaluation, ignorance of important clinical history (such as drug allergies), failure to confirm that required instruments, devices, and blood products are on hand, failure to make essential images available to the surgeon, neglect of protection against venous thromboembolism, failure to administer prophylactic antibiotics on schedule, failure to confirm sterility of equipment, inappropriate labeling of specimens, and omission of sponge, needle, and instrument counts.

In addition to these recurring errors of omission, human factors that contribute to poor surgical outcomes include the ineptitude, inexperience, or poor judgment of any member of the surgical team, inadvertent breaks in sterile technique, and miscommunication.

A brief historical review may clarify some of the numerous risks involved in modern surgery and explain the basis for efforts to minimize them.

The origins of surgery are lost in prehistory, but we can confidently surmise that very early Man used physical measures to stop hemorrhage, close wounds, extract decayed or broken teeth, remove foreign bodies and, eventually, incise abscesses and excise tumors. Just as, in primitive cultures, certain persons assume the role of shamans or healers, in more advanced civilizations a class of surgeons arose, professionals who were skilled in binding wounds, setting fractures, and cutting stones from the bladder.

The word *surgery* is a corruption of Greek *cheirourgia* 'handicraft', 'manipulation'. Homer (8th century BC) referred to the Achaian battle surgeons simply as *iatroi* 'physicians', but by the time of Hippocrates (4th-5th centuries BC) *cheirourgia* referred specifically to mechanical forms of treatment for injuries and certain disorders. The Hippocratic writings indicate that some forms of surgery, particularly orthopedics, had reached a considerable degree of sophistication, and also mention ocular surgery, hernia repair, and even craniotomy.

But during the early Christian era and throughout the Dark Ages, progress in surgery not only ceased but actually reversed. The profession of medicine became increasingly entangled in theories and counter-theories, elaborate classifications of diseases and systems of treatment, while gradually drifting away from hands-on examination and treatment of the sick. Academically trained medieval physicians sometimes rendered diagnoses and prescribed drugs without ever seeing their patients. Cultural and professional taboos discouraged these physicians from undertaking anything resembling operative surgery.

From the days of Hippocrates down to the eighteenth century of our era, medical theory was dominated by a system of physiology, pathology, and therapeutics founded on the conviction (utterly preposterous to our way of thinking) that health depends on a proper balance of four "humors"—blood, phlegm, yellow bile, and black bile (the last of which doesn't even exist). All disease was perceived as a lack of harmony or equilibrium among these humors, generally due to an overabundance of one of them.

With seemingly impeccable logic, then, a principal goal of therapy was to expel the superabundant humor. Among the most-used medicines were emetics to induce vomiting and cathartics to empty the bowels, often supplemented by enemas. Bloodletting was a standard procedure for treating a broad variety of ills, particularly fever. Small amounts of blood might be removed by scarification (making a row of shallow scratches in the skin), cupping (application of a vacuum device to the skin surface, often after scarification), or attachment of several leeches (blood-sucking worms) to the skin. The more usual technique, however, was phlebotomy: incising a superficial vein and allowing blood to flow until the patient lost consciousness.

For many centuries, bleeding and the administration of enemas were relegated to apothecaries (druggists) or to unlearned, often illiterate barber-surgeons, who also performed minor surgery (wound and fracture treatment, dentistry, lancing of boils). Several overwhelming obstacles blocked further progress in surgery.

Early operators were hampered by a profound ignorance of internal anatomy and physiology. Osteology could be learned by studying a skeleton or at least a partial collection of bones. But because dissection of cadavers was forbidden by civil or ecclesiastical authorities, or both, the shape, position, and relation of internal organs were only imperfectly known, often from ancient descriptions based on animal dissections, or from stylized, schematic, and even fanciful drawings.

Circulation, respiration, and metabolism were entirely misunderstood.

The impossibility of inducing adequate anesthesia turned every major procedure into a nightmare of agony. Sublethal doses of intoxicants such as opium, mandragora, and wine could barely take the edge off the pain of an abdominal incision or the amputation of a limb. The surgeon worked deftly and with lightning speed while a team of muscular attendants struggled to immobilize the writhing, screaming patient. Under such circumstances, complex procedures and refinements of technique were out of the question.

Early methods of controlling surgical bleeding were primitive, not to say barbarous. Ligation of severed vessels was known and practiced even in antiquity, but the medieval surgeon generally relied on slapdash bandaging, cautery (application of a red-hot iron), or sealing bleeding surfaces with boiling oil. Not surprisingly, many surgical patients succumbed to exsanguinating hemorrhage.

An equally frequent cause of postoperative morbidity and mortality was infection. Not until the middle of the 19th century was postoperative infection recognized as due to an overgrowth of pathogenic microorganisms introduced into the wound by the surgeon's fingers and unsterile instruments and dressing materials. So frequently did infection occur in open wounds and surgical incisions that suppuration (pus formation) was viewed as a natural, even desirable part of the healing process.

The era of modern surgery began with the discovery of the anesthetic properties of three inhalants (ether, chloroform, and nitrous oxide) and the introduction of surgical asepsis based on an understanding of the nature of infection. These advances, dating back just a century and a half, opened the door to numerous improvements in technique and instrumentation. Other major steps forward gradually followed—x-ray and other imaging methods, blood transfusion and blood banking, prophylactic antibiotics, operating microscopes and laparoscopes with high-intensity lighting and fiberoptics.

But nearly every one of these advances has been accompanied by a downside or negative feature. Ether is dangerously flammable. Inhaled nitrous oxide provides true anesthesia only at a concentration above 80%, which means that the patient is breathing less than the 20% oxygen normally present in the atmosphere, and therefore heading toward asphyxia. More modern inhalant anesthetics, injected muscle relaxants, and other components of anesthetic "cocktails" have their own sets of objectionable properties, including allergenicity and adverse interactions among themselves or with medicines the patient has been taking.

The same can be said of prophylactic antibiotics and other agents administered during the perioperative period. Transfused blood and blood products introduce lethal risks of yet another kind. Donor grafts and implanted synthetic materials (reinforcing mesh, artificial joints, ocular lenses, pacemakers) can elicit inflammatory or allergic responses or frank rejection.

Complex, multi-stage surgical procedures and elaborate armamentaria of instruments and appliances offer numerous opportunities for errors of omission. So, indeed, do many measures intended to avoid negative surgical outcomes, such as the placement of semirigid catheters in the ureters before pelvic surgery to reduce the risk of their being accidentally injured, administration of prophylactic antibiotics before bowel surgery, and application of compressive stockings to reduce the risk of deep vein thrombosis (DVT) and pulmonary embolism.

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An operation of moderate complexity may require the interaction of a surgical team of as many as ten persons. In a typical operating room scenario the key figures, gowned and masked almost or entirely beyond recognition, hover around the patient on the operating table like so many bundles of blue or green laundry. If this team works together day in and day out, identities and roles are clear-cut, and (with due allowance for differing temperaments, personal quirks, and bad hair days) collaboration is smooth and maximally productive. When distinctions of identity are lost, individual functions and areas of responsibility also tend to become blurred.

In a high-volume surgical department with frequent reassignment of ancillary personnel, the team that assembles to perform a given operation may be all but strangers to one other. Although there is seldom any doubt that the chief surgeon is in charge of the proceedings, communication among team members may be poor, with too much taken for granted instead of being clearly spelled out.

With this background, the advantages to be anticipated from going over a formal checklist as a preliminary to a surgical operation should be evident.

1. A checklist program forces both surgeon and colleagues to pause for a moment of reflection before taking irrevocable steps. The review of critical data carried out during this "time out" period may well lead to modification, postponement, or cancelation of the procedure.

2. A checklist serves to jog memories, reducing the risk of errors of omission and combatting the risk that crucial steps will be omitted or that complex tasks will not be carried out in proper sequence.

3. A growing body of evidence links teamwork in the operating room to significantly lower rates of adverse events. Ideally, every member of the team should be known by name

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to every other member, and each one's professional role clearly known to all. Involvement of the entire operating team in the checking process helps to promote a spirit of collaboration, of working together for a common goal.

4. The use of a checklist fosters ongoing communication—not just transmission of orders and directives from above downward but a free exchange of information among all members of the team.

5. When routine becomes ritual, attention lags. A checklist program stimulates alertness and promotes a culture of thoroughness and safety-mindedness.

The use of formal checks to avoid errors in the operating room is not without precedent. If you have ever observed open abdominal surgery on an obese patient, you can readily understand how an instrument as big as an egg-beater (or as small as a needle) can be overlooked even with the most meticulous visual and manual search of the the abdominal cavity by the surgeon before closure. Many decades of bitter experience have shown that, in every thoracic, abdominal, or pelvic operation, a formal count of sponges, needles, and instruments before surgery, and a recount at the end of the procedure but before the incision is closed, must be performed to supplement the surgeon's efforts to ensure that no foreign objects or materials are accidentally left inside the patient. (A surgical "sponge," or "lap sponge," is a disposable absorbent pad of coarse-mesh gauze folded to 8- or 12-ply in sizes varying from 2″ x 2″ to 4″ x 8″ or larger.)

In 1998 Dr. Peter Pronovost, currently medical director of the Johns Hopkins Center for Innovations in Quality Patient Care, began evidence-based research into practical measures to improve healthcare delivery in Intensive Care Units (ICUs) —specifically to reduce the incidence of catheter-related bloodstream infections. Between March 2004 and September 2005, over 100 ICUs implemented specific safety interventions: hand washing, using full-barrier precautions during the insertion of central venous catheters, disinfecting the site with chlorhexidine, avoiding the femoral vein as an injection site if possible, and removing unnecessary catheters. Use of a written checklist was an integral part of this program.

Infection rates were recorded before, during, and up to 18 months after the study period. Rates of infection per 1000 catheter days were measured at three-month intervals. It was found that the median rate of infection decreased from 2.7 per 1,000 catheter-days at baseline to 0 within the first three months after implementation of the intervention. The improvement was sustained, and there was a 66% reduction in the rate of catheter-related bloodstream infections at 16 to 18 months.

But the adoption of similar programs in surgery, requiring formal review of a written list of safety issues before the commencement of any operation, has been blocked or retarded by various technical and personal factors. The principal surgeon seems the logical person to carry out such checks but, like most members of the operating room team, the surgeon is sterilely gloved and ill-suited to make checkmarks on a form. The ungloved, or at least "unsterile," circulator or O.R. technician might seem a fitting alternative but, being at the bottom of the surgical hierarchy, may gain acceptance in this role only with difficulty. Many surgeons perceive checklists as reflections on their competence or assaults on their autonomy. To be perfectly frank, people who are open to regulation, assessment, and sharing responsibility with subordinates seldom become surgeons.

Despite these obstacles, during the past 10 years national and international organizations have adopted evidence-based strategies that have resulted in a decrease of adverse surgical events. In May 2004, WHO approved the creation of a World Alliance for Patient Safety. A major project of this collaboration was the Safe Surgery Saves Lives program, designed to reduce the number of surgical deaths around the world by addressing prominent issues such as inadequate anesthetic safety practices, avoidable surgical infection, and poor communication among surgical team members.

To support the efforts of operative teams to reduce adverse surgical events, WHO identified a set of safety checks that could be performed in any operating room. The purpose of the WHO Surgical Safety Checklist (see box, next page), of which the first draft was published in 2008, is to reinforce accepted safety practices and to foster better communication and teamwork in the operating room. The checklist is not a regulatory device or a component of official policy. It is intended as a tool for use by surgeons, surgical teams, and institutions interested in improving the safety of operations and reducing unnecessary surgical deaths and complications.

The checklist was designed for brevity and ease of use. Its ultimate goal is to help the surgical team consistently follow a few critical safety steps and thereby minimize the most common and avoidable risks endangering the lives and well-being of surgical patients.

Essential to the success of the checklist program is the assignment of one person to read out the items on the list and check the boxes as appropriate. This coordinator can be the circulator, the anesthetist, or any other member of the operating team. Standard procedure is for the coordinator to read each item on the checklist in proper sequence, to check a box only when the item has been properly addressed, and to prevent the team from progressing to the next phase of the operation until the previous step has been satisfactorily completed.

Surgical Safety Checklist

World Health Organization | Patient Safety — A World Alliance for Safer Health Care

Before induction of anaesthesia → Before skin incision → Before patient leaves operating room

Before induction of anaesthesia

(with at least nurse and anaesthetist)

Has the patient confirmed his/her identity, site, procedure, and consent?
- ☐ Yes

Is the site marked?
- ☐ Yes
- ☐ Not applicable

Is the anaesthesia machine and medication check complete?
- ☐ Yes

Is the pulse oximeter on the patient and functioning?
- ☐ Yes

Does the patient have a:

Known allergy?
- ☐ No
- ☐ Yes

Difficult airway or aspiration risk?
- ☐ No
- ☐ Yes, and equipment/assistance available

Risk of >500ml blood loss (7ml/kg in children)?
- ☐ No
- ☐ Yes, and two IVs/central access and fluids planned

Before skin incision

(with nurse, anaesthetist and surgeon)

- ☐ **Confirm all team members have introduced themselves by name and role.**
- ☐ **Confirm the patient's name, procedure, and where the incision will be made.**

Has antibiotic prophylaxis been given within the last 60 minutes?
- ☐ Yes
- ☐ Not applicable

Anticipated Critical Events

To Surgeon:
- ☐ What are the critical or non-routine steps?
- ☐ How long will the case take?
- ☐ What is the anticipated blood loss?

To Anaesthetist:
- ☐ Are there any patient-specific concerns?

To Nursing Team:
- ☐ Has sterility (including indicator results) been confirmed?
- ☐ Are there equipment issues or any concerns?

Is essential imaging displayed?
- ☐ Yes
- ☐ Not applicable

Before patient leaves operating room

(with nurse, anaesthetist and surgeon)

Nurse Verbally Confirms:
- ☐ The name of the procedure
- ☐ Completion of instrument, sponge and needle counts
- ☐ Specimen labelling (read specimen labels aloud, including patient name)
- ☐ Whether there are any equipment problems to be addressed

To Surgeon, Anaesthetist and Nurse:
- ☐ What are the key concerns for recovery and management of this patient?

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged.

Revised 1 / 2009

If a step is skipped for any reason, the box is left unchecked. For some steps, a "Not Applicable" box is provided.

The checklist divides the operation into three phases and prescribes a review procedure for each phase.

1. **Sign In** (before induction of anesthesia; 7 items). The coordinator obtains oral confirmation of identity from the patient, determines the correctness of the proposed procedure and operative site (including marking the site with a felt-tipped skin pen if appropriate), and ensures that informed consent for surgery has been given in writing. The coordinator then reviews with the anesthetist the patient's risk of blood loss, airway difficulty, and allergic reaction and verifies that a full anesthesia safety check (including a formal inspection of the anesthetic equipment, a check of drugs and supplies on hand, and a review of the patient's anesthetic risk) has been completed.

Death from airway loss, a relatively common complication of inhalation anesthesia, can be prevented with appropriate planning. The coordinator confirms that the anesthetist has examined the patient's airway for signs pointing to a difficult intubation and has assessed the risk of vomiting with aspiration due to overactive gag reflex or a full stomach. With a difficult airway or significant aspiration risk, minimal precautions include the availability of emergency resuscitation equipment and the presence of a capable assistant.

The coordinator asks the anesthetist for an estimate of blood loss during the procedure. The risk of hypovolemic shock during surgery escalates with blood loss above 500 mL. If estimated blood loss exceeds that figure, WHO advises placement of at least two large bore intravenous lines or a central venous catheter before skin incision, and confirmation that replacement blood or fluids are available.

WHO strongly recommends the use of pulse oximetry in conjunction with general anesthesia. The checklist coordinator confirms that a pulse oximeter has been placed on the patient and is functioning properly.

2. **Time Out** (after induction of anesthesia but before the first incision; 7 items). Under the direction of the coordinator, team members identify themselves to one another by name and specify their functions during this procedure. They must unanimously agree that they are performing the correct operation on the correct patient at the correct site.

The coordinator verifies that prophylactic antibiotics have been administered within the previous 60 minutes. Approximately 1 million patients suffer from postoperative wound infections each year in the U.S., extending the aver-

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age hospital stay by 1 week and increasing the cost of hospitalization by 20% for an additional $1.5 billion in healthcare costs annually. The administration of prophylactic antibiotics is standard with many procedures, including most operations involving the heart, pharynx, esophagus, bowel, urinary tract, and uterus, and in the management of contaminated wounds. In a study of 2,847 patients, the lowest postoperative infection rate (<1%) was noted when an antibiotic was administered within 60 minutes before surgery, and the risk of infection increased progressively as more time elapsed between administration and surgery.

The coordinator now initiates a dialogue involving the surgeon, anesthetist, and nursing team. A preview of the intended procedure by the principal surgeon alerts all team members to any expected technical difficulties and to steps involving the risk of rapid blood loss or injury. The surgeon predicts the duration of the procedure and confirms or revises the anesthetist's estimate of blood loss.

The anesthetist reports any patient-specific risks arising from severe blood loss, cardiac or pulmonary disease, arrhythmias, coagulation disorders, and other conditions, and describes specific plans to reduce those risks and to carry out resuscitation if necessary.

The scrub nurse or technician verifies that necessary instruments and equipment (including suction, irrigation, and electrocautery devices) are on hand and functioning, and that needed grafts, implants, or other materials are available. Sterility of heat-sterilized equipment is confirmed with the appropriate indicators.

Finally, the support staff confirms that essential images are properly displayed for viewing by the surgeon.

3. **Sign Out** (at the completion of the procedure but before wound closure is completed; 5 items). Together the team reviews the operation that was performed, including unforeseen findings, variations in technique, complications, equipment malfunctions, and errors. The labeling of surgical specimens is confirmed to be correct and complete. Sponge, needle, and instrument counts are repeated. In case of a discrepancy, the team searches the wound as well as drapes and waste containers until the count is correct. X-rays may need to be taken to rule out the retention of an instrument or sponge at the surgical site.

Before the patient leaves the operating room, plans and expectations for postoperative management are discussed by the surgeon, anesthetist, and nursing personnel, with particular attention to specific risks or problems.

Because the draft checklist was intentionally made short and simple rather than comprehensive, many users have added further safety checks. WHO endorses modification of the checklist to fit particular procedures, teams, or operative settings, but advises against omission of steps simply because they cannot be accomplished in an existing environment or circumstances. Rather, the list should promote changes that will enable the operative team to comply with each item.

Supplementary checks that may be added involve prophylaxis against deep vein thrombosis (DVT) and hypothermia. DVT with resulting pulmonary embolism is the leading cause of preventable hospital deaths. All patients undergoing surgery should be screened for DVT risk before admission. Mechanical prophylaxis (anti-embolism stockings) is routinely provided for high-risk patients and for all those undergoing surgical procedures lasting longer than 30 minutes. Pharmaceutical prophylaxis (injected heparin) is also appropriate for some patients. Both of these measures should be initiated before the patient leaves the operating room, and the appropriate check can easily be added to the checklist.

Environmental temperature settings in operating rooms are geared to the comfort of the operating team (capped, masked, and swathed in sterile surgical garb) rather than to that of the patient, who is practically nude but oblivious of body temperature. By the end of a long procedure the patient's core temperature may fall as low as 96°F. Current research indicates that a body temperature lower than 96.8°F or higher than 100.5°F increases the risk of postoperative surgical site infection, the need for blood products, and cardiac irritability. Monitoring the patient's temperature, providing blankets with or without heating elements, and using warmed parenteral fluids can help avoid surgical hypothermia. A check on these measures may be included in the checklist.

Since late in the 20th century the concept of evidence-based practice has dominated medical thinking. Current theories of pathophysiology and treatment protocols are based on rigorous statistical analysis of hard observational and experimental data rather than on tradition, anecdote, or "conventional wisdom." One by one, many venerable canons of belief and therapeutic rituals have fallen by the wayside as controlled trials have shown them to be without foundation.

What proof exists that the use of a safety checklist in the operating room offers any benefits in lives saved or complications averted?

Atul Gawande, MD, a surgeon at Brigham and Women's Hospital in Boston and an associate professor in the Department of Health Policy and Management at the Harvard School of Public Health, led the team that drafted the WHO Surgical Safety Checklist. Even before the checklist was published, Gawande and colleagues initiated a research program to assess its effectiveness.

Between October 2007 and September 2008 they gathered data at eight hospitals in eight cities: Toronto, Canada; New Delhi, India; Amman, Jordan; Auckland, New Zealand; Manila, Philippines; Ifakara, Tanzania; London, England; and Seattle, Washington. Before implementation of the checklist, the researchers recorded information on clinical processes and outcomes from 3733 consecutively enrolled patients 16 years of age or older who were undergoing noncardiac surgery. They then recorded parallel data on another 3955 consecutively enrolled patients after the introduction of the Surgical Safety Checklist.

The study focused on six checklist items, all involving basic safety issues. Although individual steps were often found to be omitted, overall adherence to the core group of six safety indicators increased by two thirds, from 34% to 57%. Adoption of the checklist involved changes in systems and routines as well as changes in individual and group behavior. For example, at some study hospitals the responsibility for administering prophylactic antibiotics was transferred from the nursing staff in the surgical wards to the anesthetist. For most of the hospitals, oral confirmation of patient identity and marking of the operative site represented new departures. However, incorporation of the checklist into operating room practice was not observed to cause delays, disrupt routines, or generate antagonism or dissatisfaction.

The primary end point of the study was the rate of complications, including death, during hospitalization within the first 30 days after surgery. The rate of death was 1.5% before the checklist was introduced and declined to 0.8% afterward, a reduction of 47%. Major postoperative complications occurred in 11.0% of patients at baseline and in 7.0% after introduction of the checklist, a reduction of 36%.

Rates of surgical-site infection and unplanned reoperation also declined significantly. Although benefits of the checklist were more marked at some geographic sites than at others, no single site was responsible for the overall effect, nor was the effect confined to high-income or low-income sites. In a survey of more than 250 surgical staff members who participated in the study, 78% reported witnessing the prevention of an operating room error because of the checklist.

An important limitation of the study is that information on complications was recorded only during patients' hospital stays. That means that data collection for patients undergoing outpatient procedures ceased within a few hours after surgery. In addition, some of the improvement in performance and outcomes can probably be attributed to the so-called Hawthorne effect, a temporary improvement in workers' motivation, performance, and productivity when they know they are being observed or assessed.

Despite some reservations about the study outcomes, medical and surgical authorities around the world have generally expressed enthusiastic acceptance of the WHO Surgical Safety Checklist, or at least of the basic concepts underlying it. Ireland, Jordan, and the Philippines have already established nationwide programs to implement the checklist in all operating rooms.

"Surgical complications are a considerable cause of death and disability around the world. They are devastating to patients, costly to healthcare systems, and often preventable, though their prevention typically requires a change in systems and individual behavior. . . ." —Atul Gawande

As of February 1 of this year, all hospitals in England and Wales are required by the National Patient Safety Agency to use the checklist. To date only about 10% of U.S. hospitals have adopted versions of the WHO checklist, but 5 states (New York, Washington, North Carolina, South Carolina, and Indiana) now have quasi-legal requirements for preoperative checking.

In conclusion, it seems fitting to quote the final words of the article in which Gawande and colleagues reported their findings (Alex B. Haynes, et al., "A surgical safety checklist to reduce morbidity and mortality in a global population," *The New England Journal of Medicine*, 2009;360(5):491-499):

"Surgical complications are a considerable cause of death and disability around the world. They are devastating to patients, costly to healthcare systems, and often preventable, though their prevention typically requires a change in systems and individual behavior. In this study, a checklist-based program was associated with a significant decline in the rate of complications and death from surgery in a diverse group of institutions around the world. Applied on a global basis, this checklist program has the potential to prevent large numbers of deaths and disabling complications, although further study is needed to determine the precise mechanism and durability of the effect in specific settings."

For a much fuller discussion of this topic, see Atul Gawande, *The Checklist Manifesto: How to Get Things Right*. New York: Metropolitan Books-Henry Holt & Co., 2009. ISBN-13: 978-0-8050-9174-8. 193 pp., $24.50.

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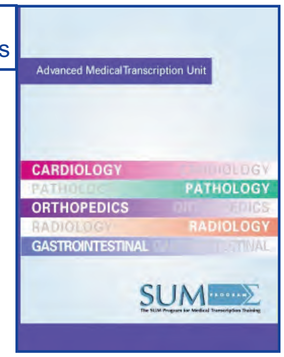

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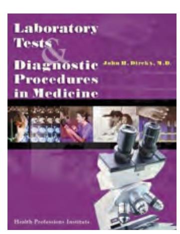
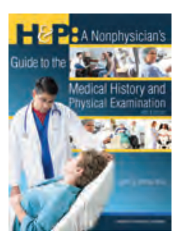
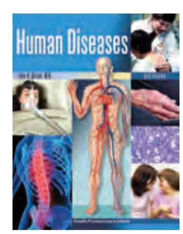
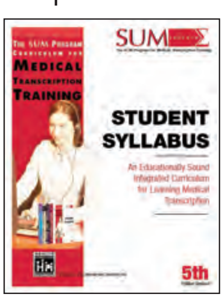






Help for Teachers

Help for Students



The SUM Program Teacher's Manual and the accompanying articles are over 200 pages of information on course offerings and curriculum planning. **Download it for free** at **www.SUMprogram.com**. Numerous articles are grouped into the following sections:

- Curriculum and Program Design
- Teaching Methodologies
- Evaluation and Grading
- Organization Tips
- Educationalese and Marketing
- Professional Growth

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