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An Exploration of the Evidence on Preventing Wrong-Site Surgery

Paige Frarey
The College at Brockport, frareyp@gmail.com

An Exploration of the Evidence on Preventing Wrong-Site Surgery

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By
Paige L. Frarey
Nursing Major

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Thesis Director: Dr. Paula Barbel, PhD, PNP, Assistant Professor, Nursing

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Abstract

Preventable medical errors are now the Centers for Disease Control and Prevention's (CDC) third leading cause of death, which equates to 9.5% of all deaths in the United States, or nearly 700 deaths per day. One of these preventable medical errors is wrong-site surgery. Wrong-site surgery (WSS) is defined as "any surgical procedure performed on the wrong patient, wrong body part, wrong side of the body, or at the wrong level of the correctly identified anatomic site" (The American College of Obstetricians and Gynecologists, 2010, p. 786). The purpose of this project is to examine what measures have been implemented to prevent these errors from occurring and to examine what can be done to prevent these serious errors. This project is pertinent because errors in healthcare delivery pose a direct threat to patient safety and healthcare professionals need to fully understand standardized protocols, error causation, and be knowledgeable of ways to prevent these unsafe events. This project is a literature review on medical error studies and case studies of wrong-site surgeries. Several medical databases were used to search for peer-reviewed articles. Using root-cause analysis, the top causes of WSS were found to be communication failures, procedural compliance issues, and complications in leadership. Studies have demonstrated that "safety net" implementations have led to improved outcomes, as well as switching the focus to systems accountability rather than personal accountability when mistakes are made. Systems accountability, or just culture, is when events can be reported and errors can be examined, so conclusions can be reached and actions taken to be collectively understood. Medical errors can be prevented by following the universal protocol established for surgical procedures and by healthcare systems establishing a non-punitive environment in order to create a safety culture.

Introduction

The healthcare industry is an essential part of our everyday lives. Health care is generally seen as effective; however, this is not always the case, particularly when medical mistakes and errors occur. The Institute of Medicine defines a medical error as "the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim" (Kohn, Corrigan, & Donaldson, 2000, p. 1). This study reported that at least 44,000 people, and possibly as many as 98,000 people, die in hospitals each year as a result of medical errors that could have been prevented, according to estimates from two major studies (Kohn, Corrigan, & Donaldson, 2000). This study was published in 1999 and in 2017, researchers at John Hopkins University are estimating that more than 250,000 deaths per year are due to medical error in the United States (Daniel, 2016). That figure has surpassed the Centers for Disease Control's third leading cause of death (Daniel, 2016).

Background

Research on deaths caused by medical errors has been challenging to conduct. Since 1949, the United States has been using the International Classification of Diseases (ICD) billing codes to classify and count causes of death (Daniel & Mackary, 2016). Medical errors were not originally included in the ICD classification system, so it has been under-recognized as a cause of death, meaning researcher's estimates about the fatal impact of medical errors may be lower than reported (Daniel & Mackary, 2016). The current calculated figure for medical errors translates to 9.5% of all deaths each year in the United States and equates to nearly 700 deaths a day (Daniel & Mackary, 2016). One major medical error noted in "To Err is Human," is wrong-site surgery. Wrong-site surgery is defined as "any surgical procedure performed on the wrong patient, wrong body part, wrong side of the body, or at the wrong level of the correctly identified

anatomic site" (The American College of Obstetricians and Gynecologists, 2010). This definition also includes "any invasive procedure that exposes patients to more than minimal risk, including procedures performed in settings other than the OR (operating room), such as a special procedures unit, an endoscopy unit, and an interventional radiology suite" (Mulloy & Hughes, 2008, p. 381). The Joint Commission on Accreditation of Health Care Organizations (JCAHO) also defines wrong-site surgery as a sentinel event, or "an unexpected occurrence involving death or serious physical or psychological injuries, or the risk thereof" (Mulloy & Hughes, 2008, p. 381). The Joint Commission Center for Transforming Healthcare's website states that there are approximately 40-60 wrong site surgeries per week in the United States (The Joint Commission Center for Transforming Healthcare, 2018). The American Medical Association published an article in 2013 which discussed a review of medical liability settlements between 1990 and 2010. They found that there were 2,447 cases in which the wrong procedure was performed, 2,413 cases in which the wrong surgical site was involved, and 27 cases involving the wrong patient (Mehtsun, Ibrahim, Diener-West, Pronovost, Makary, 2013). These numbers include the average payout amounts, so these cases were reported due to medical liability settlements and judgments (Mehtsun, Ibrahim, Diener-West, Pronovost, Makary, 2013). In order to prevent wrong-site surgery, healthcare professionals should fully understand standardized protocols, error causation, and be knowledgeable of ways to prevent these unsafe events.

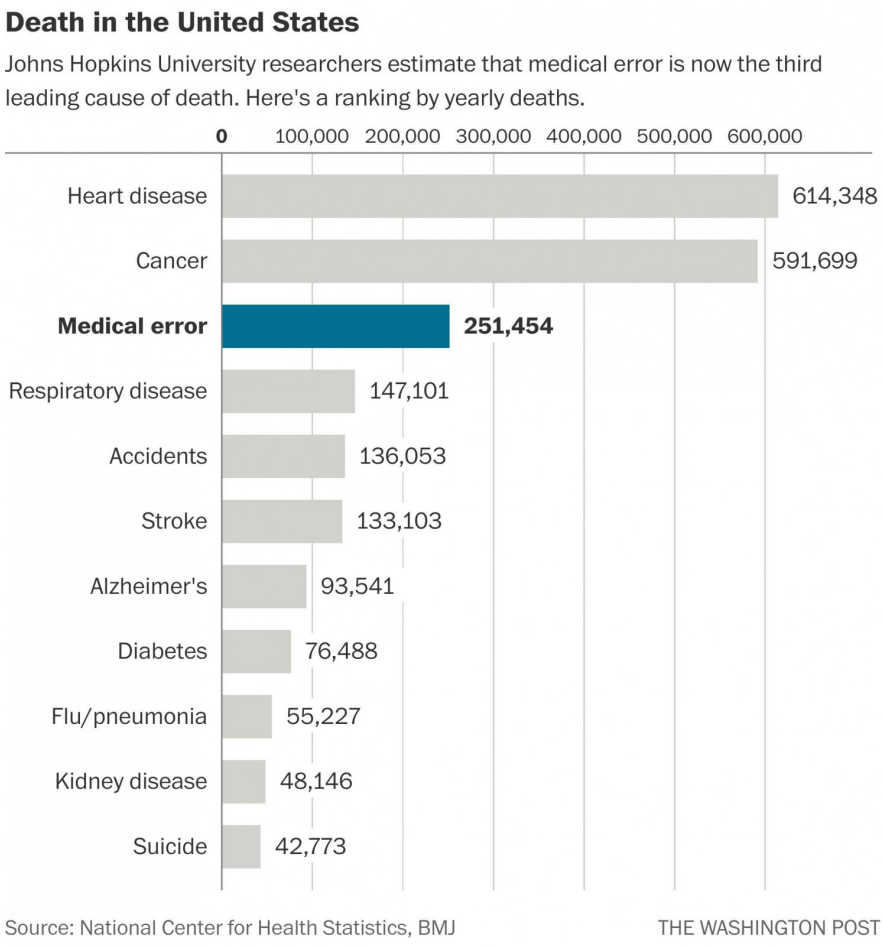


Figure A: Graphic depicting medical error as the third leading cause of death in the United States.

Purpose

The purpose of this literature review is to examine what measures have been implemented to prevent wrong-site surgery errors from occurring and to examine what can be done to prevent these serious errors.

Methods

A search of the databases CINAHL and Medline was conducted using the search terms "wrong site surgery," "wrong site surgery AND causes," "wrong site surgery AND prevention," "surgical checklist," and "punitive approach AND healthcare." Search parameters included peer

reviewed articles and articles published between 1999-2018. Exclusion criteria included articles that were not in the English language, articles that required payment to view, was an abstract only, was a duplicate, lacked sufficient detail, and no results were reported.

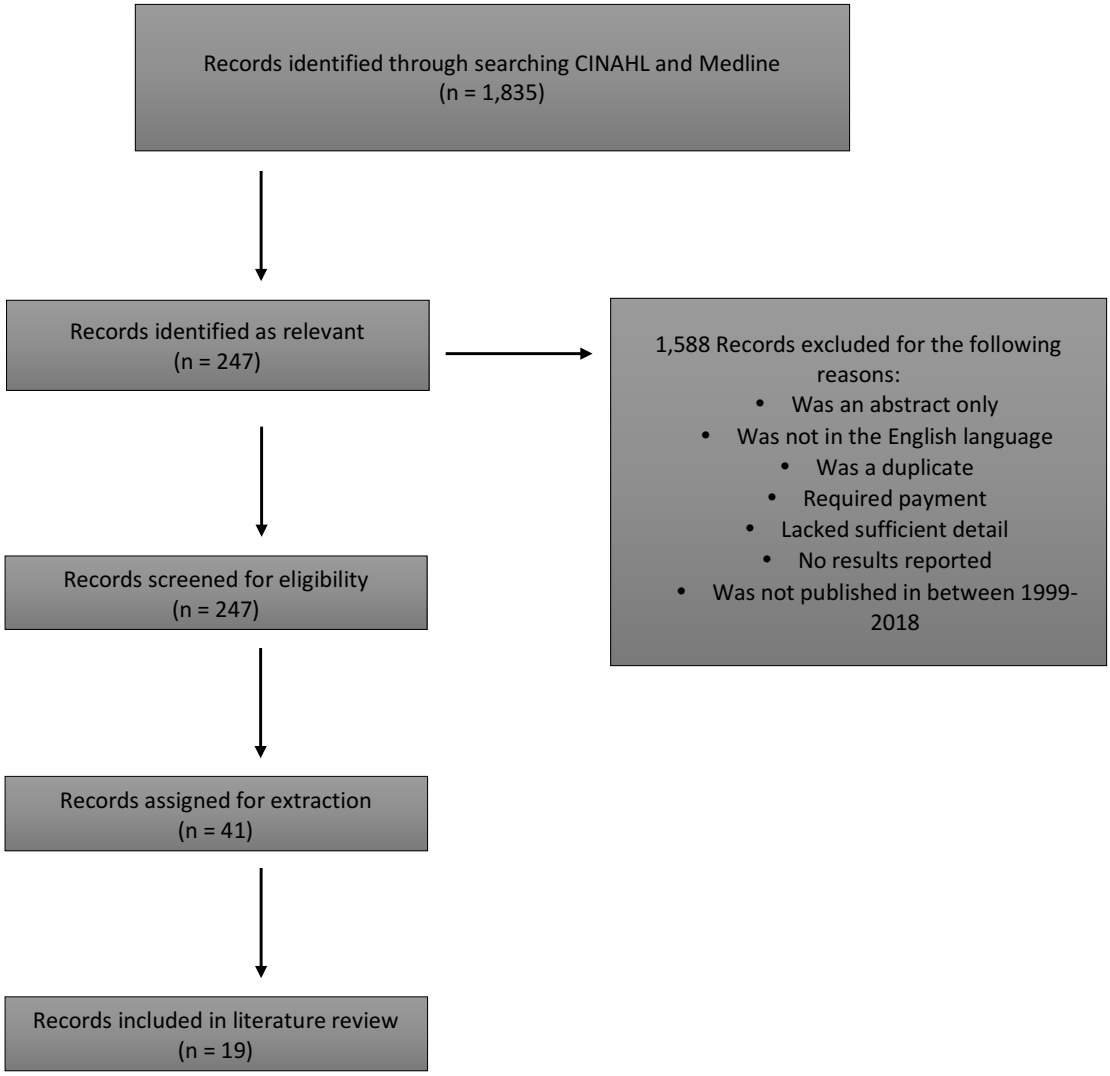


Figure B: Methods flowchart.

Results

Why Errors Occur

There have been numerous studies investigating why WSS happen. Studies have investigated the various causes of solutions to WSS. Using root-cause analysis, one study found that the top causes of WSS were communication failure (70%), procedural noncompliance (64%), and leadership (46%) (Mulloy & Hughes, 2008). This study also discusses how the causes of WSS can be broken down into categories of system factors and process factors. A system factor is also termed "latent error," which is the result of an organizational system or design failure that will allow active errors to happen and cause harm (Collins, Newhouse, Porter, & Talsma, 2014). Some examples of system factors are: 1) lack of institutional controls/formal system to verify the correct site of surgery, 2) lack of a checklist, 3) unusual time pressures, 4) team competency and credentialing, 5) organizational culture, 6) orientation and training, 7) staffing, and 8) environmental safety/security (Mulloy & Hughes, 2008). A process factor or "active error" is defined as an error that is the result of an individual's failure and occur at the point of contact between a human and an aspect of a larger system (Collins, Newhouse, Porter, & Talsma, 2014). Some examples of process factors: inadequate patient assessment, inadequate care planning, inadequate medical record review, miscommunication among members of the surgical team and the patient, failure to include the patient and family when identifying the correct site, failure to mark or clearly mark the correct operation site, incomplete or inaccurate communication among members of the surgical team, failure to recheck patient information before starting the operation, among others (Mulloy & Hughes, 2008).

Another example of error analysis is Reason's Swiss Cheese Model of Errors. Reason reported that "in a complex system such as health care, human error is likely to occur and that

expecting perfection from imperfect human beings or punishing them for their mistakes will not improve safety" (Collins, Newhouse, Porter, & Talsma, 2014, p. 68). The Swiss Cheese Model demonstrates error prevention or an error causing harm through the application of multiple steps that function as a safety net (Collins, Newhouse, Porter, & Talsma, 2014). In the OR, these multiple steps would be the surgical safety checklist, the surgical team, and policy and procedures. Reason notes, "each defensive layer can be viewed as a slice of Swiss cheese. Holes are present in several defense layers, and, unintentionally, the holes can line up, allowing an error to occur" (Collins, Newhouse, Porter, & Talsma, 2014, p. 68). This model focuses on not personal accountability, but rather systems accountability when mistakes are made. The model demonstrates a broader viewpoint for determining how to prevent the error from recurring. (Collins, Newhouse, Porter, & Talsma, 2014). Another major factor of Reason's model is that just culture is essential and must be established within the organization to create and sustain a safety culture (Collins, Newhouse, Porter, & Talsma, 2014). He also concluded that "the human condition cannot be altered; however, the environment in which the human functions can be controlled to reduce variability" (Collins, Newhouse, Porter, & Talsma, 2014, p. 69).

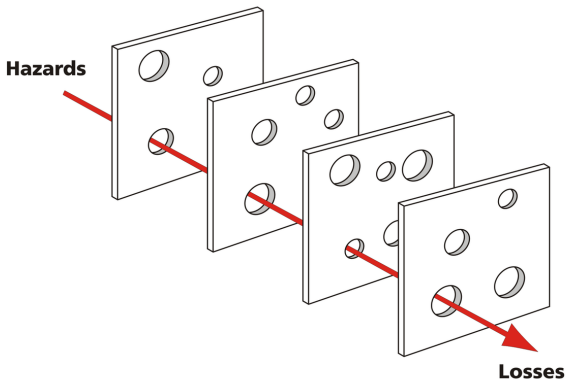


Figure C: Graphic depicting Reason's Swiss Cheese Model of Errors.

A study of 417 facilities was performed by Clarke to identify the barriers to implementation and strategies for successful implementation of the 21 Pennsylvania Patient Safety Authority recommendations for preventing WSS. The survey found that the top reason was physician behavior-surgeon intimidation, resistance, non-compliance, lack of accountability, acceptance, commitment, engagement, cooperation from surgeon officers, lack of perceived value, surgeons unavailable, and surgeons overriding protocols (Clark, 2012). Other top reasons were difficulty with accurate pre-op information, time pressures, education of personnel, inability to see site markings, general communication problems, and the need to change culture (Clark, 2012). Another study examining the barriers to implementation of a checklist conducted by Papaconstantinou et al., found barriers to be: redundancy of items in existing checklists, poor communication between surgical team members, negative perception of efficiency, time spent completing the checklist, and a lack of understanding and commitment to the process (Papaconstantinou, ChanHee, Reznik, Smythe, & Wehbe-Janek, 2013).

In human factor analysis, two approaches have been used. One approach, critical incident analysis, examines a significant occurrence to understand where the system broke down, why the incident occurred, and the circumstances surrounding the incident (Kohn, Corrigan, & Donaldson, 2000). This type of analysis helps to provide an understanding of the conditions that produced an actual error, the risk of an error and contributing factors (Kohn, Corrigan, & Donaldson, 2000). One study regarding anesthesia using critical incident analysis, found that human error was involved in 82% of preventable incidents (Kohn, Corrigan, & Donaldson, 2000). Another analytic approach is called naturalistic decision making. This approach examines the way people make decisions in their natural work settings (Kohn, Corrigan, & Donaldson, 2000). The analysis can help to uncover the factors weighed in making the decisions

when faced with ambiguous information under time pressure (Kohn, Corrigan, & Donaldson, 2000). Through a process of reporting, investigation, innovation, and dissemination, the analysis process can result in a shift in the industry baseline performance. This study concluded that reporting or identifying errors can aid people in discovering where errors are occurring and where improvements can be made (Kohn, Corrigan, & Donaldson, 2000).

Current Error Prevention Practices

It is hard to determine the prevalence of wrong-site surgeries because reporting of sentinel events to the Joint Commission is voluntary. Mulloy and Hughes note that researchers have confirmed that the Joint Commission's numbers are low and found wide variations in the number of WSSs: 1 out of 27, 686 cases, or 1 out of every 112,994 surgeries, or 1 in 5 hand surgeons during their career, or 1 out of 4 orthopedic surgeons with 25 years' experience" (Mulloy & Hughes, 2008). Even though the prevalence is difficult to determine, these devastating medical errors can be prevented with standardization across perioperative settings. The Joint Commission also released their number of reported sentinel events to demonstrate the increase over time. In 1998, there were 15 reported cases compared to June 30th, 2007, when there were 592 reported cases (Mulloy & Hughes, 2008).

One of the first attempts to address wrong site surgery was in 2003. The Joint Commission held a summit in order to address the dramatic increase in wrong site surgeries (WSS). One of the major outcomes from JCAHO's summit was a new protocol called "The Universal Protocol for Preventing Wrong Site, Wrong Procedure, and Wrong Person Surgery." This protocol would be used in settings for any invasive procedure is performed. The Universal Protocol was developed based on prevention theories that direct safe practices in other high-risk industries, including aviation and nuclear weapon development (Mulloy & Hughes,

2008). The three elements for the WSS protocol include a preoperative verification process, marking the operative site, and taking a time out. These three elements are now required as part of the accreditation process for health care organizations by the Joint Commission (Mulloy & Hughes, 2008). In 2009, the World Health Organization (WHO) published the Surgical Safety Checklist as part of the "Safe Surgery Saves Lives Campaign" (Pugel, Simianu, Flum, & Dellinger, 2015). The checklist was adapted from the field of aviation. The purpose of the checklist was to help OR teams remember important details and to serve as a tool to encourage teamwork and communication. The WHO encourages hospitals to customize the checklist to their needs, but the general format should remain the same. Studies have validated the efficacy and benefits various checklists, but the mechanism by which this occurs is unclear (Pugel, Simianu, Flum, & Dellinger, 2015).

The first step to be implemented in the Universal Protocol is the preoperative verification process. The purpose of this is (Mulloy & Hughes, 2008):

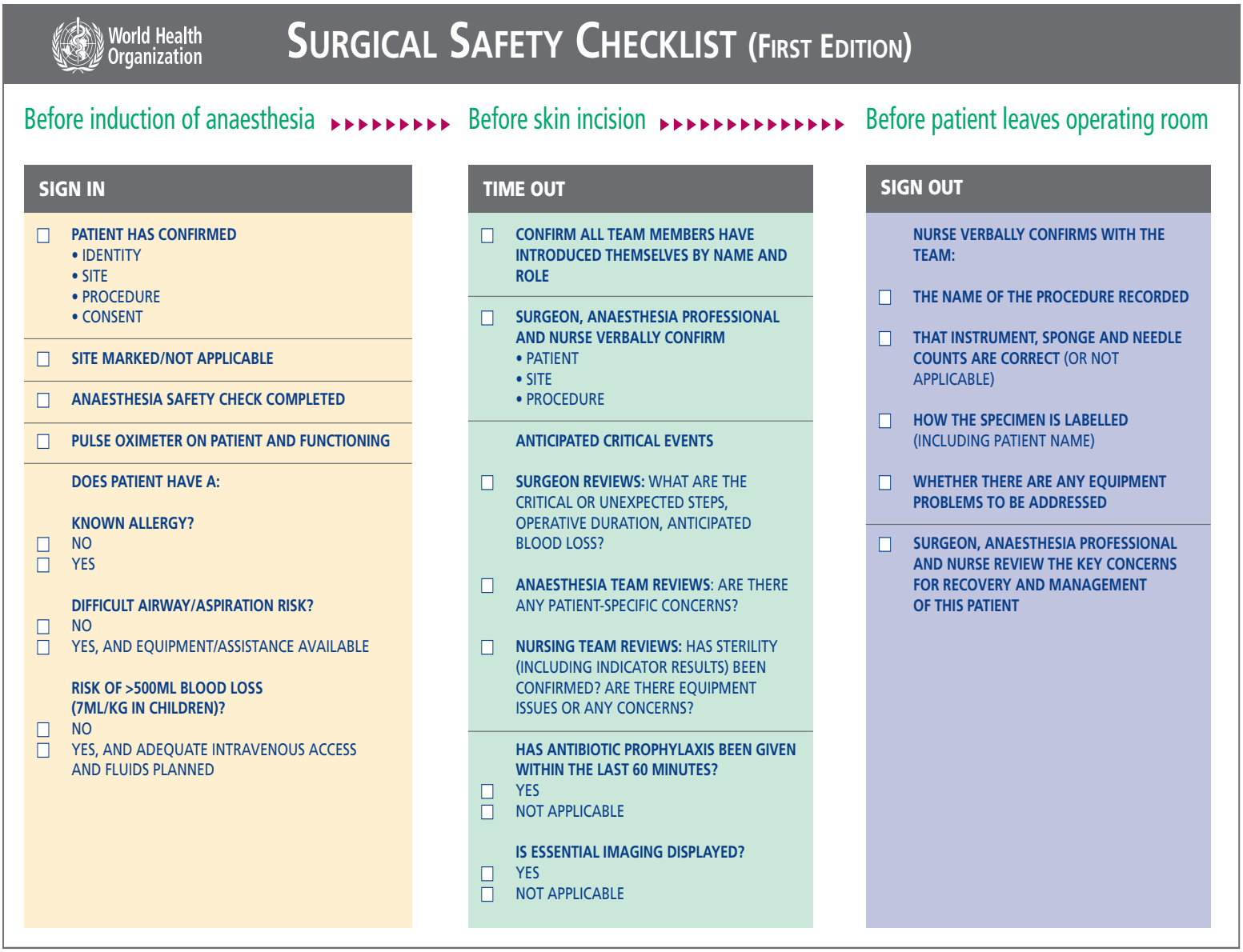
> to ensure that all of the relevant documents and studies are available prior to the start of the procedure and that they have been reviewed and are consistent with each other and with the patient's expectations and with the team's understanding of the intended patient, procedure, site, and, as applicable, any implants. Missing information or discrepancies must be addressed before starting the procedure. (p. 384)

This verification process should occur (Mulloy & Hughes, 2008):

> at the time of the surgery/procedure is scheduled, at the time of admission to the facility, anytime the responsibility for care of the patient is transferred to another caregiver, with the patient involved, awake, and aware, if possible, and before the patient leaves the preoperative area or enters the surgical room. (p. 384)

The next step is marking the operative site. The purpose of this is "to identify unambiguously the intended site of incision or insertion" (Mulloy & Hughes, 2008, p. 384). There are various specific instructions for marking the intended site. One important aspect is that the mark must be made using a marker that is sufficiently permanent to remain visible after completion of the skin prep application. The person performing the procedure is the person who should mark the site. Marking must take place with the patient involved, awake, and aware, if possible. Final verification of the site mark must take place during the "time out." There are a few exemptions for site marking as well. These are: single organ cases (such as cesarean section, cardiac surgery), interventional cases for which the catheter/instrument insertion site is not predetermined (cardiac catheterization), teeth, or premature infants because the mark may cause a permanent tattoo (Mulloy & Hughes, 2008).

The final step is the time out. The purpose is "to conduct a final verification of the correct patient, procedure, site and, as applicable, implants" (Mulloy & Hughes, 2008, p. 384). The time out process should involve active communication among all members of the surgical team and should be conducted in the location where the procedure will be done, just before starting the procedure. The time out should also be briefly documented and include correct patient identity, correct side and site, agreement on the procedure to be done, correct patient position, and the availability of correct implants and any special equipment or special requirements (Mulloy & Hughes, 2008). The procedure should not be started until any questions or concerns are resolved. A study that investigated a pre-procedural briefing in cardiac surgery (similar to the WHO surgical safety checklist), found that the number of miscommunication events declined by 50% in the briefing group compared to the group that did not use the briefing tool (Pugel, Simianu, Flum, & Dellinger, 2015).



World Health Organization

SURGICAL SAFETY CHECKLIST (FIRST EDITION)

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

SIGN IN

☐ PATIENT HAS CONFIRMED
- IDENTITY
- SITE
- PROCEDURE
- CONSENT

☐ SITE MARKED/NOT APPLICABLE

☐ ANAESTHESIA SAFETY CHECK COMPLETED

☐ PULSE OXIMETER ON PATIENT AND FUNCTIONING

DOES PATIENT HAVE A:

KNOWN ALLERGY?
☐ NO
☐ YES

DIFFICULT AIRWAY/ASPIRATION RISK?
☐ NO
☐ YES, AND EQUIPMENT/ASSISTANCE AVAILABLE

RISK OF >500ML BLOOD LOSS (7ML/KG IN CHILDREN)?
☐ NO
☐ YES, AND ADEQUATE INTRAVENOUS ACCESS AND FLUIDS PLANNED

TIME OUT

☐ CONFIRM ALL TEAM MEMBERS HAVE INTRODUCED THEMSELVES BY NAME AND ROLE

☐ SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE VERBALLY CONFIRM
- PATIENT
- SITE
- PROCEDURE

ANTICIPATED CRITICAL EVENTS

☐ SURGEON REVIEWS: WHAT ARE THE CRITICAL OR UNEXPECTED STEPS, OPERATIVE DURATION, ANTICIPATED BLOOD LOSS?

☐ ANAESTHESIA TEAM REVIEWS: ARE THERE ANY PATIENT-SPECIFIC CONCERNS?

☐ NURSING TEAM REVIEWS: HAS STERILITY (INCLUDING INDICATOR RESULTS) BEEN CONFIRMED? ARE THERE EQUIPMENT ISSUES OR ANY CONCERNS?

HAS ANTIBIOTIC PROPHYLAXIS BEEN GIVEN WITHIN THE LAST 60 MINUTES?
☐ YES
☐ NOT APPLICABLE

IS ESSENTIAL IMAGING DISPLAYED?
☐ YES
☐ NOT APPLICABLE

SIGN OUT

NURSE VERBALLY CONFIRMS WITH THE TEAM:

☐ THE NAME OF THE PROCEDURE RECORDED

☐ THAT INSTRUMENT, SPONGE AND NEEDLE COUNTS ARE CORRECT (OR NOT APPLICABLE)

☐ HOW THE SPECIMEN IS LABELLED (INCLUDING PATIENT NAME)

☐ WHETHER THERE ARE ANY EQUIPMENT PROBLEMS TO BE ADDRESSED

☐ SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE REVIEW 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.

Figure D: The World Health Organization's Surgical Safety Checklist (first edition).

Error Prevention

Various studies have investigated causational errors in cases of wrong-site surgery and several researchers discuss the lack of research on WSS. Most studies have been retrospective,

chart reviews, case studies, and surveys of several professional organizations (Mulloy & Hughes, 2008). Another problem with this specific research is that medical error data are often transferred to medical claims data and medical liability, which prevents the sharing of data (Mulloy & Hughes, 2008), and there are no randomized control studies that evaluate the effect of the Universal Protocol on WSS. A recent implementation that aids research is some states have recently required mandatory reporting on events like WSS (Mulloy & Hughes, 2008). It is important for healthcare professionals to adhere to the Universal Protocol, as studies have investigated its efficacy in perioperative settings. One study found that when discrepancies occurred with clinicians, a review of patient information could resolve the discrepancy (Mulloy & Hughes, 2008), so preoperative verification was found to be beneficial. Two studies found that the time out component can prevent the majority of WSS, but not all (Mulloy & Hughes, 2008). Mulloy and Hughes suggest that eliminating WSS errors requires a systems approach and "institutionalizing robust systems" to help correct site verification and that will address potential causes of breakdowns in the systems (Mulloy & Hughes, 2008).

In a study done by Bohmer about the implementation of a safety checklist, a survey of employees 3 months after the introduction of the checklist, the researchers found that from a staff perspective, "safety factors can be handled significantly better and with greater awareness by implementing a safety checklist" (Bohmer et al., 2012, p. 36). Braff conducted a literature review that explored the role of documents and documentation in communication failure in the perioperative setting. They found that effective communication is an essential aspect for the delivery of safe patient care (Braff, Manias, & Riley, 2011). One explanation for improved patient outcomes with the use of safety checklists is that the use of a checklist can improve the

safety culture by facilitating communication between the health care team (Pugel, Simianu, Flum, & Dellinger, 2015).

Kalapurakal et al. instituted a voluntary error reporting system to record errors. The researchers also implemented checklists, time outs, and monitored staff compliance, which successfully eliminated the errors (Kalapurakal et al., 2013). In a prospective observational study done by Mainthia, the researchers implemented an electronic whiteboard that was interactive during the time out process. The circulator would read out each item and check it off once it was completed. Required steps were colored red and once steps were completed, it turned green. This process took an average of thirty-five seconds to complete. The researchers found a statistically significant increase in time out procedural compliance, which improved patient outcomes and reduced preventable complications and death (Mainthia et al., 2012). In Papaconstantinou's study of barriers to checklist implementation, they found that explaining why and showing how, active leadership, deliberate enrollment, extensive discussion and training, piloting, multidisciplinary communication, real-time coaching, and ongoing feedback were effective ways for implementing a checklist (Papaconstantinou, ChanHee, Reznik, Smythe, & Wehbe-Janek, 2013). Thakkar and Mears performed a prospective randomized controlled trial to quantitatively and qualitatively evaluate the visibility of the surgical site markings after using two different skin prep solutions (chlorhexidine or iodine based). In this study, black permanent marker was used to mark the patient's skin and patients were randomly assigned to either the chlorhexidine or iodine skin prep application. The analysis was performed by ten orthopedic surgeons, which found that chlorhexidine-based skin preparation solution erased surgical markings more frequently than iodine-based skin preparations (Thakkar & Mears, 2012). The researchers noted that additional research was needed to find a skin prep solution that has

maximum effect to prevent infections and does not erase site markings (Thakkar & Mears, 2012).

Hospital and surgery center leaders and managers should ensure that their center adheres to the standardization of the Universal Protocol, as well as evaluate their policies regarding WSS to ensure prevention is effective. All healthcare personnel should be aware and knowledgeable about the Universal Protocol, not just surgeons. Studies found that executive and clinical leaders need to communicate expectations to physicians and staff, provide resources, be a visible support, and recognize individual and organizational successes (Rydrych, Apold, & Harder, 2012). Another aspect of safe care is designing jobs with attention to human factors. This means that institutions need to pay consideration to work hours, workloads, staffing ratios, sources of distraction, and an inversion in assigned shifts, and their relationship to fatigue, alertness, and sleep deprivation (Kohn, Corrigan, & Donaldson, 2000). Designing jobs for safety also means "addressing staff training needs and anticipating harm that may accompany downsizing, staff turnover, and the use of part-time workers and 'floats'" (Kohn, Corrigan, & Donaldson, 2000, p. 170). The development of standards is important in the healthcare industry. Standards can establish minimum levels of performance or can establish consistency or uniformity across multiple individuals and organizations (Kohn, Corrigan, & Donaldson, 2000). Developing standards can also set expectations for the organizations and health professionals involved (Kohn, Corrigan, & Donaldson, 2000). Current standards in health care "do not provide adequate focus on patient safety…organizational licensure accreditation focus on…credentialing, quality improvement, and risk management, but lack a specific focus on patient safety issues" (Kohn, Corrigan, & Donaldson, 2000, p. 137). Rydrych encourages healthcare professionals to acknowledge their "humanness." Regardless of training or

intelligence, humans forget things, make mistakes, downplays risks, and go on auto-pilot (Rydrych, Apold, & Harder, 2012). Healthcare professionals should be aware of traits that can contribute to medical errors. Overconfidence and automated behaviors can lead to mistakes. The surgical team must also be aware of confirmation bias, which is "discounting info[rmation] that disagrees with preconceived ideas" (Rydrych, Apold, & Harder, 2012). Birnbach et al., found evidence-based actions that can aid in preventing WSS. They found that actions like leadership commitment, everyone taking responsibility, empowerment of governing bodies to create and enforce safety policies, elimination of preventable harm, establishment of a universal, uniform approach for safety management, mandated reporting of safety issues, errors, and near misses, and cultivation of learning as part of the organizational mentality (Birnbach, Rosen, Williams, Fitzpatrick, Lubarsky, & Menna, 2013). Other evidence-based actions to prevent WSS studied by Birnbach et al., were: 1) development of policies where medical staff are educated, 2) performance is monitored, 3) feedback is provided, 4) leadership promotes patient safety and encourages medical staff to voluntarily participate in safety initiatives, 5) elimination of the hierarchy so all can feel free to speak up when a patient safety issue is noticed, and 6) to emphasize the team approach and team responsibility (Birnbach, Rosen, Williams, Fitzpatrick, Lubarsky, & Menna, 2013).

Current error response and prevention focuses on the punishment of individuals, usually in the form of firing the individual or pursuing legal action. Punitive action is not an effective way to prevent recurrence because large system failures "represent latent failures coming together in an unexpected way" (Kohn, Corrigan, & Donaldson, 2000, p. 56). A section in "To Err is Human" discusses that since the same mix factors is unlikely to occur again, "efforts to prevent specific active errors are not likely to make the system any safer" (Kohn, Corrigan, &

Donaldson, 2000, p. 56). This study also notes that a punitive response may be appropriate in certain cases, like in the instance of deliberate "malfeasance" (Kohn, Corrigan, & Donaldson, 2000). This report presents some ways to prevent errors in large organizations like healthcare: "discovering and fixing latent failures, and decreasing their duration, are likely to have a greater effect on building safer systems than efforts to minimize active errors at the point at which they occur" (Kohn, Corrigan, & Donaldson, 2000, p. 56).

Discussion

Every year since 2003, the Joint Commission releases its National Patient Safety Goals. One goal that is repeatedly listed, is to prevent and eliminate wrong-site surgery. In 2018, JCAHO updated their newest Patient Safety goals. "Preventing mistakes in surgery" still reigns on the list. The reported numbers of WSS cases continues to rise as healthcare organizations become more transparent to medical errors. In order to eliminate wrong-site surgery, institutions require a systems approach, with rigorous process systems to verify and address potential causes of breakdowns in the system. Hospital and surgical leaders should also evaluate their current policies and procedures regarding WSS in order to improve on additional "safety net" resources and to ensure that no WSS should occur. Health care organizations should adhere to the Universal Protocol, which standardizes preoperative preparations, improves function of the health care team, and should avert any potential for WSS. All healthcare personnel should be knowledgeable and trained in the elements of the Universal Protocol: preoperative verification process, marking the site, and the time out. Healthcare professionals should also speak up if they feel that patient safety is being compromised. Understanding the barriers to communication can help to improve safety culture in these highly complicated settings. Effective leaders communicate expectations, provide resources, are a visible support, and recognize individual and

organizational success. When a team approach is emphasized, everyone feels responsible and empowered to speak up when necessary. Healthcare standards should also provide a focus on patient safety, which will aid in helping to meet JCAHO's National Patient Safety Goal of preventing wrong-site surgery.

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Appendix A

Table 1: *Results Table*

Title	Author & Year	Purpose	Results & Findings
Wrong-Site Surgery: A Preventable Medical Error	Mulloy & Hughes (2008)	The purpose is to discuss the prevalence and causes of WSS and strategies to decrease the number of WSS.	The study found that the main causes of WSS were organizational failures, including communication failure, procedural noncompliance, and leadership issues. In order to prevent WSS, healthcare organizations should adhere to the Universal Protocol.
What Keeps Facilities from Implementing Best Practices to Prevent Wrong-Site Surgery? Barriers and Strategies for Overcoming Them	Clarke (2012)	The purpose was to identify the barriers to implementation of the 21 Pennsylvania Patient Safety Authority (PPSA) recommendations for preventing WSS. The purpose was also to identify strategies for successful implementation of the 21 PPSA recommendations.	The study found that the top barriers were physician behavior (surgeon intimidation, resistance, non-compliance, lack of accountability, lack of perceived value, surgeons overriding protocols), difficulty with accurate pre-operative information, need to change policy, time pressures, inability to see site markings, general communication problems, and a need to change culture.
Implementation of a Surgical Safety Checklist: Impact on Surgical Team Perspectives	Papaconstantinou et al. (2013)	The purpose was to evaluate a surgical team's perspectives before and after the implementation of a WHO adapted checklist.	The study found there were improvements in awareness of patient safety, communication, quality of care, and perception of the value and participation in the time out process.

Title	Author & Year	Purpose	Results & Findings
The Role of Documents and Documentation in Communication Failure Across the Perioperative Pathway: A Literature Review	Braff, Manias, & Riley (2011)	The purpose was to explore the role of documents and documentation in communication failure among health care providers across the perioperative, intra-operative, and post-operative areas.	The study found that documents such as surgery notes, anesthesia records, and nursing perioperative notes that are deficient contribute to the development of communication failure leading to WSS and that effective communication is vital to the delivery of safe patient care.
A Comprehensive Quality Assurance Program for Personnel and Procedures in Radiation Oncology: Value of Voluntary Error Reporting and Checklists	Kalapurakal et al. (2013)	The purpose was to determine the effectiveness of a voluntary error reporting system to record errors. The purpose was to analyze the clinical impact and guide implementation for future measures.	The study found that the voluntary error database recorded 356 total errors. The program had instituted checklists, time outs, and monitored staff compliance, which successfully eliminated the errors.
Novel Use of Electronic Whiteboard in the Operating Room Increases Surgical Team Compliance with Pre-Incision Safety Practices	Mainthia et al. (2012)	The purpose was to determine the effectiveness of an interactive electronic checklist system.	The study found that pre-intervention observations demonstrated that checklists involved only 49.7% of the core elements, while 1-month post-intervention showed that checklists involved 81.6% of the core elements, and 9-month post-intervention showed 85.6% of core elements. There was a statistically significant increase in time procedural compliance.

Title	Author & Year	Purpose	Results & Findings
A Framework for Patient Safety: A Defense Nuclear Industry-Based High-Reliability Model	Birnbach et al. (2013)	The purpose is to discuss strategies and evidence-based actions to prevent WSS.	The study found effective strategies, such as: establishing a universal approach for safety management, mandate reporting or safety issues, errors, and near misses, cultivate learning as part of the organizational mentality, commitment of leadership, elimination of the medical hierarchy, and emphasis of the team approach.
Effectiveness of the Surgical Safety Checklist in Correcting Errors: A Literature Review Applying Reason's Swiss Cheese Model	Collins, Newhouse, Porter, & Talsma (2014)	The purpose was to determine the effectiveness of the surgical safety checklist in correcting and preventing errors in the OR.	The study found that the Swiss cheese model provides a framework for identifying the problematic processes that lead to errors and the surgical safety checklist has been a successful intervention that reduces the recurrence of errors in the OR.
Patient Safety in the Surgical Environment	The American College of Obstetricians and Gynecologists (2010)	The purpose was to discuss a systems approach involving a team effort by all individuals participating in the surgical process, as well as to discuss the effects of stress and fatigue on human error.	The study found that communication among members of the surgical team is crucial throughout the surgical process, particularly during the preoperative phase and that protocols to identify and manage stress and fatigue in surgical personnel may help to avoid surgical errors and patient injuries.

Title	Author & Year	Purpose	Results & Findings
To Err is Human: Building a Safer Health System	Institute of Medicine (1999)	The purpose is to inform about the prevalence of medical errors in the United States and to recommend strategies on how to improve health care system design.	The study found that the majority of medical errors do not result from individual recklessness or the actions of a particular group, but rather errors are caused by faulty systems, processes, and conditions that lead people to make mistakes or fail to prevent them. Mistakes can best be prevented by designing the health system at all levels to make it safer.
Study Suggests Medical Errors Now Third Leading Cause of Death in the U.S.	Daniel & Makary (2016)	The purpose is to discuss how researchers are advocating for updated criteria for classifying deaths on death certificates.	The study found that deaths due to medical errors are underreported and that more research on preventing medical errors from occurring is needed. Researchers also reported their estimates of death due to medical error, which translates to 9.5% of all deaths each year in the U.S.