Patient Safety in Surgery

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Abstract

Medical error is becoming well recognized and studied. Strategies to reduce error are slowly being developed and embraced by surgeons, but are challenged by the "superman" surgical culture. This review addresses definitions, incidence and causes of error, methods of error detection, and strategies to minimize errors and maximize patient safety.

MeSH words: Patient safety, error, surgery

Introduction

Patient safety means minimizing harm to patients arising from medical treatment. This subject has received significant attention in lay articles and the scientific literature. The 1999 Institute of Medicine Report suggested medical errors are the eighth leading cause of death in the United States, causing up to 100,000 deaths annually [1]. Adverse events in health care cost society through medical expenses, lost earnings and productivity, morbidity and mortality, pain and suffering, and litigation [2].

It is imperative for doctors to report their complications, particularly surgeons, whose complications can have devastating consequences for patients. Health care professionals need to recognize their fallibility openly and develop strategies for minimizing harmful errors. Error reduction requires designing systems to prevent errors, implementing methods for detection and measurement of errors, analyzing errors to determine their causes, and addressing the causal factors that precipitate errors. We review medical error and examine tools to improve safety for surgical patients.

Definitions

An error is the failure of a planned action to be completed as intended (error of execution) or the use of the wrong plan to achieve an aim (error of planning) [3]. Errors can be intercepted by appropriate action. A nurse questions if a surgical sponge is left behind as a surgeon closes after a laparotomy. The surgeon re-explores the abdominal cavity and finds it.

An adverse event (AE), or complication, is any unintended result of medical treatment that results in prolonged hospital stay, morbidity, or mortality [1]. If an AE is caused by error, it is preventable. If the abdominal sponge above was not removed and the patient developed an abdominal abscess, this would be a preventable

AE. If a patient develops an abscess but no foreign body was left in the wound and no other errors occurred, the AE would be judged non-preventable. Up to 50% of AEs are preventable [4-8].

Incidence of Errors

Approximately half of AEs occurring in hospital are associated with surgery [4, 5, 9]. The higher incidence of errors in surgery is explained in part by the higher number of treatment events surgical patients undergo during an operation compared to medical inpatients. In addition, unlike medical management, the complexity of a surgery imparts more opportunities for human error to impact the patient than single events in medical management [10].

Approximately half of all surgical AEs are preventable [5]. Eight specific operations have a higher risk of a preventable AE: lower extremity bypass graft, abdominal aortic aneurysm repair, colon resection, coronary artery bypass graft/cardiac valve surgery, transurethral resection of the prostate or bladder tumor, cholecystectomy, hysterectomy, appendectomy. The three leading AEs were technical complications, wound infections, and postoperative bleeding [5].

Retrospective studies are limited in their ability to detect the exact errors that contribute to AEs. It is easy to detect a postoperative stroke, but what errors preceded the event and how did sleeplessness and technical factors contribute to the stroke? Very few prospective studies on error have been carried out. The senior author (MB) has prospectively documented every error, including over 1700 elective neurosurgical operations since 2000. Out of 1108 elective procedures reported over a six year period, 87% of patients incurred at least one error, 23% of the errors were major, and 79% were deemed preventable [11].

Evolving Models of Error

James Reason describes two views of errors; the traditional individual approach and the more modern systems approach [12]. The pervasive traditional perspective explains human errors through individual factors, such as forgetfulness, carelessness and negligence. If an error occurs, someone is to blame and it is the individual's responsibility to remediate and address their personal shortcomings. The more modern systems perspective posits that individuals are fallible and human errors are expected. However, systemic factors influence both the etiology of human errors and their ultimate impact on patient care. In essence, a workplace environment may influence an individual worker's likelihood of performing an error and the probability the error will be prevented and/or intercepted. Under this approach, when an error occurs, blaming the individual accomplishes less than identifying systemic factors that precipitated the error and creating systems for future prevention. The systems approach to patient safety is gaining increasing acceptance. Residents who chose to pursue training in surgery aspire to help patients and avoid harm. Surgeons and trainees must work in an environment that permits these intentions to come to fruition.

Causes of Errors

Most preventable AEs are not simply the result of human error but are due to defective systems that allow errors to occur or go undetected. The causes of errors and the reasons errors evade detection and prevention can be classified into organizational, situational, team, individual, task, and patient factors [13].

Organizational factors are systemic background conditions that predispose to errors. These include personnel and equipment, scheduling and timing of procedures, and substitution of usual team members with new members. Inadequate documentation protocols on a surgical service result in a patient receiving the wrong medications post-operatively.

Situational factors comprise distractions, interruptions, and equipment design, including monitors and displays. Nurses report that telephone interruptions in surgical wards increase the risk of performing an error during drug rounds more than other types of interruptions [14]. Equipment dysfunction is an important source of error, causing about one-third of AEs in the ICU [15]. User interfaces, such as displays and monitors, can be designed to reduce the potential for error using principles from cognitive engineering [16].Team factors include communication, confidence in team members, and the ability to deal with unexpected events. The complex group dynamics in an operating room (OR) result in an environment in which communication can be suboptimal. Teamwork failure and communication breakdown were the strongest predictors of surgical errors in a cardiovascular surgery service [17].

Individual factors such as mental readiness, technical performance, and fatigue are important sources of error. Physicians working night shifts have impaired motor and cognitive performance. The effect of 28 hours of sleep deprivation on cognitive psychomotor performance is equal to that of a blood alcohol level of 0.10%, which is above the legal limit for driving a car [18].

Task factors relate to the clarity of the task at hand, including clear protocols and accurate available information. A significant number of adverse drug events can be traced to impaired access to information, such as a history of drug allergy, renal dysfunction, and possible drug–drug interactions. This led to the development of interventions that improved access to information, like computerized drug order entry [19]. A simple task analysis can identify fruitful areas for safety improvement. During spine surgery omitting the task of ascertaining the correct surgical level would produce clear harm to the patient. The omission is readily avoidable using a simple mechanism, such as obtaining a localizing intraoperative radiograph.

Patient factors may contribute to surgical error, including anatomic variation, disease severity, and co-morbidity. For example, during laparotomy the presence of extensive adhesions increases the risk of bowel injury. Elderly patients experience more preventable adverse events because their care is more complex [20].

Detecting Errors

There are several methods for detecting errors and AEs. The most sensitive involve direct prospective observation of clinical care, including attending clinical rounds, daily review of charts, and interviews with caregivers [11, 21, 22]. Prospective recording of errors has been conducted in a small number of surgical practices and in a busy emergency department [11, 23-25]. By contrast, retrospective chart review detects far fewer errors and AEs [4-8]. One of the commonest tools for detecting AEs is the use of incident reports, but voluntary reporting is the least sensitive detection method [26]. Morbidity and mortality rounds are a form of voluntary reporting of AEs used commonly by surgeons, but they detect only a small proportion of AEs [27, 28]. Despite this limitation, morbidity and mortality rounds are an excellent method for teaching surgical residents to reflect on AEs and encouraging openness in reporting if carried out appropriately with the right attitude. A Japanese neurosurgery department recently used two years of morbidity and mortality rounds to classify and quantify the types and causes of AEs [29].

Reducing Errors

Create a Culture of Safety

The most important approach to reducing the number of preventable AEs is to ensure that the surgical environment encourages a culture of safety. Supporting the systems approach over the individual approach is an important step in achieving this goal. Errors and AEs must be viewed as learning opportunities to improve future care. Involved individuals must be viewed as valuable participants in a learning process rather than inadequate workers. Team members must be trained to both challenge, and expect challenges, when faced with important decisions.

The transformation to a culture of safety is slow and challenging, especially for surgeons. The threat of professional and legal consequences is a powerful deterrent, and fear and shame are formidable obstacles. The presence of leadership is paramount; commitment to improve patient safety should be demonstrated by the entire health care delivery team and senior management of the organization. Residents and trainees must be exposed to an environment conducive to improving patient safety through openness and collaboration in teaching hospitals if they are to lead future efforts to further reduce patient harm in health care.

Small gestures can help foster a safety-oriented workplace. Once a health professional has come forward and reported a close call or an error, his/her professionalism and courage should be publicly acknowledged with, at minimum, a letter of appreciation from management. Every health care professional is thus encouraged to report incidents in a communal effort to improve the quality of patient care. Orientation of new physicians, residents, and other health care providers is an excellent forum for promoting patient safety.

Improve Measurement of Error

In the medical profession the reporting system for errors is inadequate, partly due to the existing culture of shame and blame compounded by the public's view that the medical profession, and especially surgeons, should be flawless. Close scrutiny of near misses is a useful strategy for improving patient safety in this difficult environment. Suppose a wrong-side surgery was caught just before the incision was made. The system failures that allowed a patient to almost undergo wrong-side surgery can be studied with frank discussion of the close call without the threat of blame, or professional or legal consequences. The information from the many near misses that occur daily offers a unique opportunity for making useful safety improvements.

Embrace a Systems Approach

The systems approach is based on three principles: (1) human error is unavoidable; (2) faulty systems allow human error to cause harm to the patient; (3) systems can be designed that prevent human error from harming a patient. These principles have been validated in numerous industries including commercial aviation. Another term that embodies these principles is "human factors." This involves gathering information about human abilities, limitations, and other characteristics and applying it to tools, machines, systems, and environments to allow safe and effective human usage [30]. Communication, teamwork, and debriefing are germane activities. Human shortcomings are expected, and mistakes are absorbed by the system so no harm ensues.

These principles have not been widely embraced in the surgical arena. Surgeons deny the effect of fatigue on performance and do not promote an environment where subordinates can safely question the actions of senior surgeons. This contrasts with the airline industry, where strict limitations on work hours are enforced [31]. During airline training, crews learn to use a two-check override system, which allows a junior member to override a senior member's decision if a satisfactory explanation is not given after two challenges.

Know What to Fix

A thorough understanding of the problem is necessary before safety solutions can be developed [32]. Thorough understanding derives from systematic evaluation of the factors that contributed to an error. Anesthesia has excelled at identifying systemic problems and designing systematic solutions beyond all other medical specialties. Since the 1970s, anesthesiologists have scrutinized adverse events, embraced human factors analyses and the systems approach, applied technological solutions, created standards and guidelines and incorporated patient simulation in residency training. As a result, anesthesia is now safer than ever [33].

Be Suspicious and Proactive

New ways of doing things create ample opportunity for doing things incorrectly [34]. A dry run can ensure that the mistakes are intercepted or mitigated before harm can occur. This approach is extremely useful for reducing error related to new technology and techniques. If a new laparoscopic surgery tool was being introduced, the most efficient way to determine if it will be used safely is to have surgeons try it in a simulated OR environment. If there are any errors, they become apparent during the testing phase and can be rectified before the instrument is used on patients. Invoking the input of surgeons in the development of new equipment and techniques is a proactive approach to developing new technology that is user-friendly.

Safety changes may also unexpectedly lead to deterioration in other aspects of care so it is essential to be wary of the potential downsides of safety initiatives. Preparation of surgical trays of instruments in a central location outside the OR ensures better setup of surgical trays in general but decreases flexibility. This may lead to delays when an additional instrument becomes needed during surgery.

Adopt Forcing and Constraining Functions

Humans will continue to make mistakes, but the work environment can be designed to prevent these mistakes from leading to harm. Forcing functions make it impossible to carry an error through to completion. Wrong-side brain surgery, one of the most dramatic, visible, and devastating of all surgical errors, can be essentially eliminated by using a surgical navigation system married to imaging for every cranial operation [35].

Constraining functions are less powerful than forcing functions, but make it difficult for an error to go undetected and unmitigated. A policy of routinely marking the surgical site and a "time-out" in the OR reduces the incidence of wrong-side surgery [36].

Conclusion

Human error is inevitable and unavoidable. Surgeons must embrace a culture in which they study errors in an open and prospective manner and use them as learning opportunities. The patient safety issues encountered by surgeons are closely related to those encountered by emergency physicians, as many commonalities exist between these two disciplines. Clinicians from both of these disciplines must embrace initiatives to implement systems to minimize the occurrence of errors and their impact, including adopting a change in culture which encourages open questioning of their activities.

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