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Medical Error Prevention

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Introduction

Medical errors are a serious public health problem and a leading cause of death in the United States. It is a difficult problem as it is challenging to uncover a consistent cause of errors and, even if found, to provide a consistent viable solution that minimizes the chances of a recurrent event. By recognizing untoward events occur, learning from them, and working toward preventing them, patient safety can be improved (Oebay, 2013).

Part of the solution is to maintain a culture that works toward recognizing safety challenges and implementing viable solutions rather than harboring a culture of blame, shame, and punishment. Healthcare organizations need to establish a culture of safety that focuses on system improvement by viewing medical errors as challenges that must be overcome. All individuals on the healthcare team must play a role in making the provision of healthcare safer for patients and healthcare workers (Helo & Moulton, 2017).

All providers know medical errors create a serious public health problem that poses a substantial threat to patient safety. Yet, one of the most challenging unanswered questions is "What constitutes a medical error?" The answer to this basic question has not been clearly established. Due to unclear definitions, “medical errors” are difficult to scientifically measure. A lack of standardized nomenclature and overlapping definitions of medical errors has hindered data analysis, synthesis, and evaluation.

There are two major types of errors:

1. Errors of omission occur as a result of actions not taken. Examples are not strapping a patient into a wheelchair or not stabilizing a gurney prior to patient transfer.
2. Errors of the commission occur as a result of the wrong action taken. Examples include administering a medication to which a patient has a known allergy or not labeling a laboratory specimen that is subsequently ascribed to the wrong patient.

Health care professionals experience profound psychological effects such as anger, guilt, inadequacy, depression, and suicide due to real or perceived errors. The threat of impending legal action may compound these feelings. This can also lead to a loss of clinical confidence. Clinicians equate errors with failure, with a breach of public trust, and with harming patients despite their mandate to "first do no harm."

Fear of punishment makes healthcare professionals reluctant to report errors. While they fear for patients' safety, they also dread disciplinary action, including the fear of losing their jobs if they report an incident. Unfortunately, failing to report contributes to the likelihood of serious patient harm. Many healthcare institutions have rigid policies in place which also create an adversarial environment. This can cause staff to hesitate to report an error, minimize the problem, or even fail to document the issue. These actions or lack thereof can contribute to an evolving cycle of medical errors. When these errors come to light, they can tarnish the reputation of the healthcare institution and the workers (Robertson & Long, 2018).

Some experts hold that the term "error" is excessively negative, antagonistic and perpetuates a culture of blame. A professional whose confidence and morale has been damaged as a result of an error may work less effectively and may abandon a career in medicine. Many experts suggest the term "error" should not be used at all. Due to the negative connotation, it is prudent to limit the use of the term "error" when documenting in the public medical record. However, adverse patient outcomes may occur because of errors; to delete the term obscures the goal of preventing and managing its causes and effects (Battard, 2017).

Errors, no matter the nomenclature, typically occur from the convergence of multiple contributing factors. Public and legislative intolerance for medical errors typically illustrates a lack of understanding that some errors may, in fact, not be preventable with current technology or the resources available to the practitioner. Human factors are always a problem, and identifying errors permits improvement strategies to be undertaken. In particular, blaming or punishing individuals for errors due to systemic causes does not address the causes nor prevent a repetition of the error. The trend is for patient-safety experts to focus on improving the safety of health care systems to reduce the probability of errors and mitigate their effects, rather than focus on an individual's actions. Errors represent an opportunity for constructive changes and improved education in health care delivery.

Governmental, legal, and medical institutions must work collaboratively to remove the culture of blame while retaining accountability. When this challenge is met, health care institutions will not be constrained from measuring targets for process improvement, including all errors, even with adverse outcomes.

Healthcare providers want to improve outcomes while reducing the risk of patient harm. Despite provider best efforts, medical error rates remain high with significant disability and death. Preventable medical errors contribute substantially to healthcare cost, including higher health insurance costs per person expenses. Only by health professionals working together will the cost and injury associated with medical errors be mitigated.

The Joint Commission Patient Safety Goals

The Joint Commission has introduced several patient safety goals to assist institutions and healthcare practitioners in creating a safer practice environment for patients and providers (The Joint Commission, 2018). The Joint Commission Goals include:

- Identify patient safety dangers and risks
- Identify patients correctly by confirming the identity in at least two ways
- Improve communication such as getting test results to the correct person quickly
- Prevent infection by hand-cleaning, post-op infection antibiotics, catheter changes, and central lines precautions.
- Prevent mistakes in surgery by making sure the correct surgery is done on the correct body part; pause before surgery to double check.
- Use device alarms and make sure that alarms on medical equipment are heard and checked quickly.
- Use medicines correctly and safely, double checking labeling and correctly passing on patient medicines to the next provider.
- Label all medications, even those in a syringe. This should preferably be done in the area where the medications are prepared.
- Take extra time with patients who have been prescribed anticoagulants and chemotherapeutic agents.
- To prevent nosocomial infections, hand washing should be routine before and after visiting each patient.

Accountability

While it is true that individual providers should be held accountable for their decisions, there is a growing realization that the majority of errors are out of the clinician's control (Delacroix, 2017). This being said, it remains difficult to change a culture of non-reporting.

Questions to consider include:

- The potential for errors in healthcare is very high. Due to cost control measures, are individuals accountable, or is increased workload and staff fatigue the reason for errors?
- Why report? Failure to report errors may subject clinicians to disciplinary action and increased risk for legal liability. Beneficence and nonmaleficence are ethical concepts that are violated when an error is not reported.

- Practitioners often fear they will gain a reputation for committing mistakes and may not self-report. They know that mistakes and written warnings are often recorded in personnel files. Does the system need modification to decrease the penalty and encourage reporting?

Punishment may, in fact, reduce reporting errors because of the discipline and humiliation that is associated with repeated errors. Nevertheless, not addressing the problem increases the potential for more adverse events which places more patients at risk. Rather than placing blame, administrators and review boards need to move toward eliminating the blame-shame-discipline structure and move toward a prevention and education structure.

This culture incorporates both learning and improvement efforts that target system redesign and a reporting culture whereby all providers feel safe from retribution and, therefore, report issues about safety that help to constantly improve patient care and improve the safety of the system (Battard, 2017).

To this end:

- All providers must accept the inherent issues in their roles as healthcare workers that contribute to error-prone environments.
- Effective communication related to medical errors may foster autonomy and ultimately improve patient safety.
- Error reporting better serves patients and providers by mitigating their effects.
- Even the best clinicians make mistakes, and every practitioner should be encouraged to provide peer support to their colleagues after an adverse event occurs.

Medical errors and near misses should be reported when they are discovered. Healthcare professionals are usually the first to notice a change in a patient's condition that suggests an adverse event. A cultural approach in which personal accountability results in long-term increased reporting reduces errors.

Definitions

Patient safety has typically been *outcome-dependent* and the focus has been on preventing patients from experiencing adverse outcomes when receiving medical care. This may stem from Hippocrates, *primum no nocere*, or “First, do no harm.” While definitions in the literature are unclear, some general concepts can be garnered. Multiple similar definitions are available for each of these terms from various sources; the health practitioner should be aware of the general principles and probable meaning (Grober & Bohnen, 2005); (Pietra et al., 2005).

Active Error

- Active errors are those taking place between a person and an aspect of a larger system at the point of contact.
- Active errors are made by people on the front line such as clinicians and nurses. For example, operating on the wrong eye or amputating the wrong leg are classic examples of an active error.

Adverse Event

Adverse events may be *preventable* when there is a failure to follow accepted practice at a system or individual level.

- An adverse event attributable to an error usually is a preventable adverse event.
- An adverse event is a type of injury that most frequently is due to an error in medical or surgical treatment rather than the underlying medical condition of the patient.
- Not all adverse outcomes are the result of an error; hence, only *preventable adverse events* are attributed to medical error.
- An unintended injury is medical or surgical patient management that results in prolonged hospitalization, measurable physical disability, or both.
- An unintended injury or complication is the result of prolonged hospitalization or disability or is caused by factors inherent in the healthcare system rather than a disease.

Latent Error

- These are errors in system or process design, faulty installation or maintenance of equipment, or ineffective organizational structure.
- These are present, but may go unnoticed for a long time with no ill effect.
- When a latent error occurs in combination with an active human error, some type of event manifests in the patient. The active human error triggers the hidden latent error, resulting in an adverse event.
- Latent errors are basically "accidents waiting to happen." A classic example is a hospital with several types of chest drainage sets, all requiring different connections and setups, yet not all frontline clinicians and nurses are familiar with the intricacies of each setup, creating the scenario for potential error.

Medical Error

- The failure to complete the intended plan of action or implementing the wrong plan to achieve an aim.

- An unintended act or one that fails to achieve the intended outcome.
- Deviations from the process of care, which may or may not result in harm.
- When planning or executing a procedure, the act of omission or commission that contributes or may contribute to an unintended consequence.

Negligence

- Failure to meet the reasonably expected standard of care of an average, qualified healthcare worker looking after a patient in question within similar circumstances. For example, the healthcare worker may not check up on the pathology report which led to a missed cancer or the surgeon may have injured a nerve by mistaking it for an artery.

Negligent Adverse Events

- A subcategory of *preventable*, adverse events that satisfy the legal criteria used in determining negligence.
- The injury caused by substandard medical management.

Near Miss

- Any event that could have had an adverse patient consequence but did not.
- Potential adverse events that could have caused harm but did not, either by chance or because someone or something intervened.
- Near misses provide opportunities for developing preventive strategies and actions and should receive the same level of scrutiny as adverse events.

Never Event

Never events are errors that should not ever have happened. A classic example of a never event is the development of pressure ulcers or wrong-site surgery. The National Quality Forum has identified the following as Serious Reportable Events:

- Care Management
- Device/Product

- Environmental
- Patient Protective
- Surgical
- Radiological

Noxious Episode

- Untoward events, complications, and mishaps that result from acceptable diagnostic or therapeutic measures deliberately instituted. For example, sending a hemodynamically unstable trauma patient for prolonged imaging studies instead of the operating room. The result could be a traumatic arrest and death.

Patient Safety

The process of amelioration, avoidance, and prevention of adverse injuries or outcomes that arise as a result of the healthcare process.

Potentially Compensable Event

- An error that could potentially lead to malpractice claims.
- An event due to medical management that resulted in disability, and, subsequently, a prolonged hospitalization.

Root Cause

A deficiency or decision that, if corrected or avoided, will eliminate the undesirable consequence (Kellogg et al., 2017).

Common root causes include:

- Changes in mental acumen including conducting healthcare in an automatic fashion, not seeking advice from peers, misapplying expertise, not formulating a plan, or not considering the most obvious diagnosis.
- Communication issues, having no insight into the hierarchy, having no solid leadership, not knowing whom to report the problem, failing to disclose the issues, or having a disjointed system with no problem-solving ability.
- Deficiencies in education, training, orientation, and experience.
- Inadequate methods of identifying patients, incomplete assessment on admission, failing to obtain consent, and failing to provide education to patients.

- Inadequate policies to guide healthcare workers.
- Lack of consistency in procedures.
- Inadequate staffing and/or poor supervision.
- Technical failures associated with medical equipment.
- No audits in the system.
- No one prepared to accept blame or change the system.

Sentinel Event

The Joint Commission defines a "sentinel event" as “any unexpected occurrence involving death or serious physical or psychological injury, or the risk thereof...The phrase 'or the risk thereof' includes any process variation for which a recurrence would carry a significant chance of a serious adverse outcome.” (The Joint Commission, 2017). Sentinel events are so called because, once discovered, they frequently indicate the need for an immediate investigation, discovery of cause, and response.

Extent of the Challenge

Approximately 400,000 hospitalized patients each year experience some type of preventable harm (James, 2013).

- Depending on the study, medical errors account for over $4 billion per year.
- Medical errors cost approximately $20 billion a year.
- Medical errors in hospitals and clinics result in approximately 100,000 people dying each year.
- Medical errors typically include surgical, diagnostic, medication, devices and equipment, and systems failures, infections, falls, and healthcare technology.
- Missed diagnoses or injuries from medication are common in outpatient settings.
- Most malpractice claims in hospitals are related to surgical errors, whereas most claims for outpatient care are related to missed or late diagnosis.
- Slightly more than half of the paid malpractice claims are related to outpatient care.
- To decrease overhead, hospitals often reduce nursing staff; staffing of RNs below target levels is associated with increased mortality.

Function

The function of reporting error-prone situations is to mitigate future medical errors. Multiple studies have identified that if error-prone situations are reported and managed by modification of the system, a decrease in frequency of the error and concomitant errors associated with it will occur.

Reporting

The Joint Commission requires member healthcare agencies to report sentinel events. A sentinel event, according to the Joint Commission, is "any unexpected occurrence involving death or serious physical or psychological injury, or the risk thereof." Sentinel events signal the need for investigation and response. The intense analysis is often required to confirm medication errors and transfusion reactions (The Joint Commission, 2017).

The Joint Commission reviews events that have resulted in unexpected mortality, major permanent harm, or severe temporary harm requiring intervention to sustain life. A sentinel event may stem from the following:

- Abduction of any patient
- Any intrapartum maternal death
- Any unauthorized departure of a patient from a staffed-around-the-clock care setting resulting in death or harm
- Unanticipated death of a full-term infant
- Discharge of a child to the wrong family
- Hemolytic transfusion reaction involving administration of blood/blood products with major incompatibilities
- Procedures on the wrong patient or at the wrong site
- Prolonged fluoroscopy with total dose greater than 1500 rads to a single field
- Radiotherapy to the incorrect body region or more than 25% above the planned dose
- Rape, assault, or homicide of any patient receiving care
- Severe maternal morbidity resulting in permanent harm or severe temporary harm
- Severe hyperbilirubinemia in a neonate greater than 30 milligrams/deciliter
- Suicide of any patient receiving care in a staffed-around-the-clock care setting within 72 hours of discharge
- Unintended retention of a foreign object in a patient during surgery

Most sentinel event reporting occurred in acute care hospitals, while approximately 10% were reported in psychiatric hospitals.

Reporting medical errors and requiring institutions to develop plans to correct errors is a national agenda. Two major frameworks for analysis are used: root cause and failure mode effect analysis.

Root Cause

Root cause analysis (RCA) is used to identify the causative factors that underlie variations in performance (Kellogg et al., 2017). Root cause typically evaluates sentinel events that result in physical or psychological injury or death. A sentinel event triggers an investigation that identifies the cause and improves the systems and processes to decrease the odds of a repeat event.

The Joint Commission requires healthcare institutions to do a root cause investigation after any sentinel event. This process discovers the causative event and factors that resulted in the occurrence of a sentinel event and helps prevent future repeat errors. The process for improvement is developed into action plans.

- For example, a provider prescribed Azithromycin for a patient allergic to erythromycin and the patient developed acute anaphylaxis and died. This sentinel event was reported to The Joint Commission. The hospital conducted a root cause investigation and an action was developed to educate the entire medical staff on drug-drug interactions.
- The Joint Commission receives a copy of the report. The Joint Commission aggregates all of the reports and publishes risk-reduction strategies in the “Sentinel Event Alert” newsletter.

RCA is designed to help discover the causes of errors and get to the source. It is intended to discover the hidden cause or causes of an error. The individuals on the RCA team focus primarily on systems and processes, not on the action of the individual. The team identifies changes in systems and processes that will improve performance and reduce the incidence of the same sentinel event (Kellogg et al., 2017).

If a healthcare agency fails to perform an RCA, the institution is placed on accreditation watch. This is a publicly disclosable indication that a sentinel event occurred without having an acceptable action plan completed. When patient health and safety is threatened by a sentinel event, the Joint Commission conducts onsite reviews. A RCA should lead to action plans that include strategies that identify and reduce the risk of future similar events. Because patient safety is the goal of healthcare agencies, reporting should be encouraged. Information from reports should be shared and published across the entire organization to prevent future errors.

Failure Mode Effect Analysis

Failure mode effect analysis fosters safety and the prevention of accidents through a proactive process of identifying potential or real failures, causes, and effects. Failure mode effect analysis concludes errors will occur even if healthcare professionals are careful. Failure mode effect analysis engages in a continual process of quality improvement to assess and correct areas where an error has occurred or is likely to occur. The strategy with failure mode effect analysis is to build redundancies to serve as safety nets that trap errors (Van Tilburg et al., 2006).

Examples of failure mode effect analysis include:

- Provider writes an order, a unit clerk reads and transcribes the order, a nurse checks order, and the clerk confirms the accuracy.
- A pharmacist dispenses a drug, a nurse confirms the pharmacists are dispensing accurately, and the drug is administered.

Error-prone Situations

The following are the most common medical errors (AHRQ, 2017):

- Pressure ulcer
- Postoperative infection
- Postlaminectomy syndrome
- Postoperative hemorrhage
- Accidental puncture during a procedure
- Mechanical complication of a non-cardiac device, implant or graft
- Ventral hernia
- Postoperative hematoma
- Mechanical complication of cardiac device, implant, or graft

Situations and drugs that commonly result in errors include:

- Antithrombotic agents (e.g., insufficient dosing leading to a thrombotic event like a stroke, excess dosing resulting in bleeding)

- Cardioplegic solutions (e.g., errors in preparation, team breakdown, lack of technical competence, and poor monitoring of the patient)
- Chemotherapeutic agents (e.g., administering the wrong dose, wrong drug, wrong number of days supplied, and missed doses). In addition, drug administration errors including wrong flow rate or failure to monitor the site of intravenous (IV) transfusion are often reported with chemotherapeutic drugs administered intravenously.
- Dialysis solutions (e.g., administering wrong medication, wrong dose, infection at site, hyperkalemia, patient falls, and access-related errors)
- Epidural or intrathecal medications (risks include erroneous infusions-administering an IV medication via the intrathecal route, giving wrong medication or wrong dose)
- Hypertonic solutions (known to cause renal failure, edema, hyperchloremic metabolic acidosis, coagulation abnormalities)
- Hypertonic sodium chloride for injection (associated with renal failure, confusion, coma, seizures)
- Hypoglycemic agents (known to cause hypoglycemic episodes when the dose is unmonitored)
- IV Adrenergic agonists such as epinephrine, norepinephrine, and phenylephrine (administered in a vein that infiltrates, can lead to severe vasoconstriction leading to ischemia and gangrene of the hand and digits)
- IV Adrenergic antagonists such as labetalol, metoprolol, and propranolol
- IV Anesthetic agents such as propofol
- IV Antiarrhythmics such as amiodarone and lidocaine
- IV Inotropic agents such as digoxin and milrinone
- IV Radiocontrast agents
- Liposomal drugs such as liposomal amphotericin B
- Medication ordering and delivery
- Narcotics and opioids (prescribing and dispensing high doses of opiates to native opiate users resulting in respiratory depression, seizures, and even death)
- Neuromuscular blocking agents such as succinylcholine, rocuronium, succinylcholine, vecuronium
- Parenteral nutrition preparations

- Patients with impaired cognition, flexibility, or strength, flexibility
- Sedation agents such as dexmedetomidine, midazolam, and chloral hydrate
- Sterile water for injection, inhalation, and irrigation
- Transfusion of blood products

High-risk medications:

- Epinephrine
- Epoprostenol
- Insulin
- Magnesium sulfate
- Methotrexate
- Nitroprusside sodium
- Opium tincture
- Oxytocin
- Potassium chloride
- Potassium phosphates
- Promethazine
- Vasopressin

High-risk medications have the potential to cause significant patient harm or even death when used erroneously. Special safeguards are in place in most healthcare institutions to minimize the risk of errors associated with these medications (Graham, 2008).

Issues of Concern

According to The Institute of Medicine, a medical error is “The failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim.”

The Quality Interagency Coordination Task Force, a Federal Agency for Healthcare Research and Quality, describes a medical error as a “failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim. Errors can include problems in practice, products, procedures, and systems” (AHRQ,2001).

A medical error is usually a preventable adverse effect of medical care. Some of the most common problems that occur when providing health care are:

- Adverse drug events
- Burns
- Equipment failure
- Failure to provide prophylactic treatment
- Falls
- Improper transfusions
- Misdiagnosis, delay in diagnosis, or failure to utilize the appropriate test as well as a failure to act on the laboratory result
- Mistaken patient identities
- Pressure ulcers and deep vein thrombosis
- Preventable suicides
- Restraint-related death
- Surgical injuries
- Under and overtreatment or errors in administering treatment (wrong dose or wrong site of administration)
- Wrong-site surgery

Higher error rates usually occur in stressful, fast-paced environments such as emergency departments, intensive care units, and operating rooms. Medical errors are associated with extreme age, high acuity, and new procedures. Errors often occur when necessary personnel are not available when needed. When multiple practitioners are involved, an incomplete preoperative assessment may occur. Students, interns, residents, and fellows may be inadequately supervised due to time constraints or lack of understanding their abilities. Inconsistent postoperative monitoring procedures may lead to errors.

TYPES OF ERRORS

Surgical Errors

Over 200 million surgical procedures are performed each year globally, and despite awareness of adverse effects, surgical errors continue to occur at a high rate. Surgical errors account for a significant number of adverse events (Christensen, 2015).

- At least 4000 surgical errors occur each year in the United States each year.
- Operating on an incorrect body part is a common source of surgical error.
- Robotic surgery results in an increase in accidental hemorrhage caused by lacerations and injury to surrounding tissues.

What is interesting about surgical errors is that these errors appear to be more common before and after the surgical procedure rather than mistakes made in the operating room. Some of the causes of surgical errors include the following:

- Lack of adequate surgeon training and education
- Absence of standardized rules and regulations
- Major gap in communication between the surgeon, anesthesiologist, and other ancillary staff
- Gap in communication between the surgeon and the patient
- Use of unreliable systems or protocols
- Rush to complete cases
- Human factors

Prevention

Errors in surgery do not arise spontaneously. They develop from the interaction of multiple people and equipment. In order to decrease surgical errors, providers need to know when and where errors may occur (AHRQ, 2017).

The key risk factors to be aware of include:

- An attitude that a surgeon's decisions should not be questioned. Some surgeons do not like to be questioned by junior staff about the procedure or availability of pertinent images in the operating room. Over the years, a

number of malpractice cases have resulted because surgeons failed to listen to operating room staff about the site of surgery and the lack of biopsy results.

- Distraction: some surgeons and other operating staff were distracted by their digital devices when caring for a patient.
- Incomplete or missing pertinent imaging information and relying on memory.
- Incomplete preoperative assessments such as failing to note abnormal pre-op labs or EKGs.
- Multiple surgeons performing more than one procedure.
- Poor staffing.
- Time pressures leading to shortcuts or not following established timeout requirements
- Wrong-site surgery (wrong patient, wrong body part, wrong side, or wrong anatomic level).
- Wrong labeling of the specimen or even discarding the specimen as waste.

To prevent surgical errors and enhance patient safety, hospitals have introduced the following guidelines:

- Adopting a checklist of things that must be done. Prior to induction of anesthesia two independent healthcare professionals must confirm the patient's identity, site of surgery, type of procedure, and review the consent form.
- Prior to making the skin incision, the anesthesiologist, surgeon, and nurse must again confirm the identity of the patient and confirm the type of surgery. This team also identifies the need for antibiotic prophylaxis and deep vein thrombosis prevention maneuvers.
- After completion of the surgery but before leaving the operating room, the surgeon, anesthesiologist, and a nurse verbally conclude the completeness of the count of instruments and sponges, verify that the specimen is labeled, and note the clinical status of the patient.

Wrong-site surgery can be minimized if patients and family members are given an opportunity to correct a significant mistake before it occurs. Engaging patients, nurses, scrub techs, anesthesiologists, anesthetists, and surgeons in knowing and minimizing the risks helps avoid wrong-part surgery, wrong-patient surgery, or a wrong-surgical procedure. Increasing communication with healthcare providers, family, and patients about the possibility of such mistakes alerts all involved to double and triple check to avoid grave mistakes.

Probably the most essential surgical safety measure is a timeout: a preoperative pause involving all members of the surgical team. Timeouts need to occur when the patient is on the operating table before surgery begins. A timeout is

done to ensure the correct site, correct procedure, and correct patient will minimize costly mistakes. Following a defined protocol is mandatory.

Diagnostic

Diagnostic errors result in death or injury to 40,000 to 80,000 patients per year according to the Joint Commission. Diagnostic errors are most common in primary care solo practice due to workload and inability to cross reference easily with colleagues. In healthcare institutions, patients are usually seen by many health care providers, e.g. attendings, residents, fellows and medical students) decreasing the chance of diagnostic error (Singh et al., 2017).

Many of these deaths are preventable. The following data emphasizes the need for improved safety measures:

- One patient in every six is affected.
- One in every 1000 primary care visits causes preventable harm.
- Inaccurate diagnosis may occur with clinicians, radiologists, and pathologists.
- The most common diagnostic errors occur in primary care settings include failure to order appropriate tests, faulty interpretation, failure to follow-up, and failure to refer.
- A common cognitive error is closing the diagnostic process prematurely. This can result in common, benign diagnoses for patients with uncommon, serious disease.
- Delaying treatment after the diagnosis is made is the third most common error and results in increased costs for readmission and further treatment.

Commonly missed diagnosis includes the following:

- Acute renal failure
- Acute pyelonephritis
- Acute vascular occlusion
- Adverse effect of medication
- Aneurysms
- Angina
- Appendicitis

- Arrhythmias
- Asthma exacerbation
- Cellulitis
- Decompensated heart failure
- Hypertension
- Metastatic cancer
- Metabolic disorders like hypoglycemia, gout
- Osteomyelitis
- Primary malignancy
- Pneumonia
- Spinal cord compression
- Symptomatic anemia
- Urinary tract infection

Diagnostic error is a potential challenge for virtually all medical specialties. The overall misdiagnosis rate is approximately 10% to 15%.

Prevention

Clinicians should be aware of the most commonly misdiagnosed conditions and take extra precautions to seek and confirm the diagnosis. Clinicians must be aware of and carefully consider the following common "high risk" diagnoses.

Cardiac

Diagnostic error is the most common, with coronary atherosclerosis frequently missed. Aortic disease, such as an aneurysm and dissection, can also be misdiagnosed. Procedures involving angioplasty and cardiac catheterization are significant sources of medical cardiovascular liability.

Pulmonary Embolism

Pulmonary embolism (PE) is often challenging to diagnose. It is known as the "great masquerader" for a reason. The symptoms can be nonspecific and range from mild to severe. Patients present with a broad range of signs and symptoms similar to other diseases, including shortness of breath, chest pain, confusion, hypotension, and cardiovascular collapse. PE potentially has very mild symptoms, and it is an incidental finding in approximately 3% of chest CTs.

Cancer

Failure to diagnose and treat cancer early can result in more difficult therapy and lower the success rate of cure. Error rates in the tissue diagnosis of cancer are as high as 15%. The clinical diagnosis of malignancy is often challenging. High risk patients need annual screening for skin and other cancers.

Neurologic

There is a challenge to making the initial diagnosis, particularly in young patients, psychiatric patients, and those with other diseases that may cause stroke-like symptoms. Misdiagnosis of a neurologic emergency may be mitigated with a detailed history and physical exam, early access to imaging, and rapid consultation with neurologists.

Medication

Medication errors are considered a preventable event (Hines et al, 2018).

Common medication errors include:

- Ability to override medication-use safeguards.
- Deterioration of medication.
- Different medications mixed in the same drawer.
- Dispensing machines filled with the wrong product.
- Errors in gaining access to medication dispensers.
- Failure to pay attention to the product label.
- Incorrect storage of medications.
- Lack of double-checks when restocking.
- Lack of pharmacist involvement in preparation and dispensing.
- Medication misuse associated with drugs, healthcare related products, procedures, order and product labeling, packaging, monitoring, nomenclature, administration, compounding, dispensing, distribution, and use.

- Unused medication returned to the wrong place.
- Unintentional overdose in children can occur because of the differences in weight, body surface area, and metabolic rates. Additionally, many pediatric medications come in liquid form.
- Use of out of date medications.

Prevention

Systems can help decrease hospital medication errors. Some examples include electronic medical records, standardized units of measure, avoiding confusing units of measure, weight-based dosing, and having a pharmacist available to assist with calculating the correct dose. To avoid preventable medication errors, review medication and dosing before administration.

Barcode administration and handheld personal digital assistants increase medication administration safety. Providing real-time patient information, medication profiles, laboratory values, drug information, and documentation reduces errors. Electronic medication administration helps identify incorrect and omitted medications and canceled or changed medication orders. Circumventing barcode procedures decreases safety at the point of care. Automatic dispensing systems that make drugs available to patients quickly at the point of care free up pharmacists and nurses time to engage in other safety activities, such as medication reconciliation.

Some techniques to reduce medication errors include:

- Enforcing double and triple check.
- Installing keypad backlighting.
- Involving pharmacists.
- Maintaining sealed drug sets with correct dosing for code situations.
- Placing concentrations on one screen.
- Preprinting drug labels to identify tubing.
- Providing alerts when a rate or dose is out of the normal range.
- Training nurses or pharmacists to double-check pump doses.
- Using tubing separators.

All healthcare providers should work together for medication prescribing, administration, and monitoring. Interdisciplinary collaboration is necessary to establish safe medication use and distribution. Physicians and nurse practitioners should double-sign high-alert medications, especially those with narrow safety ranges for a therapeutic effect.

Pharmacists and nurses should stock look-alike medications away from more dangerous medications. Hospitals should reduce look-alike medications by grouping drugs by category instead of alphabetical order. Computer-based forms should be available for parenteral nutrition orders. Pharmacists should remove dangerous medications from floor stock and discard out-of-date drugs. Oral liquids should be in unit-dose packages only. Concentrated electrolytes should not be on patient care units.

Tubing Misconnection

Errors involving tube and catheter connections are common. If a misconnection is not caught early and corrected, these adverse events can have life-threatening effects (Wolf et al, 2009). To further complicate the situation, medications and food supplements are often delivered via these routes, and the wrong placement of a tube can result in a potentially toxic substance ending up in the wrong locations.

Factors resulting in misconnections and misplacement include:

- Connecting feeding tubes to the ventilator port.
- Deliberately or accidentally using catheters for unintended purposes, such as using IV extension tubing for drains, epidurals, and central lines.
- Placing feeding tubes in the lung instead of the stomach.
- Universal connectors that allow catheters with a dissimilar function to be connected.

Prevention

Clinicians and support staff must be educated that tubing misconnections and incorrect placement of feeding tubes, dialysis catheters, IV catheters, blood pressure cuff inflation lines, epidural lines, pulmonary artery catheters, and tracheostomy tubes may result in serious injury or death.

Use of Luer connectors is a common factor in tubing misconnections. Luer-lock (connection made by rotating connector) and Luer-slip (connection made by the insertion of the tapered male end into the female receptor) connections vary which results in high-risk error-prone situations. Providers and support staff must always trace lines

back to the origin before connecting or disconnecting devices or starting infusions. It is important to label high-risk catheters.

Device and Equipment

Health professionals generally believe technology will improve healthcare efficiency, lower cost, increase quality, and promote safety; however, these same technologies may also introduce errors and adverse events. Given that there are approximately 5000 types of medical devices used by millions of healthcare providers throughout the world, device-related errors are inevitable. The benefits of technology may not be realized due to four common pitfalls:

- Inadequate maintenance
- Inadequate plan for implementing technology into practice
- Poor technology design that does not consider human factors and ergonomic principles
- Poor technology interface with the environment and patient

Medical and equipment flaws in design, mishandling, user-error, and malfunction are common causes of medical errors. User errors are often attributable to:

- Differences in function between devices from different manufacturers.
- Inadequate testing.
- Lack of standardization.
- Poor design.
- Poor maintenance.

There is also a tremendous increase in the number and type of medical devices implanted in patients such as pacemakers, defibrillators, nerve and brain stimulators to control pain and seizures, and shunts. Malfunction of these devices may result in life-threatening events.

Prevention

Workplaces, instruments, and equipment should be developed to consider human factors in design. A health professional user can maximize safety through the selection process, confirming that equipment is maintained, and proactive risk-assessment methods.

Health professionals should:

- Be involved in setting and evaluating institutional, organizational, and public policy related to technology.
- Make sure that technology used meets quality and safety standards.

Institutions should:

- Make decisions concerning technology with the input of critical stakeholders
- Have policies and processes related to maintenance, training, monitoring, and reporting adverse events related to technology.

Iatrogenic Infection

Healthcare-related infections are considered a failure of the system. As much as one in 20 hospitalized patients may acquire a healthcare-related infection which may increase complications, length, and cost of the hospital stay. Healthcare-related infections add close to $35 billion to the annual cost of healthcare in the United States. Nosocomial infections are a common problem in hospitalized patients. Preventing them requires adherence to infection control protocols (Revelas, 2012).

Causes of hospital-acquired infections include:

- Failure to practice basic hand hygiene.
- Poor technique in placing indwelling Foley and vascular catheters.

Iatrogenic Infections

Common Associated Organisms

Acinetobacter baumannii has mainly been found in the intensive care unit and in other areas of the hospital where critically ill patients are managed. The bacteria do not pose a threat to healthy individuals but can lead to a severe infection in patients with a suppressed immune system. These organisms have been found to cause meningitis and pneumonia, wound infections, and urinary tract infections. Another major concern is that *Acinetobacter* is rapidly developing resistance to many of the commonly used antibiotics.

Bacteroides fragilis is a normal occurring organism in the colon. The organism is generally not harmful but is an opportunist. When patients take antibiotics, this cansuppress other normal flora and allow *Bacteroides* to enter the

systemic circulation. The slow growth of bacteria and its occurrence with other colon pathogens often makes treatment difficult.

Clostridium difficile is the most well-known because of its ability to induce life-threatening colitis. The bacteria thrive in the presence of antibiotics and can easily spread via the oral-fecal route in a hospital setting. *C. difficile* is resistant to most routine cleaning solutions, including alcohol-based sanitizers. *C. difficile* can be treated, but in some cases, a fecal transplant may be required.

Carbapenem-resistant *Enterobacteriaceae* have become very common in hospitalized patients. These organisms are easily transferred from human to human by contact with skin or an infected device such as a Foley catheter. High mortality rates occur in patients who develop sepsis with these resistant organisms.

Enterococcus faecalis is a highly resistant colonic organism. Most isolated cases in hospitals reveal that this strain is resistant to vancomycin, leaving very few treatment options for patients. While *enterococcus* is normally found in the colon, it can enter the systemic circulation and cause sepsis, wound infections, urinary tract infections, and even pneumonia.

Escherichia coli is another gram-negative organism found in the intestinal tract, but it can become pathogenic when the opportunity arises. It is the most common cause of urinary tract infections in hospitalized patients. The 0157.H7 strain can cause hemolytic uremic syndrome.

Klebsiella pneumoniae is a common cause of pneumonia, urinary tract infections, wound infections, and meningitis. The risk of infection with *Klebsiella* is greater in patients with catheters and those on ventilators. Many species of *Klebsiella* are resistant to traditional antibiotics. These organisms are often a cause of infections in the neonatal intensive care unit and carry a high morbidity and mortality.

Other organisms that are associated with hospitalized patients include methicillin-resistant *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Stenotrophomonas maltophilia*, and vancomycin-resistant *Staphylococcus aureus.*

Prevention

Appropriate hand-washing is one of the single most effective methods to decrease infection transfer. High-risk procedures such as indwelling Foley catheter and vascular catheter infection rates can be decreased by adhering to the use of sepsis bundles.

Effective hand washing is linked to decreased morbidity and mortality rates. Sink availability or alcohol-based hand rubs prevent nosocomial infections. The Centers for Disease Control and Prevention guidelines include:

- Avoiding artificial nails.
- Changing gloves after each patient is evaluated or treated.
- Keeping natural nails less than one-fourth of an inch long.
- Use alcohol-based hand rubs.
- Washing hands with soap and water.

Hospital-acquired pneumonia causes significant morbidity and mortality. Risk factors include anemia, malnutrition, chronic renal failure, depressed mental status, thoracic surgery, and recent hospitalization. While decreasing hospital-acquired infections is a difficulty, attention to risk factors and interventions may help decrease the incidence. *C. difficile*-associated infection has become a significant problem. *C. difficile* is most associated with the use of clindamycin, cephalosporin, and penicillin and warrants frequent surveillance.

Falls

Falls are a common problem. Each year, over one-third of people over the age of 65 suffer a fall, and one-third of these falls cause injuries (Erin et al., 2013). In a healthcare setting, a number of factors may further increase the risk of falls, including:

- Blood loss.
- Medication side effects.
- Post-anesthesia effects such as diminished lower-body sensation.
- Volume loss.
- Decreased blood sugar.
- Altered mental status.
- Environmental change.
- Urge to void or defecate.
- Decreased strength or balance.

Factors that induce falls may be divided into two types: intrinsic and extrinsic.

- Intrinsic factors include vision, gait, and health history. These factors are not typically modifiable.
- Extrinsic factors include environmental hazards and medications. These may be modifiable and preventable.

Prevention

Patient falls decrease when patients who are assessed as at risk of falling are attended to hourly. To decrease the incidence of falls:

- Identify high-risk patients with armbands or other visual cues alerting providers of the fall risk.
- Provide safety companions to aid patients who fall risks.
- Educate families about fall prevention.
- Set bed alarms for close monitoring of at-risk patients.
- Do frequent safety rounds on all high-risk patients.

Information Technology

Electronic Health Records

Information technology may result in errors. Perhaps the most common is accidentally charting information or placing orders on the wrong patient. While electronic health records (EHR) provide more clearly written information, they also may facilitate charting information on the wrong patient. Currently, there are no regulatory agreed-upon design standards that successfully limit potential errors (Walker et al., 2008).

Electronic records often decrease clinician efficiency. In addition, clinicians report the computer comes between them and the patient and creates constant distractions.

Often EHRs are designed to be additive, and it may be impossible to correct prior errors. This can lead a clinician to propogate forward incorrect information.

With the deployment of electronic records, three phases of medical malpractice risk have been recognized and include the following:

1. Implementation phase. During this phase, practitioners are acquiring new skills and learning a novel system. Thus, lack of or inadequate training with implementation during this phase leads to new errors.

2. Transition phase. During the move from a paper record or from one computerized system to another, records can be misplaced or incorrectly added to a patient's record.
3. Mature phase. System-wide failures, such as server errors or intranet failure, may occur, creating chaos and interfering with documentation.

Computerized Prescriber Order Entry

Computerized order entry helps prescribers, pharmacists, and nurses distributing medications reduce adverse drug events. Unfortunately, only about one-third of hospitals have these systems in place and even fewer use barcode medicine administration to decrease medication errors (Palojoki et al., 2016).

Prevention

Actions to decrease errors in information technology include:

- Automating dispensing devices.
- Barcoding.
- Computerizing the medication administration record.
- Computerizing order entry and decision support.
- Intercepting error messages at the time medications are ordered.
- Prompt warnings for drug interaction, allergy, or overdose.
- Providing drug-specific information.
- Filling prescriptions using robotics.
- Providing up-to-date information on new drugs.

Studies have suggested that computerized provider order entry systems could reduce medical errors by approximately 50%. Clinicians completing orders should have distraction free locations to optimize this potential.

Communication

Verbal ErrorsIneffective communication, a common cause of medical errors, risks patient safety (Singh et al., 2008).

Risk factors include:

- Disruptive behavior including rude language or verbal abuse.
- Environmental noise issues such as cell phones, pagers, and phones.
- Cultural differences among patients and providers.
- Hierarchy issues.
- Providers acting as autonomous agents.
- Personality differences.
- Language barriers.
- Lack of working as a team.
- Multiple conversations are occurring simultaneously.
- Socioeconomic variables, such as education and literacy.

Prevention

A courteous and respectful workplace in which the interdisciplinary team collaborates promotes a safe work environment for all members of the healthcare team, families, and patients. Risk management committees and multidisciplinary task forces should work collaboratively on risk assessment and risk reduction. Joint education programs help providers and support staff learn roles and develop relationships with the goal of improving safety.

Healthcare organizations should maintain policies that require printed prescriptions. If verbal orders are given, they should be read back orders and receive confirmation. The Joint Commission's Safety Goals require that for critical test results and verbal or telephone orders, a "read-back" is required by the person receiving and recording the result or order, who must read back the order verbatim to the practitioner. The practitioner should verbally acknowledge the orders accuracy.

Clinicians should follow well-communicated protocols that guide care and communication. Providers should listen to patient questions concerning how care is delivered. Concerns need to be respected and accepted as correct and documented if contrary to established evidence-based medicine. Providers need to help patients with the information they need to know about their care. Well-informed patients avoid serious medical errors. The Joint Commission has supported "Speak Up" initiatives, which encourage hospitals to inform patients about the importance of their contributions to the care they receive. To make patients active participants in avoiding medical errors, encourage patients to ask about unfamiliar tests, unplanned diagnostic tests, medications, and to verify the correct surgical site.

Written Errors

Using non-standard abbreviations and illegible handwriting, failure to question inappropriately written orders, and failure to complete correct specimen labeling are common sources of written communication errors.

Prevention

Staff should never be reprimanded for questioning orders. When writing orders or prescriptions, clinicians should:

- Avoid @ (use “at”).
- Avoid < or > (use “less than” or “greater than”).
- Avoid a trailing zero (0.1 mcg, not 0.10 mcg).
- Avoid abbreviations that look alike such as QD, QOD, U, IU, and HS.
- Avoid cc (use “mL” or “milliliters”).
- Avoid hand-writing orders and prescriptions; if necessary, print.
- Avoid µg (use “mcg” or “micrograms”).
- Avoid medication abbreviations, like MgSO4 for magnesium sulfate and MS or MS04 for morphine sulfate
- Use standard abbreviations.
- Write a zero before a decimal point dose (0.1 mL, not .1 mL).

The Joint Commission requires healthcare professionals to use two or more patient identifiers when labeling, delivering, and maintaining specimens. Practitioners should always double-check that the patient’s name is spelled correctly and their correct date of birth is present. Since this is a National Patient Safety Goal, The Joint Commission closely monitors healthcare institution adherence to this requirement as they prepare medications, transfusions, and transfer patients unit to unit.

Patient Hand-offs

Patient handoffs are a common source of errors (Saleem et al., 2015). This can occur if incorrect information is passed to the receiving clinician and/or there is a failure to remember to follow-up on all of the pending issues.

Prevention

There are two common techniques to help minimize error development when handing off patients (1) providing the receiving clinician with an action plan to assist in assuming the care of the patient and (2) use mnemonics to assist in remembering the checklists. Two mnemonics to assist in remembering the checklists are the following:

- I-PASS (Illness severity, Patient summary, Action lists, Situational awareness and contingency planning, and Synthesis by receiver)
- SBAR (Situation, Background, Assessment, and Recommendation)

In addition, the clinician discharging the patient should remember to perform a final bedside evaluation and review discharge instructions before sending any patient home. Important components include:

- Reexamine the patient one last time.
- Give the patient a thorough follow-up plan including welcoming their return to the hospital or office for new, worsening, or persisting symptoms.
- Document discharge.

Acute Intervention

A code or arrest, intubation, or other acute, life-threatening event is a high-risk situation for medical error. Due to the rapidity of decision making and the instant need for life-saving drugs and procedures, there is a significant risk of error.

Prevention

Rapid response teams trained and organized to prevent or respond to cardiac or respiratory arrest mitigate errors in this acute setting. Critical response teams bring expertise to the bedside when it is needed. Team effectiveness is improved if end-of-life plans of care for deteriorating patients are addressed with the patient and family at the time of admission. Family meetings can result in identifying goals that improve end-of-life care and avoid unnecessary end-of-life procedures.

Clinical Significance

A medical error is one of the most common causes of injury or death in the United States. Health professionals work hard to save countless lives; however, the incidence of concomitant error is high. All health professions should be focused on the effort to “first do no harm” and work towards decreasing human and system error.

Most medical errors do not occur as a result of the practices of one practitioner or a group of practitioners. Most errors are due to systems or process failures that lead to practitioners making mistakes. For example, stocking two types of

similar medical devices for the same procedure that have slightly different implementation or stocking dangerous drugs on floor dispensers without pharmacist supervision.

Errors can be prevented by modifying the healthcare system to make it more difficult for practitioners to perform incorrect actions and easier for them to do correct actions. While individuals need to be held accountable for errors attributable directly to them, the system and culture need to be revised so that reporting errors leads to system improvement and not individual punishment. The greatest good for the greatest number of patients is achieved when the system constantly focuses on continuous quality improvement and avoiding repetition of the same error.

The most common errors that practitioners should maintain a high level of diligence in avoiding include catheter-associated urinary tract infections, central line bloodstream infections, adverse drug events, falls, pressure ulcers, obstetrical adverse events, venous thrombosis, surgical site infections, and development of ventilator-associated pneumonia.

Common sources of error usually involve diagnoses, delay in diagnosis, or incorrect diagnosis. This often relates to failure to develop a complete differential diagnosis, failure to pursue a differential diagnosis, failure to order appropriate diagnostic tests, failure to address an abnormal test result, and failure to consider all information available. Further adverse events result from failure to consult and premature discharge from the hospital.

Some of the most common misdiagnosed conditions include myocardial infarction, stroke, pulmonary embolism, spinal epidural abscess, necrotizing fasciitis, testicular torsion, meningitis, subarachnoid hemorrhage, lung cancer, septicemia, appendicitis, and fractures.

Patients at high risk of diagnostic error include those with comorbid conditions that distract practitioners from considering a complete differential. Practitioners err by focusing on previously established conditions rather than ruling out potentially new organic problems. Patients with poor hygiene are at higher risk as practitioners may spend less time with them. When patients and their caregivers have language barriers or communicate through interpreters communication errors may result. Patients that do not follow instructions or follow-up are also at particular risk of inducing error.

Poor communication between patient and family are potentially leads to situations fraught with error.

Suggestions for avoiding diagnostic errors include:

- Avoid first impression diagnosis.
- Document a complete differential diagnosis and evaluation.
- Ensure that specialists evaluate patients with potentially or active life-threatening conditions.

- Obtain appropriate consultation.
- Ensure that all handoffs are handled in a manner that assures the patient will be taken care of appropriately. The handoff should include clear delegation of follow-up on all test results and a plan of action proposed for the patient's disposition.

Common problems developing after discharge from the hospital included several unexpected findings related to the hospitalization. The most common are:

- Atypical clinical presentation or an unusual presentation of a well-known disorder.
- Chronic disorder with an unexpected outcome or sudden decompensation.
- Abnormal vital signs, particularly tachycardia, have been associated with adverse outcomes when present at discharge.
- Patients hospitalized for chronic psychiatric illnesses.

Patient safety, mortality, and morbidity rates will decrease when institutional efforts result in the implementation of action plans which reduce medical errors. Patient deaths resulting from healthcare-associated infections, equipment, and drug and test distribution decline when protocols are created and sustained that assist in error reduction. Blood transfusion errors are avoided by standardizing procedures and orienting staff to follow verification procedures. Care quality and patient safety are improved with decreased nosocomial infections, better pain management, skin integrity maintenance, and improved fall precautions.

Teamwork, education, and training through structured initiatives are the most effective mechanism to improve patient safety. Accepting the contributions of team members, reducing barriers to reporting errors, and promoting a work environment where all individuals work together will have the most significant effect on improving patient and staff safety.

Other Issues

Safety Promotion

- Build better teams
- Build safeguards into administration that require double- and triple-checks involving look-alike or sound-alike drugs.
- Carefully label medications delivered in bulb syringes, medication cups, and basins.

- Decrease time to report abnormal test results.
- Encourage following written protocols and procedures.
- Establishing a “quiet zone” or “time out” when preparing medications for administration.
- Check hospital discharges through the clinician, nurse, family, and patient; if any have reservations, reconsider discharge.
- Insert tubes correctly and confirm placement location before activation.
- Involve a pharmacist in all high-risk drug delivery to patients
- Limit shift duration to avoid fatigue-related errors.
- Place hazard warnings where they will be seen.
- Promote education in avoiding errors and encourage safety.
- Promote the institution's patient safety organization.
- Store dangerous drugs in a separate area of the electronic dosage medication system.
- Take precautions to prevent central line-associated infections.
- Use anti-coagulants safely.
- Use computer technology for order entry.
- Use established guidelines to prevent venous thromboembolism.
- Use good design principles.
- Work toward improving your hospital’s patient safety culture.

Questions

To access free multiple choice questions on this topic, click here.

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