Chapter 4: Preventable Adverse Events

10 Contact Hours

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Learning objectives

• Explain the different strategies of patient safety.
• Describe various measures that improve patient safety.
• Classify the different medical errors and discuss the efficacy of interventions intended to reduce them.
• Differentiate preventable from non-preventable adverse events.
• Assess the nature and the frequency of adverse events to patients.
• Investigate the extent and frequency of drug-related safety issues.
• Identify the different safety issues in hand-offs/transfers by medical professionals.
• Assess patient reports about errors and compare the patient’s reports to events recorded by health care providers.
• Quantify the extent of inappropriate prescriptions to both children and adults.
• Discuss the importance of the Agency for Healthcare Research and Quality (AHRQ) reports on patient safety and the accepted AHRQ hospital patient safety indicators (HPSI).
• Differentiate the common types of adverse events of patients post-discharge and find and discuss ways to improve them.
• Recognize the risk factors, as well as the incidence and the different types of post-discharge events, such as drug administration errors, nosocomial infections, procedure-related errors, pressure ulcers, and diagnostic errors.
• Evaluate the various treatment options for diagnostic errors.
• Further investigate the mechanisms of diagnostic errors in both clinical and hospital settings to detect the warning signs for possible errors.
• Identify the different types of diagnostic errors and suggest ways to improve the process.
• Give examples of clinical scenarios and their adverse events/medical errors and evaluate the various ways to correct them.
• Discover potential sources of errors and opportunities for systematic improvement.
• Describe the key elements of electronic health records and their importance to the public.
• Discuss the impact of information flow between health care professionals on prevention of adverse events.
• Analyze the screening methods of collecting data and their contributing factors.

Introduction

During the past decade, several countries have increased scrutiny of the limitations that exist in the health care system. In response to this increased attention, many physicians and hospitals have implemented new standards and systems to reduce medical errors, as well as adverse events. However, the complexity of modern technology and health care systems makes complete elimination of preventable adverse medical events only marginally possible, at least for the foreseeable future.

Certain important questions must be answered, including which adverse events are preventable and which are not, and whether everything humanly possible is being done to reduce the incidence of preventable events. These answers will influence issues such as medical liability, and can also significantly affect the reimbursement provided for negligent health care services.

Scientific literature, physicians, and the lay press have reached a consensus that the basic definition of a preventable adverse event is one that causes injury to a patient as a result of medical intervention that could have been prevented. Moreover, physicians define a preventable adverse event as an injury that resulted due to medical intervention and not an underlying medical condition. A preventable adverse event represents an unintentional harm to the patient that might arise from any aspect of health care management.

Many of the preventable adverse events can be anticipated immediately, especially those that occur because of changing technologies. System failures, such as dysfunctional corporate cultures, poor management decisions, poor communication, poor staffing, inadequate resources, lack of safeguards, poor documentation, and lack of checkpoints, can facilitate increased incidences of preventable adverse events.

Human errors can be skill-based, knowledge-based, and also fatigue-based. Many times, human errors result from a failure to follow basic rules and regulations, which then result in technical mistakes or the problems coping with the demands and complexities of the health care system. Preventable adverse events are a direct result of the inability of physicians and health care professionals to follow the guidelines at the system level or at the individual level.

The accepted standards of care are the expected level of performance from the average competent health care system practitioner to manage any specific medical condition. Both health care systems and physicians are generally held responsible for continuous implementation, monitoring, upgrading, and enforcement of applicable standards. Any ignorance of and disregard for the standards can result in preventable adverse events.

Certain examples of preventable adverse events include:

- Wrong surgery performed at the wrong site, performed with the wrong procedure, or performed on the wrong patient.
- Leaving a foreign object in the patient after surgery.
- Transplant organ or blood incompatibility.
- Transmission of infection to the patient.
- Administering incorrect dosage of medication to the patient.
- Trauma sustained by the patient on the premises of the hospital, such as falls and burns.
- Pulmonary embolism without appropriate prophylaxis or deep venous thrombosis.
- Infection of the surgical site due to physician negligence.
- Ulcers caused by high blood pressure.
- Infection acquired from catheter.

Preventable adverse events are also caused by failure to diagnose, misdiagnosis, delayed treatment and diagnosis, poor performance of the practitioners in the operating room, and failure to follow up. These examples usually require unbiased expert opinion on an individual case-by-case basis to determine whether the accepted standards of health care were met. Many times, these examples ultimately lead to medical liability.
In any case of preventable adverse events, the health care systems and the responsible practitioners are subjected to financial penalties to solve the problem. Patients receive a payment or a report indicating that the adverse event that occurred at the hospital was an avoidable condition or complication.

An adverse event is a negative consequence of health care that results in unintended illness or injury of a patient that may or may not have been avoidable. A preventable adverse event, on the other hand, is an avoidable event in a given set of circumstances.

According to the World Health Organization (WHO), the risk of being harmed while receiving health care is much greater than the risk of being harmed by nuclear plants or travel – the chance of being harmed while receiving health care is 1 in 300, while the chance of being harmed in an aircraft is 1 in 1 million. This average estimation is based on the incidence of adverse events that occur across the world. However, it is important to stress that differences between developing countries and developed countries do exist and the risk can be 20 to 25 times higher in developing countries.

Patients in the health care system can be harmed by transfusion errors, wrong site surgery, adverse drug events, surgical injuries, treatment-related infections, and even mistaken identity. Adverse events are rare and a majority of them are completely preventable, which leads us to the question of just how safe is the healthcare system, and ultimately identify how and when these adverse events occur.

**Patient safety**

High quality healthcare is where our patient’s feelings of security are safeguarded. For example, patient safety is defined by the Institute of Medicine (IOM) as being indistinguishable from the delivery of high-quality health care. Even ancient philosophers such as Plato and Aristotle had contemplated the definition and attributes of quality. In fact, quality is considered to be one of the great ideas of the Western Hemisphere.

The definition for patient safety that has emerged from the quality health care movement is as equally abstract as the definition of quality. Moreover, the definition of patient safety has various approaches with concrete essential components. The IOM defines patient safety as the prevention of harm occurring to patients. Hence, increased emphasis is placed on the system of delivering quality health care to prevent errors and to learn from the errors that occur irrespective of all the precautions taken. Patient safety is built on the culture of safety that involves not just the health care system, but also patients and professionals.

Patient safety practices have also been defined as activities that reduce the risk of adverse events related to medical intervention across a range of conditions or diagnoses. Even though this definition seems to be concrete, it is incomplete because many practices have not been studied for their effectiveness in preventing harm.

Patient safety practices include, but are not limited to:

- Using prophylaxis properly so the practitioner can prevent venous thromboembolism in patients.
- Proper usage of perioperative beta blockers in appropriate patients to prevent perioperative mortality and morbidity.
- Proper usage of maximum sterile barriers during appropriate placing of central intravenous catheters to prevent infection.
- Asking patients to restate and recall what they have been told during informed consent to verify patient understanding.
- Continuous aspiration of subglottic secretions to prevent ventilator-associated pneumonia.
- Proper usage of pressure-relieving bedding materials to prevent pressure ulcers.
- Using real-time ultrasound guidance during the insertion of central line to prevent complications.
- Patient self-management for warfarin to prevent appropriate outpatient anticoagulation and other complications.
- Appropriate provisions for nutrition, with particular emphasis on initial enteral nutrition in surgical patients and the critically ill to prevent complications.
- Using antibiotic-impregnated central venous catheters to prevent common catheter-related infections.

**Quality health care**

Peter Harteloh (1960), philosopher, wrote a PhD thesis on quality management in 2000 in which he explored the philosophical origins of the quality concept and the principles of quality management. He worked as a quality manager in health care organizations and taught Quality Management and Ethics at the Erasmus University Rotterdam. The multiple conceptualizations of quality were reviewed by Harteloh who concluded that quality is essentially the optimal balance between different types of possibilities that are realized within a framework of values and norms. This conceptual definition states that quality does not exist in reality as a discrete entity; rather, it exists as an abstraction.
There are five principles for the quality of health care, called the five “Ds”:
1. Disease.
2. Death.
3. Discomfort.
4. Disability.
5. Dissatisfaction.

The elements of quality health, as set by the American Academy of Nursing Expert panel, are:
1. Self-care.
2. Quality of life.
3. Health-friendly behavior.
4. Observation of symptoms.
5. Health care criteria.

Medical errors

Because of increasing medical error rates, the incident reporting procedure (IRP) system was introduced and is gaining popularity. This system, which has been used since 2000, helps to identify medical errors and improve patient safety by enhancing reporting and communication systems.

The IRP system has its pros and cons – it enhances communication and flow of information, as it demands recognition and awareness by supervisory roles, yet requires a highly punitive environment, which is difficult to achieve. There is an inherently negative connotation to the reporting of errors, especially to those in supervisory positions where the possibility of retribution exists. There appears to be a corresponding hesitation in the reporting of errors as just 10% of cases have been documented by the IRP.

There are five types of medical errors:
1. Errors in medication prescriptions – this is the most common error.
2. Maintaining medical records.
3. Laboratory test execution.
4. Analysis.
5. Delivering medications.

Medical errors cause almost 98,000 deaths in developed countries every year and cost around $17 billion. A recent IOM report suggests that a significant percentage of patient deaths are caused by medical errors – even more than deaths due to other causes. The report’s findings led to health care sector improvements in many developed regions. Training for physicians, medical staff, nurses, and patients and their families results in lower rates of medical errors.

Training and knowledge is not enough to prevent medical errors and ensure patient safety. Because of the diverse and complicated nature of health care, there will always be room for progress and further development.

Implementing ethical policy changes

One of the most common problems in determining the solution is the long-term inclination of the health care professionals and the public to link errors with the tort system, especially when lawsuits are filed by patients without legitimate claims. Policies that remove obstacles in sharing data about patient safety can be an effective solution. One such obstacle is sealing malpractice settlements, which make case evaluations difficult.

Preventable vs. non-preventable adverse events

The health care industry and researchers focus on understanding both preventable and non-preventable disorders. A study in 2011 by Harvard Medical School concluded that preventable disorders include hospital-incurred trauma, acute myocardial infarction, adverse drug reactions, and pulmonary embolism or cardiovascular accident that occurs after an attack. The list also included casualty, neurological disorders, respiratory problems, and cardiac attack either after or during transferece from general care to intensive care.

Aileen B. Dequito et al. conducted a study at the University Medical Center in the Netherlands in 2011 that estimated the number of patients admitted to hospitals each year due to preventable and non-preventable adverse conditions, in various parts of the world. The findings showed that about 58% of patients passed through these conditions and about 88% encountered only non-preventable conditions. Therefore, the report concluded that almost half of the patients admitted in hospitals were the victims of poor health care practices.

Discontinuities in care

Preventable medical conditions are directly linked with health care standards in hospitals. These conditions can vary when patients are transferred between physicians or hospitals. Thus, proper communication between medical institutions and physicians is important to help prevent adverse medical conditions for the patients; however, this is usually neglected.
Physicians also focus patients’ post-discharge plans on continued care, including outpatient procedures and tests. Medical errors, as defined by the IOM, are the failure of certain actions to be done as planned. The most common cause of preventable adverse events in the outpatient setting is the continuation of patient care.

Studies have shown that less than 50% of all outpatient primary care providers are provided information about the discharge and medication plans for recently hospitalized patients. Studies have also shown that patients required fewer re-hospitalizations when they were assessed by primary care providers who also assessed their discharge summaries. Similarly, other studies have shown that discharged patients who were assessed as outpatients by the same primary care provider who had cared for them during hospitalization experienced fewer visits to the emergency room within 1 to 2 months of discharge. Thus, this continuity of care can result in three types of errors – medication continuity errors, test follow-up errors, and work-up errors.

A work-up error is the poor execution of a test. For example, a recommendation is made for a positive fecal occult blood test at the time of discharge, but the outpatient chart missed it. Carlton Moore et al. conducted a study that reported 49% of hospitals surveyed had at least one of these three types of errors. It was also revealed that 95% of patients facing work-up errors need to be hospitalized after their first outpatient visit. Therefore, is the study concluded that errors increase the likelihood of re-hospitalization.

**Handoffs/transfers**

There are many terms given to patient transfers, including handoffs, handovers, and sign-outs. A handoff or handover is the transfer of a patient from one health care provider or hospital to another, while a sign-out can mean the transfer of legal authority from one health care provider to another. This information has critical consequences for care provision. For example, a patient who is handed-off has been transferred to a new location, but the health care provider is the same. If that healthcare provider does not follow-up with the patient’s plan of care, medical consequences are likely to result. Poor information flow puts patients’ safety at risk and promotes the likelihood of adverse events.

**Discontinuity of care from handoffs/transfers**

Transfers are of critical importance because they are linked with two aspects of flow – information flow and flow of control. Health care sectors require considerable training to avoid deviations in correct information or control flow. There are challenges such as deadlines, location issues, modes of communication, duration, personnel involved, etc.; however, the process must be properly completed.

**Participants**

An effective and proper handoff is necessary to ensure proper health care provision. However, challenges such as deadlines can lead to improper or insufficient handoff processes. It is difficult to predict what is going to happen in future; therefore, generalizations are used to define roles and avoid adverse impacts.

Handoffs have been divided into three major classes:

1. **Old transfers.**
2. **New transfers.**
3. **Cross-borders transfers.**

The old transfer occurs when both patient health care providers have the same expertise and are both aware of the patient’s history and conditions (e.g., when a patient is transferred from night staff to day staff).

New transfers involve patient transfer between providers that have similar expertise, but the new provider is not aware of the patient’s history and conditions (e.g., when a patient who was under the supervision of a professional at the time of admission is handed over to the professional coming at night).

In cross-borders transfers, a patient is transferred from one professional to another; both of them having diverse expertise and training backgrounds (e.g., when a patient is transferred from the emergency department to pediatrics). Since both professionals have diverse backgrounds, differences in work practices might occur; therefore, these transfers are more complicated than the others.

**Content**

Handoffs require effective information flow. Giving information that receiving professionals already possess will waste time, while overlooking critical information can cause severe problems. Another challenge in effective information flow is a system with lax recording and maintenance of documents, records, etc. Language differences may also cause communication issues and further affect the flow of information.

**Length of handoff and time pressures**

Handoffs must be balanced in duration and communication of information. For example, there must be a definite number of patients to be handed off and the time needed to do so.

**Communication media and location**

The mode of communication also matters for effective handoffs and greatly depends upon hospital setting. For example, in traditional hospitals, handoff information is exchanged through written records, while in modern hospitals, electronic reporting systems are used. Each communication method has pros and cons. Sometimes written records are important, and sometimes electronic reporting is more effective.

The location where communication or flow of information takes place also matters. For example, a crowded hospital might distract conversation and affect the privacy of the information.

**Interdepartmental communication**

A hospital has a mixture of physicians, nurses, and other medical staff and any communication gap among them can result in errors. Differences in work practices among staff can also adversely affect the process. Effective communication among departments promotes safety and avoids medical errors. Communication between patients and medical staff is also important, especially for older patients.

There should be a proper and flawless information flow between medical staff from all departments, especially those who are directly
involved in caring for patients and distributing medications. For example, younger patients usually require lower dosages compared with older patients – this should be communicated to medical staff by physicians.

Communication between physicians and nurses is also critical. Poor or incomplete communication may lead to severe consequences, as nurses are also directly involved in patient care and medication administration. For example, patients can die because of excessive drug dosages if there is a communication breakdown. Nurses must be well trained, qualified, and experienced. To ensure effective, timely, and flawless communication among departments, hospital administration should create an interdisciplinary committee. The IOM has proposed an interdisciplinary committee to create both financial and regulatory incentives to promote a safer healthcare system. The recommendations provide a systematic way to design safety into the process of care. The report also calls for a program re-evaluation after five years to determine progress in achieving a safer healthcare system. The committee should oversee two additional recommendations that specifically address medication system errors, since they represent a major proportion of the total errors addressed. To oversee these operations, the IOM has appointed the Agency for Healthcare Research and Quality (AHRQ).

### Language issues

Language differences also create challenges in effective flow of information and communication. These issues are broadly classified as:

1. **Unfamiliar jargon.**
2. **Ambiguity.**
3. **Second language problems.**

Ambiguity means there is not clarity in terms, which can lead to severe outcomes. For example, some physicians who are interns or in training can be confused about unfamiliar medical terms and are too shy to ask about them.

Ambiguity can be reduced by using generalized or standard terms instead of jargon. If unique terms, phrases, or abbreviations are used by medical staff, they may not be understood by physicians outside the group.

### Time pressures

Since communication needs time to flow and an environment free of distractions, the extremely busy and active environment of the hospital might cause challenges in shortage of time and distraction.

### Status symmetry

The information flow in hospitals is often subject to medical hierarchy, which might limit the scope and create a communication gap. For example, in training hospitals, physicians train senior supervisors, senior supervisors train less-experienced supervisors, and they, in turn, train medical students. There is a similar hierarchy in nursing departments. The personnel at lower levels try to achieve higher levels, which motivate them to gain more knowledge and skills. However, they may not want to look inept by asking for clarifications, which may create problems.

Authority and hierarchy can also affect the attitude of staff. For example, day staff usually has more responsibilities than night staff. This difference might affect care provisions and lead to communication gaps.

Communication challenges become worsen when a single patient is under the supervision of multiple individuals. It not only causes ambiguity, but may also lead to severe outcomes (e.g., the assumption regarding the execution of a prescribed test by another person).

### Major, common inpatient adverse event/medical error studies

Numerous studies have been conducted to study inpatient adverse events and medical errors. The purpose of the studies was to chart contributing factors to preventable adverse events or medication errors made by health care practitioners and nursing staff in a hospital setting.

Over the years, the findings have revealed that both individual and organizational factors contribute to the occurrence of preventable adverse events or medical errors. A breakdown in communication, high workload, distractions, unsuitable working environments, and interruptions are organizational factors. Individual factors, on the other hand, include the inability of health care practitioners and nursing staff to follow protocol, personal qualities of health care practitioners or the nursing staff, and inadequate knowledge of medications.

The studies suggested developing and improving the physical environment, medication management protocols, and error reporting as ways to reduce the occurrence of preventable adverse events or medication errors. The studies also suggested investing in the competence of medical staff and health care practitioners to take part in in-service training and seminars.

A study observed that safe medication management is essential for proper patient safety and forms an important part of the health care and nursing professions. Because more people are being treated with medications and the nursing staffadministers these medications, the nursing staff in a hospital carries a greater responsibility than ever before. Implementation of successful patient safety requires knowledge about protocols of the health care setting and thorough knowledge of the action mechanisms and adverse reactions of the medications.

Medication errors have varying consequences, and these errors increase patient mortality and morbidity, resulting in increased economical demands and prolonged hospital stays (The Institute of Medication 2000). The IOM reported that in United States alone, there were more than 7000 deaths that occurred due to medical errors, and approximately two of every 100 patients experienced a preventable adverse event. Such errors have diminished patients' trust in the health care system, and this lack of trust can be psychologically traumatic to the health care staff involved.

Medical errors that occur during the medication process are usually committed by various health care professionals. Errors during the prescribing phase are usually made by the health care practitioner, while nurses usually commit medical errors during the administration process (Lassetter-Warnick 2003).

Other researchers have recognized that the administration and prescribing phases are most prone to errors (Brown 2001; Davidhizar-Lonser 2003). They concluded that the wrong medication, followed by incorrect dosages, are the most common causes of preventable adverse events or medical errors.
During hospitalization

The IOM report found medical errors to be the most common cause behind adverse situations and causalities. Kanjanarat et al. proposed a way to measure the occurrence rate of preventable adverse medical conditions. Their study found that more than 75% of adverse conditions are reported by the CNS, gastrointestinal tests, or the electrolyte system.

Almost 4% to 16% of hospitalized patients suffer medical errors every year. These errors cause approximately 44,000 casualties worldwide every year. The rate is higher (5%) in patients aged 65 years or more compared with those less than 65 years (3%).

Drug-related errors

Many studies have been conducted since 1994 to determine things such as error types, impacts, and degrees. These studies show that cardiovascular medications are the most incorrectly prescribed as they have similar names, mechanism of action, and complications.

Kausal et al. reported that 56% of medical errors take place during treatment, 6% occur at the prescribing stage, 3% at the time of administration, and 4% at dispensing stage. Studies like Seeger et al. and Pearson et al. reported that 17% of adverse medical conditions happen due to medicine-related errors, especially usage, and 16%, and 12% of these events occur because of the wrong administration and wrong monitoring of drugs, respectively. Leape et al. reported that lack of knowledge of the physician, chemist, or medical staff led to 22% of adverse medical conditions, while 10% of errors happen due to memory lapses and slips.

Drug associated with hypotension and bradycardia lead to the most preventable adverse medical conditions simply because antihypertensives are the most commonly prescribed medications.

Non-drug – related errors

Medication-related errors are the most common cause of a patient’s casualty, but non-drug – related errors also contribute to mortality. Baker et al. and Leape et al. reported that the rate of preventable adverse non-drug – related events vary between 3% and 16%. The IOM requires hospitals to implement a adverse medical events reporting system, which helps promote awareness regarding medical errors that lead to preventable adverse medical events.

Koizumi and Inoue developed a model that evaluates medical errors and associated risks. Their study found that four practices resulted in high error rates in the six hospitals reviewed. The practices included prevention of suicide, prevention of problematic behavior, subcutaneous insulin injections, and safeguarding against falls. The study also stated that three organizational factors contributed to preventable non-drug – related adverse events, such as violation of rules, defects and standardization of nursing practices, and failure of management of labor. Thus, it supported the need for closer examination of patient safety practices used by nursing staff in the delivery of health care because the error rates that were reported in the study were significant.

CAUSES OF NON-DRUG – RELATED MEDICAL ERRORS

System/human errors

Rasmussen introduced the idea of error identification and classified them into three types:
1. Rule-based.
2. Skill-based.

James Reason later categorized errors into two types:
1. Errors in actions.
2. Errors due to lack of knowledge.

Process errors

A few studies published between 1994 and 2010 looked specifically at the nursing staff and their medication administration process. Santell and Cousins realized that administration technique errors cost 45% of the non-drug – related preventable adverse events, while inappropriate following of procedure accounted for 30% of these events. They also concluded that knowledge deficit accounted for 27% of all non-drug – related medical errors.

Pediatrics

In pediatrics, medical error rates are almost 18%. Nurses’ primary duty is drug administration, which occupies 40% of their time each day. Factors that increase the likelihood of nursing errors include increased workload, poor communication, distraction, and lack of knowledge. Tissot et al. classified drug administration error as the most common type of medical error in pediatrics.

IOM reports on patient safety

The IOM’s report on health care quality in America is considered a milestone in shaping health care practices. The report, published in 1999, greatly focused on medical errors and considered patient safety a foundation of health care principles. The second report, published in 2001, emphasized the establishment of reporting mechanisms and renovations of current medical structures.
IOM: Report I

The IOM’s 1999 report stated that 45,000 to 90,000 casualties occurred every year because of medical errors, with medication-related errors accounting for 8000 of those casualties. Medical errors have become the eighth major cause of patient deaths, leading to $18 to $30 billion in losses every year.

This report clarified terms such as patient safety, medical error, preventable adverse event, types of medical errors, types of failure, and other classifications of errors. It also gave valuable recommendations to ensure patient safety and avoid preventable adverse events.

The report also highlighted the importance of mechanisms for reporting errors to promote quality health care and avoid medical errors.

IOM: Report II

In 2001, a second IOM report detailed the required framework necessary to ensure patient safety and standard practices. Some of the policies outlined in this framework were:

- Patients must have persistent and quality health care services 24/7.
- Health care systems should be tailored to meet the most common and most specific needs of all types of patients.
- Patients should be provided all the necessary information related to their health, treatment, and medications so they can make the right decisions at the right time.
- Both inpatient and outpatient health care settings must be of high quality and free from errors. There should be consensus of opinions and treatment between both inpatient and outpatient professionals.
- Patients must have full access to their medical information.
- The health care system must be resource and time efficient.
- There must be an effective and timely communication or information flow among professionals, staff, nurses, patients, and their families.

Agency for healthcare research and quality (AHRQ) reports

The AHRQ has many facilitation and research centers that help the medical sector improve its health care practices. The agency researches the latest technologies, availability, and usages in health care to ensure error-free health care practices and patient safety. The agency is also involved in data gathering regarding reported cases and current health care practices and policies.

The major emphasis of the AHRQ reports is on clinical practices that decrease the chances of errors in the entire medical process. The AHRQ has highlighted some practices, including:

- Prophylaxis to prevent venous thromboembolism.
- Perioperative beta blockers to prevent mortality and morbidity.
- Sterile barriers to prevent infection due to central intravenous catheters fixing.
- Antibiotic prophylaxis to prevent postoperative infections in patients passing through surgical operations.
- Effective and flawless communication of information.
- Prevention of ventilator-associated pneumonia with the use of continuous aspiration of subglottic secretions.
- Real time ultrasound practices free from errors.
- Using pressure-relieving drugs to prevent pressure ulcers and using warfarin to avoid anticoagulation.
- Avoiding infections caused by catheter placement by giving antibiotics.

The AHRQ reports focus on future execution of quality health care practices that are free from all types of medical errors. The reports also present data analysis and focus on policy-making.

Incident reporting

Hospitals use a number of tools to identify and measure medical errors to better estimate morbidity and mortality rates associated with these errors.

Though the AHRQ considers computerized reporting mechanisms effective, it also highlights the inability to report each and every aspect of cases. Therefore, reports suggest adopting mechanisms followed by other industries including those in nuclear power, steel production, and aviation.

Barach and Small proposed some reporting suggestions based on the AHRQ recommendations, including:

- Emphasis on latest misses.
- Incentives on voluntary reporting.
- Privacy assurance of reporting.
- Methods to be used by system to analyze errors.

The systems are attributed to federal control and include elements like privacy, immunity, feedback mechanisms, and private reporting of information. In 1975, the reporting related to blood transfusion cases was legally implemented, while in 1995, hospital-based monitoring was implemented. In 2009, The American College of Surgeons stated that 5% to 30% of cases are reported by a system and just 20% of medical errors-related cases are highlighted.

Weingart et al. and the AHRQ both aim to enhance the reporting mechanism to ensure correct and timely reporting of cases. An incident reporting system is also called a peer review mechanism and offers legal immunity of medical liability to peer-reviewed physicians in most states. Table 1 provides examples of events in hospital incident reporting systems.

Table 1. Examples of events in hospital incident reporting systems.

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<tr>
<th>Adverse outcomes</th>
<th>Procedural breakdowns</th>
<th>Catastrophic events</th>
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| Institutionally acquired pressure sores | Discharges against medical advice (AMA)  
Errors or unexpected complications from the administration of drugs or transfusion  
Breach of confidentiality  
Errors or unexpected complications from the administration of drugs or transfusion | Suicide of a hospitalized patient  
Rape of a hospitalized patient  
Infant abduction or discharge to wrong family  
Performance of a procedure on the wrong patient  
Performance of a procedure on the wrong body part (wrong-site surgery) |
| Inpatient falls or “mishaps”          |                                                                                      |                                                          |
| Institutionally acquired burns        |                                                                                      |                                                          |
| Unexpected death or disability        |                                                                                      |                                                          |
Historically, medicine has always relied on quantitative approaches for improvement of health care quality and patient safety. For example, the FDA has collected data associated with major errors that have occurred during blood transfusions since 1975. A retrospective approach, though not possible in many complex industries outside the medical environment, is possible in the health care system. This retrospective approach to error analysis is known as root-cause analysis (RCA).

Root-cause analysis (RCA) has ties with human-factor engineering and psychology. Many experts have championed the use of RCA in the health care industry, including the Joint Commission on the Accreditation of Healthcare Organizations, which made it mandatory to use RCA in the investigation of preventable adverse events in the medical setting.

### Practice guidelines

Practice guidelines have always been important for patient safety, therefore, special emphasis has been placed on them by the AHRQ. The AHRQ defines practice guidelines as systemically developed statements that assist patient and practitioner with making appropriate health care decisions in certain clinical conditions. Practice guidelines, as observed by the AHRQ, can vary greatly from hospital to hospital, but can be considered an effective source of information to modify physicians’ behavior of to improve patient safety practices.

Practice guidelines affect patient safety because they can facilitate dissemination of information to effectively reduce preventable adverse events and medical errors. In a Medicaid audit conducted in Connecticut, charts showed that only 50% of patients who presented with acute myocardial infarction received beta blockers and aspirin on the day of admission, despite evidence showing that such practices could reduce mortality. Another report showed that, on average, 3500 myocardial infarctions could be averted, and 4000 lives could be potentially saved annually if beta blockers were appropriately prescribed to patients suffering from coronary artery diseases. Thus, practice guidelines could rectify shortcomings in patient safety and reductions in medical error.

The reports have found convincing, but not overwhelming, evidence to show that practice guidelines are effective in positively influencing the process, as well as the outcome, of quality health care. The AHRQ has conceded that many of the studies are plagued by methodology shortcomings that reflect the difficulty in studying the complete impact of practice guidelines.

### Fatigue and medical errors

Hospitals often require shift work for staff, especially physicians-in-training (residents). This around-the-clock work results in hospital staff – especially residents – being sleep-deprived. However, the AHRQ has found little research that is focused on fatigue in hospital staff and its relationship to medical errors and preventable adverse events.

Several studies conducted outside the health care industry have demonstrated an intuitive link between the degradation in performance and fatigue in personnel. Taking this into consideration, the AHRQ observes that acute and chronic fatigue can have detrimental effects on the health of hospital staff, especially medical practitioners.

Sleepiness and fatigue can affect patient safety in numerous ways. Nursing staff and physicians require sound judgment and attention and often, quick reaction times during medical situations, especially emergency situations. The degradation of memory, attention, and coordination can affect performance in such situations and lead to preventable adverse events.

Research by the AHRQ suggests that sleep patterns and requirements are idiosyncratic and vary widely across populations. To understand the relationship between sleepiness, fatigue, and poor performance, it is important to understand the signs, impacts, and prevalence of sleep deprivation.

Most experts agree that adults require between 6 and 10 hours of sleep per day and, on average, most individuals require 8 hours of sleep per 24-hour period. When adults get less than 5 hours of sleep over a 24-hour period, cognitive abilities begin to decline.

However, the AHRQ reports have found that when adults get short periods of sleep time of at least 2 to 3 hours, they can function normally – but below peak levels. Sleep deprivation of just 2 to 3 hours can result in decreased initiatives and slower response times. According to these reports, even one night of missed sleep can result in a 25% decrease in cognitive performance from the baseline. After a second night of missed sleep, there is almost a 40% reduction in cognitive performance from the baseline. The AHRQ reports suggest that with sleep deprivation, individuals develop a sleep debt, which continues over 5 to 10 days. They are rarely maximally alert, and at some point, the general performance of the individual, particularly the cognitive performance, becomes worse.

Sleep debt also results in altered mood, slower response times, and low levels of motivation. Supporting Picher et al., the AHRQ reports have found that humans who were chronically sleep-deprived function at less than the ninth percentile of non-sleep – deprived subjects. Furthermore, sleep deprivation can alter the cognitive and motor functions.

### Hospital patient safety indicators

In response to the increasing need to measure patient safety, the AHRQ has developed a set of hospital patient safety indicators (HPSIs). These indicators have been specifically designed to screen administrative data for incidences that might be related to patient safety. Although there are limitations to HPSIs, hospitals and states use them to collect data and set benchmark quality improvements.

Although the data collected using the indicators are relatively rich sources, convenient to use, and inexpensive, the disadvantages of these indicators also have to be considered to evaluate practices of patient safety. The most common limitations of administrative data collected using HPSIs include:

- Coding differences that make appropriate comparisons across departments of hospitals difficult.
Hospital patient safety indicators module

Patient safety has been an issue of considerable national interest for providers, policy makers, and consumers and, therefore, has become top priority in most hospitals in the United States. The AHRQ states that there is a growing need to monitor, assess, improve, and track the safety of hospitalized patients, especially after an IOM report that described the various risks to which hospitalized patients are exposed.

In the HPSIs Module, one way to detect and report preventable adverse events is to develop numerous screening measurements that are based on regularly collected administrative data. These data can provide adequate information about the quality of health care services, patient safety practices, and potential medical errors, taking into consideration the gender, age, admission source, and discharge status of the patients.

The AHRQ uses the HPSIs Module to assess the quality of health care provided to hospitalized patients with emphasis on potentially preventable adverse events that result from medical intervention. The module is a tool that has been designed to help health care providers identify potential preventable adverse events that have occurred during the course of hospitalization, such as during procedures, surgeries, and even childbirth.

The AHRQ does take into consideration that quality assessments based on the collected hospital administrative data cannot be definitive. Rather, these data can be used to identify potential patient safety problems and highlight the success stories.

The HPSIs Module consists of seven area-level indicators and 20 hospital-level indicators that will help reflect the quality of health care provided by each hospital. These indicators serve as flags for potential health care quality problems or preventable adverse events instead of providing definitive measurements on the quality of health care.

According to the AHRQ, the 20 hospital-level indicators have been selected based on their ability to differentiate conditions that are present in patients during admission from conditions that might be developed in the patient during the course of hospitalization. This screening ability can help prevent hospital complications, while identifying medical errors.

The 20 indicators included in the HPSIs Module are:

1. Death in low mortality.
2. Complications of anesthesia.
3. Failure to rescue.
4. Decubitus ulcer.
5. Foreign body left in place during procedure.
6. Selected infections due to medical care.
7. Iatrogenic pneumothorax.
8. Post-operative hematoma or hemorrhage.
11. Post-operative deep vein thrombosis or pulmonary embolism.
13. Post-operative sepsis.
14. Accidental laceration or puncture.
15. Post-operative wound dehiscence.
16. Transfusion reaction.
17. Vaginal delivery with instrument.
20. Vaginal delivery without instrument.

These indicators have shown that preventable adverse events vary substantially across hospitals. The variation can be attributed to the differences in quality of health care providers to hospitalized patients. These indicators are measured as rates, i.e., the number of preventable adverse events or the number of complications divided by the total number of hospital admissions for a particular procedure or condition. Hence, at the hospital level, Hospital patient safety indicators (HPSIs) will include only cases where secondary diagnosis code has identified a potentially preventable adverse event.
HPSI measures

The HPSI software generates expected, observed, smoothed, and risk-adjusted rates for all hospital-level indicators. The observed rates are actually raw rates, while the risk-adjusted rates have been derived after applying the average case mix for baseline data that reflect a large proportion of the hospitalized population in the United States. The hospital-level indicators are further risk-adjusted for gender, age, and comorbidities.

Comparing the risk-adjusted rate of a hospital with the expected rate will provide the effect of risk adjustment on the particular patient safety indicator measurement. The purpose of this analysis is to help determine which rates can be used to evaluate the performance of a hospital.

However, in general, the HPSIs are not intended to be used as definitive quality measures because the quality of performance of a certain hospital can be influenced or affected by many other factors. But the HPSI measurements can indicate differences in hospital performances over several years, which are extremely important in providing quality health care.

Limitations of HPSIs

Hospital patient safety indicator (HPSI) rates must only be seen as a starting point for assessing the quality of health care provided by a hospital. These rates are not definitive quality measures and there are a few things to keep in mind while analyzing HPSI rates, including:

- They do not address all aspects of health care quality. For example, they do not include patient feedback about the quality of health care received.
- In some cases, the specific topics that track serious performance failures of a hospital rarely happen. Therefore, these rare events must be carefully tracked, especially when comparing two hospitals.
- One of the major limitations of HPSIs is that the collected hospital administrative data might not be able to capture all cases of complications or preventable adverse events. Moreover, the indicators in the module must consist of a bigger proportion of surgical indicators than psychiatric and medical indicators. This is because medical complications are extremely difficult to distinguish from comorbidities that might be present in the patient during hospital admission.
- Incomplete reporting is another major limitation of HPSI rates because of the lack of voluntary reporting in most states and hospitals. Full disclosure is also highly unlikely in states and hospitals that do not provide complete legal immunity to the person reporting the preventable adverse event.
- The ability of administrative data to differentiate between preventable adverse events and events in which no medical error occurred is limited. This can further affect HPSI rates.

Accepted AHRQ HPSIs

As in numerous complex industries, areas in the health care industry that cannot be measured (such as patient safety) can be difficult to improve. Consumers, providers, and policymakers who are seeking to improve patient safety practices and quality of health care provided require reliable and accessible indicators of quality that they can use to identify potential preventable adverse events or medical errors. They also require these indicators identify disparities across communities, regions, and health care providers.

This requirement was noted in the IOM study, Envisioning the National Health Care Quality Report. This report also showed that these indicators are extremely important, not only in acute care but also in other aspects of care, such as hospitalization, better care during hospitalization, living with illness, living with disability, and coping with the end of life.

In response to this requirement for accessible and multidimensional quality indicators, the AHRQ developed the HPSIs, which include measurements that policymakers, providers, and researchers can use in combination with inpatient data to identify potential preventable adverse events and improve patient safety. The AHRQ HPSIs are organized into three modules: inpatient quality indicators, prevention quality indicators, and patient safety indicators.

These indicators focus on preventable complications as well as iatrogenic (harmful effects caused by medical treatment) events that occur in patients during hospitalization. They are measurements that screen for preventable adverse events that patients experience as a result of medical intervention. The first set of HPSIs was released in March 2003, and currently includes seven area-level indicators and 20 hospital-level indicators.

Introduction to AHRQ HPSIs

Hospitals in the United States provide a medical setting for some of the most pivotal events in life, including childbirth, major surgery, and treatment for various illnesses. They use some of the most sophisticated medical technology and provide state-of-the-art therapeutic and diagnostic services to patients. However, access to the services comes with certain costs, and it has been estimated that about 30% of personal health care expenditures go toward hospital care.

Apart from the cost, concerns about the quality of health care provided to patients reached a crescendo after an IOM report highlighted the risk of medical errors and preventable adverse events. A complete overhaul of the health care system was required to provide high-quality health care and to add the option of patient safety practices. Policymakers, consumers, and hospitals have made the collection of inpatient data top priority to improve the quality of health care.

Hospital administrative data provide a view of medical care delivered during hospitalization. These data are usually collected as a routine step in providing information on diagnosis and delivery of hospital services. The AHRQ HPSIs are now being used with hospital administrative data to provide quality improvement and patient safety. Many organizations are using the HPSIs to present web-based comparative reports on hospital performance and quality of health care provided.

Background of AHRQ HPSIs

The HPSIs were developed by the AHRQ as a response to the requirement by state-level organizations and hospitals for indicators that could help measure areas that were otherwise non-measurable. Thus, HPSIs were developed so that hospitals required collection of only routine hospital administrative data and data on major procedures and diagnosis performed on a daily basis along with other specific details, such as age, source of admission, and gender, and discharge status of the patient.

The HPSIs were also developed to take advantage of readily available data in hospitals to identify preventable adverse events or complications that might occur because of medical intervention. The
HPSIs comprise 27 indicators of the quality of health care provided in hospitals, but they cannot be used as the actual measures of quality of health care. These indicators can be used as a starting point to assess the quality and performance of hospitals in patient safety.

What are accepted AHRQ HPSIs?
The AHRQ identifies HPSIs on two levels: the area level and provider level.

- **Area-level indicators** can capture all causes of potential preventable adverse events that occur in a particular area, such as a county metropolitan service area during the course of hospitalization. Area-level indicators include primary diagnosis and secondary diagnosis for preventable adverse events.
- **Provider-level indicators** can provide measurement of attention to preventable adverse events for patients who received initial health care and experienced the initial complication within the same hospitalization period.

Development of HPSIs
Since the development of HPSIs, the knowledge base on health care quality has increased considerably. Methods that have been risk-adjusted have become readily available to policymakers, hospitals, and consumers. Over the years, new measures have also been developed and included in the HPSIs module, which are based on input from current users of the module.

Use of HPSIs to assess patient safety
There is a considerable amount of consensus among various health care organizations that lamentable adverse events can be reduced by improving patient safety practices and implementing technical changes, (such as electronic medical record systems) and improving awareness among medical staff. The health care organizations also believe that chemical process interventions can reduce the rates of preventable adverse events and improve patient safety, even during medical intervention.

The HPSIs are based on computerized hospital administrative data that can be used to provide better priorities and evaluation of national- and local-level initiatives. The AHRQ has provided a scenario on potential implementation of HPSIs:

A certain hospital group recognized the information requirement from its hospital members to evaluate quality of health care provided by the member hospitals. There was significant interest in monitoring, assessing, and ultimately improving, patient safety during hospitalization. After learning about the HPSIs developed by the AHRQ, the hospital group decided to implement the indicators in combination with hospital administrative data that were submitted by individual member hospitals.

For every hospital, the group developed a report with graphic presentation of the risk-adjusted rates to show a comparative analysis of the individual hospital’s performance vs. the performance of the other hospitals in the same group. The regional and national averages also provided additional external benchmarks. Three years of trend data were used so that the hospitals could examine changes in performance patterns. Every member hospital receiving the report had an internal work group composed of quality improvement and health care professionals to review it and identify areas for improvement. The leadership of every member hospital was committed to performance excellence and providing a supportive framework for development and implementation of improved patient safety practices.

For the evaluation, the member hospitals applied HPSI software on the collected hospital administrative data to distinguish patients who experienced complications during hospitalization from patients who did not experience complications. Once the initial analysis was completed, the internal work group met with various departments of the hospital that were involved in caring for the patients and began an in-depth analysis of the processes and systems of health care. With the application of process improvement, they also began to identify several opportunities for improvement that later helped in the selection of priority areas.

Surgical events
The Stanford University School of Medicine published a study using HPSIs, *Assessing Surgical Adverse Events Using Administrative Data*. The goal of the study was to implement the use of HPSIs on surgical specialties of different hospitals. Placing extra emphasis on reconstructive plastic surgery, the group of patients chosen represented a unique population because it is generally believed that the construction often occurs after the failure of other medical techniques. Hence, these patients usually receive care from different departments of a certain hospital and also undergo multiple medical procedures.

In collaboration with the AHRQ, the Stanford University School of Medicine used the database of a nationwide inpatient sample to identify adult discharge records of patients who received at least two reconstructive plastic surgeries between the years of 1998 and 2009. The patients were further categorized according to the type of wounds for which they had received treatment, such as orthopedic complication, pressure ulcer, burns, postoperative infection, and other medical error wounds.

This study concluded that 30% of patients received principal reconstructive surgery, while 70% received secondary reconstructive surgeries. For the principal procedures, about 24% of patients received the treatment because of orthopedic complications, while 22% received the treatment because of pressure ulcers. The remaining 18% received the treatment because of postoperative infections.

In cases that were identified as secondary reconstructive surgeries, 23% of patients received the treatment because of postoperative infections and orthopedic complications. The remaining 22% received the treatment because of pressure ulcers.

Average length of stay was approximately 9.4 days for principal procedures and 10.9 days for secondary procedures. Principal procedure patients received an average of 4.1 procedures in comparison to 3.9 procedures for secondary procedure patients. The average in-hospital mortality rate in cohort with primary reconstructive surgical procedure was 1.36% in comparison to 1.19% for secondary reconstructive procedure cohort. In certain instances, it was observed that patient safety events had higher rates in the primary procedure group in comparison to the secondary procedure group.

The HPSIs used to identify surgical preventable adverse events are based on diagnosis-related groups and ICD-9-CM codes. These indicators are associated with increased in-hospital mortality, length...
of stay, and hospital charges. Thus, the use of surgical HPSIs as a screening method for potential preventable adverse events is a universally replicable method that can also be used to identify lapses in patient safety practices.

Surgery is considered to be an ideal discipline to study the implementation of HPSIs because the outcomes and processes used in surgery are closely related. There are more than 200 million operations performed annually, therefore, medical errors are extremely common during surgeries. Epidemiology data that has been collected on surgical preventable adverse events are essential for the measurement and evaluation of patient safety and the quality of health care.

To study surgical preventable adverse events, secondary diagnoses are essential to properly identify a true surgical preventable adverse event from a normal surgical event. It is thus assumed that principal diagnosis is accurately coded in the hospital administrative data, while comorbid diagnoses or secondary diagnoses are often underreported. Therefore, the AHRQ considers this a limitation of HPSIs to identify surgical preventable adverse events.

According to the AHRQ, another limitation of HPSIs to screen for surgical preventable adverse events is the over-reporting of in-hospital preventable adverse events that can occur because of complications that were present in the patient during admission. When using administrative data, the lack of a temporal component of the adverse event can be a limitation. Moreover, the time of the event is extremely crucial to identify a true surgical preventable adverse event that was caused by medical intervention rather than the complications that already existed in the patient during hospital admission.

The AHRQ has taken into consideration that certain types of surgical preventable adverse events are influenced by the inclusion of already present complications in the patient during admission and the validity of the rates provided by HPSIs are questionable.

The epidemiology and identification of surgical preventable adverse events is extremely complex. In using administrative data, patients experience high rates of surgical preventable adverse events in comparison to preventable adverse events that take place in other hospital departments. Moreover, distinguishing between complications that were present in the patient during hospitalization and complications that arose due to medical intervention during the course of hospitalization is extremely important for screening surgical preventable adverse events. Monitoring and tracking these events are also important in areas that require improvement in health care quality.

### Post-operative events

Improving practices of patient safety has always been an important priority, especially during postoperative care. The AHRQ established several HPSIs to identify postoperative preventable adverse events to improving the quality of health care.

In the HPSIs module, the AHRQ identified 20 hospital-level indicators that use collected hospital administrative data so hospital staff can screen for postoperative potential preventable adverse events. Apart from using of the HPSIs to screen for potential postoperative preventable adverse events, many hospitals also use these indicators to provide performance ratings of health care institutions.

Using administrative data for screening adverse events has several intrinsic strengths, especially when used as a qualitative health care surveillance tool. Hospital data are readily available and are easily accessible. The biggest advantage of using these data is that they are inexpensively captured.

However, hospital administrative data is not without limitations. The AHRQ has concerns about the validity of hospital administrative codes and states that it can be extremely difficult to determine whether a complication existed in the patient during admission or whether the complication developed during hospitalization.

With the rapid expansion of electronic medical records and increased federal support for health care information technology, the AHRQ can better rely on the validity of collected hospital administrative data. Moreover, several hospital groups have developed automated approaches – such as extracting specific medical concepts and natural language processing – that can be used in combination with hospital administrative data to screen for postoperative preventable adverse events. Using electronic medical records with administrative hospital data, identification of postoperative preventable adverse events was possible, especially the identification of deep vein thrombosis, acute renal failure that requires dialysis, pulmonary embolism, sepsis, pneumonia, and myocardial infarctions in patients after surgery.

When electronic medical records were used with hospital administrative data, the level of false positive alerts was reduced. However, outcome rules could be developed to ensure high positive predictive values and high sensitivities. Using electronic medical records with hospital administrative data provides several potential advantages, such as flexibility and faster identification of postoperative preventable adverse events.

Unlike other previously used measures that looked at preventable adverse events as complications during hospitalization, HPSIs were designed specifically to capture instances of postoperative preventable adverse events that could compromise patient safety. Preliminary analysis of HPSIs implementation to screen for postoperative events shows substantial association with other outcomes, such as length of stay, in-hospital mortality, and total charges. This analysis is not surprising. Prior studies that are similar to HPSIs have shown that there is an increasing association between hospital-level characteristics, patient-level characteristics, and medical outcomes. Moreover, the potential for postoperative preventable adverse events can double with increased lengths of stay and hospital charges.

A recent study by Rothschild et al., found that increasing patient age can also increase risk for injury during the course of hospitalization, and the injuries can include pressure sores, nosocomial (also known as hospital-acquired) infections, and falls.

Hospitals are not the only places where medical errors can occur; well-developed administrative databases that provide information on hospital care are also susceptible to significant errors. Moreover, there are many attributes of hospital administrative data, such as limited descriptions of procedures, institutional variations, lack of completeness, and regional variations that make it impossible to perfectly risk-adjust the limited information.

Another limitation of HPSIs in screening postoperative events is that relatively few cases are voluntarily reported or identified in the incident reporting systems of hospitals. These indicators also might be limited in identifying cases in which patient safety was compromised during the course of hospitalization but there were no complications during the time of hospital admission. This means that even though HPSIs were designed to screen for postoperative preventable adverse events, they were not intended to unambiguously measure medical errors, and can result in false negatives and positives.

Leape et al., have also pointed out that HPSIs designed to screen for postoperative preventable adverse events do not take into consideration the exhaustive list of all medical complications that can occur during the course of hospitalization. Instead, the HPSIs have been designed to consider only a conservative list of medical errors that can be detected using the collected hospital administrative data.

After taking into consideration the unavoidable limitations of HPSIs, the AHRQ has a clearer understanding of their use and benefits. The HPSIs provide value cross-sectionally to hospitals to screen for...
postoperative preventable adverse events. The defined system provided by HPSIs for improving quality of health care would also minimize those events.

With the implementation of HPSIs, case-finding activities would also become easier, as would the identification of patient events that could signify medical complications. Moreover, the implementation of HPSIs, as shown by Corrigan et al., could be used as a tool to identify cases of medical complications that result in both mortality and morbidity, rather than only mortality.

In future implementation of HPSIs for screening postoperative preventable adverse events, the AHRQ is continuously seeking to expand the number of indicators used in the HPSIs module, while conducting external validation of these indicators. The University of California, under contract with AHRQ, is currently seeking to augment the number of potential patient safety indicators used by the module. Every indicator included will undergo further evaluation using clinical feedback on its usefulness and indicator validity apart from the empirical analysis of variability.

These validation and expansion efforts will help hospitals focus on patient safety using continuously changing codes and coding practices. Additionally, the AHRQ is also considering coordination of HPSI events with review of chart data for better identification of how HPSIs can precisely identify postoperative preventable adverse events. This coordination is also being considered to find out how preventable these events actually are and to help a hospital or group consider using an indicator for improvement of health care quality (Hofer et al).

**Medical events**

A medical preventable adverse event is patient injury resulting from medical intervention related to medications. Preventable adverse events continue to be a serious challenge in implementing quality health care and patient safety practices across hospital settings. The IOM report found that a significant number of adverse events from medications are completely preventable in nature, and hence, shows the risk hospitalized patients are exposed to while seeking health care. Therefore, the AHRQ developed HPSIs to screen for medical preventable adverse events.

An indicator is essentially a clue that helps the health care organization screen for potential medical preventable adverse events and ultimately assess the patient’s risk of overall harm from seeking medical intervention within a particular organization. The indicators also provide an approach to error identification standardization that can provide accurate information and consistency in comparison to traditional error reporting systems. Thus, the HPSIs module can be successfully used for identifying potential medical preventable adverse events with the use of hospital administrative data, traditional chart audits, voluntary reporting, and incident reporting systems.

Indicators used for screening medical preventable adverse events have been designed with the knowledge that pharmacovigilance is still in its infancy in most countries. With the help of a Delphi panel review, (a structured communication technique, developed as a systematic, interactive forecasting method which relies on a panel of experts to derive the “correct” answer) the AHRQ created an initial list of medical preventable adverse events indicators. The indicators were relevant general medical practices and also related to other specialties such as intensive care unit, psychiatry, and surgery.

For hospitals that want to implement HPSIs, the AHRQ provided methods of identifying, selecting, and finally evaluating the viability of various indicators to screen medical preventable adverse events. The first step in implementing the hospital patient safety indicators is to define the concepts and evaluate the framework in which they will be implemented. The HPSIs can be evaluated based on the collected hospital administrative data. A conceptual framework can be developed to standardize definitions of certain commonly used terms.

Standardized definitions include definitions for case-finding indicators, adverse event or complication, patient safety, medical error, patient safety indicators, preventable adverse event, quality, rate-based indicators, and quality indicators. The definitions are used to distinguish events that are less preventable from events that are completely preventable.

For the conceptualization of the spectrum, the AHRQ has developed three categories of conditions:

1. **Conditions that could be either a complication or comorbidity**, such as congestive heart failure. These conditions have to be present in the patient during hospital admission and must not be caused by medical intervention during the course of hospitalization.

2. **Conditions that reflect medical error**, such as a foreign body accidentally left in the body of the patient during a medical procedure. These conditions are likely to have been caused by a preventable adverse event or medical error. Most of these conditions appear rarely in hospital administrative data.

3. **Conditions that might be, but are not definitively, medical errors**, such as postoperative pulmonary embolism or deep vein thrombosis. These conditions represent the spectrum of preventable adverse events that can be further classified into two categories of iatrogenic or idiopathic. However, because of the uncertainty about the preventable aspect of these conditions, the indicators using these conditions are not as useful as the case-finding indicators.

Evaluation of the framework forms an essential part of implementing HPSIs because it can help policymakers understand the viability of each indicator. The evaluation can be done using face validity, process validity, minimum bias, construct validity, and real quality improvement. Evaluation of the framework also can be done by measuring the effectiveness of each indicator that has already been applied in other situations and is in practice.

Review of the selected indicators is also required on a periodic basis to ensure their effectiveness in screening medical preventable adverse events. Hospitals can adopt the methodology of the structured review that was initially used by the UCLA/RAND Appropriateness Method.

Six criteria can be used to review the selected HPSIs:

1. **Likelihood the indicator will be used for the measure of medical complications and not comorbidity** that was present at the time of hospital admission.

2. **Overall usability of the indicator**.

3. **Preventable duty of a particular medical complication using the indicator**.

4. **Extent to which a particular medical complication occurred** because of medical error.

5. **Likelihood that the medical complications would occur** has to be reviewed using the indicator.

6. **Extent of bias the indicator has been subjected to**, which includes systematic differences that could affect the indicator in a way that is not related to the quality of health care.

Review of the indicators can be performed using empirical analysis that will explore the variation and frequency of the indicators, and the relationship between the indicators and risk adjustment. Implementation of effective HPSIs that can be used for screening potential medical preventable adverse events requires a four-pronged approach, which includes identification, development, evaluation, and review of the selected indicators.
Several studies over the years have shown a substantial number of patients experience post-discharge adverse events after a considerable period of hospitalization. Alan J. Forster et al., determined the incidence, preventable duty, severity, and ameliorability of post-discharge adverse events in patients. The study was conducted at a multisite Canadian teaching hospital where patients were studied consecutively after they were discharged using chart review or telephone interviews to determine medical outcomes, especially if the patient experienced post-discharge adverse events. Forster et al., also classified the preventable duty, severity, and ameliorability of the post-discharge adverse events.

The Harvard Medical Practice Study found that post-discharge adverse events are experienced by 3.7% of all hospitalized patients, while another research study found that the risk of post-discharge adverse events increases with design flaws in the system of providing health care to hospitalized patients. These flaws were found to affect patient care upon discharge, a period that is associated with discontinuity in health care.

Even though some authors suggest that the discontinuity in care is due to medical error, it cannot be ignored that the post-discharge period is a time when patients usually experience extensive changes in therapy and health. Finally, the risk of post-discharge adverse events is increased because of the lack of communication between community physicians and the hospital.

A recent study found that nearly 19% of all patients discharged from a single teaching hospital located in the United States experienced a severe adverse event within one month of discharge. One third of these post-discharge adverse events were completely preventable because they occurred from a medical error. Another third of the post-discharge adverse events were judged to be ameliorable, since the severity could have been reduced with early response to the problem and better monitoring of the patient.

Patients who experience re-admission to the hospital or who die are also said to have experienced a post-discharge adverse event. Fifty-seven percent to 67% of all hospitalized patients experience an adverse outcome after discharge, and for 19% of these patients, the adverse outcome is completely preventable.

The most commonly occurring post-discharge adverse event is caused by medication interactions. Other adverse events occur because of therapeutic errors, procedural problems, nosocomial infections, diagnostic errors, pressure ulcers, and falls.

It was also specifically observed that the most commonly occurring post-discharge adverse event was diarrhea that was associated with antibiotics administered during the course of hospitalization. This was observed in 3% of all hospitalized patients. Among the patients who suffer from diarrhea because of antibiotics administration, 4% required readmission to hospital or a visit to a physician for definitive treatment.

Preventable post-discharge adverse events usually occur because of therapeutic errors defined as the concomitant use of drugs that are known to interact. Therapeutic errors are also defined as the failure to adequately monitor the treatment and the use of a treatment that is contraindicated to a patient’s specific condition. Examples of therapeutic errors include prescription of diltiazem to a patient for severe ventricular infection that results in a worsened heart condition and, ultimately, leads to stroke or for anti-inflammatory drugs that can lead to renal failure.

Many authors have also classified the severity of the post-discharge adverse events into different categories. These include nonpermanent disability, several days of symptoms, death, and permanent disability.

The findings in every study have been nearly the same despite the given difference in populations studied. Almost 50% of all the post-discharge adverse events did not require additional use of health care, but nearly 21% of them required a visit to a physician or readmission in the health care facility. The studies are extremely important because the findings have direct implications on improvement in the quality of health care provided by the hospitals during hospitalization and after discharge.

Study authors recommended close monitoring of discharged patients along with continuous communication between the hospital and community physicians. Monitoring is inadequate in cases in which discharged patients experience even an ameliorable post-discharge adverse event.

Interventions must also form an essential part of post-discharge care to improve the communication between the hospital and community physicians, keeping in mind the frailty of patients. Elderly patients are more susceptible to post-discharge adverse events.

Forster et al., also pointed out that it is essential for hospitals to periodically monitor the effectiveness of their discharge process to reduce the rates of post-discharge adverse events. This will also help demonstrate the organization’s commitment to provide high-quality health care and patient safety. A standardized and formal process for follow-up with discharged patients is also essential to reduce the rates of post-discharge adverse events. Better integration of the hospital with the care providers at community levels must be encouraged to prevent discontinuity in discharged patients’ care.

Drug-related adverse events

Care should be taken at the time of discharge because studies have shown that almost 20% of discharged patients experience adverse medical conditions again, especially drug-related problems, in first 4 to 5 weeks after discharge. However, findings also revealed that almost three-fourths of those patients had preventable medical conditions.

Collectively, studies concluded that adverse medicinal events are the most common problem after discharge.

Drug-related adverse events include results pending at the time of discharge, which can lead to the wrong medications. According some findings, discharged patients are readmitted in hospitals within 40 to
50 days after discharge with adverse medication reactions being the reason, especially in the U.S. health care industry.

One reason drug-related adverse events occur is the systematic problems arising during re-hospitalization. Traditional modes of communication are incompetent in reaching outpatient care professionals and have incomplete data, which results in miscommunication of medications to the outpatient care providers. It is especially a concern for patients having low awareness or prescribed with sensitive drugs.

A study reported that almost half of hospitalized patients are prescribed the wrong medication, both during and after discharge. Out of these patients, 61% had no medical injury, while 33% encountered mild injuries, and 6% faced severe injuries. The study concluded that an effective and timely system of communication between inpatient and outpatient health care providers would solve this problem.

A systemic hospital administration policy is required that focuses on:

- Patient’s awareness level is enhanced by educating the patient and his/her family regarding medical condition, medications, safety measures, and contact information in case of emergency.
- Communication mechanism dispenses required information in a prompt way to outpatient health care providers.
- Drug reconciliation focuses on whether the medication given to patients is actually prescribed and also checks the continuity and discontinuity of the drugs.

### Nosocomial adverse events

Studies have revealed that an improper and incomplete surveillance system is responsible for post-discharge adverse medication events. Nosocomial infections are usually diagnosed during treatment, although many are identified after discharge.

Nosocomial risks are directly proportional to the duration of hospitalization. Reports show that around 50% to 84% of patients suffer from preventable medical conditions after discharge because of nosocomial infections. The CDC has clearly explained this infection as a localized or systemic condition 1) that results from adverse reaction to the presence of an infectious agent(s) or its toxin(s) and 2) that was not present or incubating at the time of admission to the hospital. Therefore, follow-up visits are necessary, especially up to one month after surgery. The physician must diagnose the severity of the infection as per the classifications determined by the FDA, including life-threatening conditions, disabilities, re-hospitalization, and fatalities.

In a study, Thomas Hanslik et al., reported that almost 33% of patients faced infections within a day or two after discharge, while 26% had symptoms within the first week. In addition, only 30% of physicians provided information to their patients and their families regarding medications and instructions to be followed after discharge. Further, the study also clarified that these infections are not limited to patients passing through surgical operations, even though the risks are higher in these patients.

It is important to determine the clinical status of these infections in patients, both by inpatient and outpatient health care provider. Patients suffering from nosocomial infections after discharge must immediately contact their physicians. Approximately 78% to 88% of patients reported this condition within 1 to 14 days after discharge.

The outpatient healthcare provider needs to communicate detailed information to avoid any treatment delays. The information must also be given to inpatient health care providers regarding any nosocomial effects arising after discharge.

### Procedure-related adverse events

Procedure-related adverse events after discharge are extremely common among hospitalized patients, and the complications or medical problems usually manifest themselves within the first 72 hours after discharge. The findings also showed that Medicare beneficiaries were less likely to report experiencing post-discharge, procedure-related preventable adverse events compared with other patients, even if they experienced the events shortly after discharge. This attitude toward reporting remained the same, even if these Medicare beneficiaries were likely to be re-hospitalized within the first 30 days post-discharge.

The study conducted a telephone survey of 25 hospitals in 14 states across the United States and, unlike other similar studies, most of the participating hospitals were community hospitals, not teaching hospitals. The study conducted by Erich Segal et al., found that the increasing frequency of procedure-related, post-discharge preventable adverse events was not just a problem of teaching hospitals, but a national problem affecting even community hospitals. The research analyzed the findings by gender, age, and the health insurance status of the patient.

The study tried to identify the problems that caused procedure-related post-discharge preventable adverse events and found that most events occurred because of a lack of communication between inpatient and outpatient health care providers and also because the patient and his/her primary caregivers were not instructed about the medication regimen to be followed post-discharge.

Many procedure-related, post-discharge preventable adverse events also occur because the patient was awaiting test results or a diagnostic work-up during the discharge process that was not followed-up by the outpatient health care provider.

Approximately 40% to 44% of all post-discharge adverse events occurred because of procedure-related medical errors. Patients were more likely to report these events if they were female, aged 30 to 49 years, with or without receiving Medicaid. Patients who reported procedure-related post-discharge preventable adverse events...
were likely to be re-hospitalized within the first 30 days following discharge. However, the study surprisingly found that patients over age 80 years and Medicare beneficiaries were less likely to report experiencing a procedure-related preventable adverse event after discharge.

The study stated that discontinuities in health care, especially when the patient is transferred from the inpatient hospital department to the outpatient hospital department, caused an increase in procedure-related post-discharge preventable adverse events. The instances of these events increased because of faulty communication between the inpatient and outpatient pharmacies and also because of unstructured discharge summaries by the outpatient physician. Many times, unstructured physician sign-outs also caused an increase in adverse events.

**Pressure ulcers**

A pressure ulcer is essentially a localized injury to the underlying tissue or skin. A pressure ulcer usually occurs over a bony prominence and is a result of pressure or a combination of shear, friction, and pressure. They often worsen because subcutaneous tissue and muscle are more susceptible than skin to injury due to pressure.

In 2007, the National Pressure Ulcer Advisory Board stated that there were two new stages, to create a total of six stages, in the development of a pressure ulcer. The additional stages are called “unshakeable” and “suspected deep tissue injury.”

**Category/Stage I: Non-blanchable erythema**

Intact skin with non-blanchable redness of a localized area usually over a bony prominence. Darkly pigmented skin may not have visible blanching; its color may differ from the surrounding area. The area may be painful, firm, soft, warmer or cooler as compared to adjacent tissue. Category I may be difficult to detect in individuals with dark skin tones. May indicate “at risk” persons.

**Category/Stage II: Partial thickness**

Partial thickness loss of dermis presenting as a shallow open ulcer with a red pink wound bed, without slough. May also present as an intact or open/ruptured serum-filled or sero-sanguinous filled blister. Presents as a shiny or dry shallow ulcer without slough or bruising*. This category should not be used to describe skin tears, tape burns, incontinence associated dermatitis, maceration or excoriation.

*Bruising indicates deep tissue injury.

**Category/Stage III: Full thickness skin loss**

Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle are not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunneling. The depth of a Category/Stage III pressure ulcer varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have (adipose) subcutaneous tissue and Category/Stage III ulcers can be shallow. In contrast, areas of significant adiposity can develop extremely deep Category/Stage III pressure ulcers. Bone/ tendon is not visible or directly palpable.

**Category/Stage IV: Full thickness tissue loss**

Full thickness tissue loss with exposed bone, tendon or muscle. Slough or eschar may be present. Often includes undermining and tunneling. The depth of a Category/Stage IV pressure ulcer varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have (adipose) subcutaneous tissue and these ulcers can be shallow. Category/Stage IV ulcers can extend into muscle and/or supporting structures (e.g., fascia, tendon or joint capsule) making osteomyelitis or osteitis likely to occur. Exposed bone/muscle is visible or directly palpable.

Therefore, many studies have proposed the implementation of a standardized discharge process that includes database-generated discharge summaries instead of those dictated by inpatient and outpatient health care providers. A database-generated discharge summary will help improve the quality of information shared between the inpatient and outpatient health care providers.

Structured sign-outs that include a summary of the medical condition of the patient, resuscitation status, laboratory data, medication allergies, a problem list, and follow-ups can also significantly reduce instances of post-discharge preventable adverse events. A structured discharge process can further focus on early home return and early involvement of a home nurse or a social worker to prevent discontinuity in health care that can be associated with these events.

**Additional Categories/Stages for the USA**

**Unstageable/Unclassified: Full thickness skin or tissue loss – depth unknown**

Full thickness tissue loss in which actual depth of the ulcer is completely obscured by slough (yellow, tan, gray, or brown) and/or eschar (tan, brown or black) in the wound bed. Until enough slough and/or eschar are removed to expose the base of the wound, the true depth cannot be determined; but it will be either a Category/Stage III or IV. Stable (dry, adherent, intact without erythema or fluctuance) eschar on the heels serves as “the body’s natural (biological) cover” and should not be removed.

**Suspected Deep Tissue Injury – depth unknown**

Purple or maroon localized area of discolored intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer or cooler as compared to adjacent tissue. Deep tissue injury may be difficult to detect in individuals with dark skin tones. Evolution may include a thin blister over a dark wound bed. The wound may further evolve and become covered by thin eschar. Evolution may be rapid exposing additional layers of tissue even with optimal treatment.

*National Pressure Ulcer Advisory Panel (NPUAP)*

http://www.npuap.org/resources/educational-and-clinical-resources/npuap-pressure-ulcer-stagescategories/

Pressure ulcers are completely preventable in most cases. However, the prevalence of these ulcers occurring in patients after discharge is rapidly increasing. Pressure ulcer-related, post-discharge preventable adverse events vary considerably by medical setting, ranging between 4% and 38% in acute care, between 6% and 23% in long-term care, and between 2% and 15% in home care (Lyder, 2003). Pressure ulcers often hinder functional recovery, causing severe pain as well as the development of secondary serious infections. Over the years, pressure ulcers have been associated with extended hospital stays, mortality, and sepsis. In 2007, it was estimated that nearly 60,000 hospitalized patients in the United States die each year from complications from pressure ulcers acquired during hospitalization.

Lyder et al., estimated the cost of managing a single, full-thickness pressure ulcer to be as high as $80,000. The study further estimated the total cost of treatment of pressure ulcers in 60,000 hospitalized patients in the United States to be $12 billion every year. Therefore, preventing pressure ulcer-related, post-discharge preventable adverse events is extremely important.

The study suggested steps to prevent pressure ulcers and found a team approach with accurate reporting completely prevented these events. The patient and his/her family members must be informed of how to prevent occurrences after discharge, including risk assessment, relieving pressure, moisturizing skin, and optimal nutrition, as well as continuous monitoring of the patient’s calorie intake and follow-up appointments with the outpatient health care provider.
In recent years, collaboration between several medical organizations, including the National Institute for Health and Clinical Excellence and the Royal College of Nursing, developed clinical guidelines to prevent pressure ulcer-related, post-discharge adverse events. The guidelines advise hospitals on the management of pressure ulcers in both primary and secondary care. The main areas include:

- Ulcer assessment.
- Holistic assessment to reduce the treatment delay of pressure ulcers.
- Providing support services so pressure ulcers can be treated earlier.
- Positioning, repositioning, and mobility to treat pressure ulcers.
- Topical agents and dressings used for treatment.
- Use of debridement.
- Providing appropriate nutritional support to patients suffering from pressure ulcers.
- Using surgery as an option for treatment.
- Using therapeutic ultrasound to treat pressure ulcers.
- Using electromagnetic therapy and electrotherapy to treat pressure ulcers.
- Using topical negative pressure as a treatment alternative.

Hospitals must work with health care providers and non-medical staff to use the guidelines to prevent pressure ulcers after discharge. Patients, as well as health care providers, must be made aware of these guidelines and their recommendations. For effective implementation of the guidelines and effective prevention of pressure ulcers, both patients and their health care providers should be involved in decision-making for pressure ulcer treatment. There should be an integrated approach to implement these guidelines along with a clear policy and strategy that is completely supported by hospital management.

If, despite the implementation of the guidelines, discharged patients still suffer from pressure ulcers that were acquired during the course of hospitalization, they must receive initial and ongoing pressure ulcer assessment. Moreover, the outpatient health care provider must record occurrences of pressure ulcers in discharged patients, especially if the symptoms have manifested within the first 30 days after discharge. The recording must contain details about the cause, site, stage, and dimensions of the ulcer, as well as local signs of infection, surrounding skin appearance, wound appearance, pain, involvement of other clinical experts, and odor.

These guidelines are needed because pressure ulcers create a significant number of clinical, physical, and psychological difficulties for patients, their primary caregivers, and family members. Implementation of the guidelines is also required because pressure ulcer-related, post-discharge adverse events are more likely to occur in patients who are critically ill, have impaired mobility, are neurologically compromised, or who are completely immobile. These events can also occur in patients who suffer from obesity and impaired nutrition, or use equipment for poor posture.

Research has shown that pressure ulcers are a major burden of sickness for discharged patients and can also reduce quality of life by hampering their careers and family lives. Often, these patients require prolonged re-hospitalization in addition to frequent contact with an outpatient health care provider. During this time, patients suffer from much pain, inconvenience, and discomfort. Another study has also shown that these adverse events are associated with a three- to fourfold increase in deaths of older patients, especially those in intensive care units.

For complete prevention of these adverse events, health care professionals must incorporate knowledge and experience of others who have previously treated and prevented the development of pressure ulcers. At the same time, patients and their primary caregivers must be informed about any potential risk or medical complications of developing a pressure ulcer. Moreover, health care should be provided to the patient in a continuous manner while encouraging effective communication between inpatient and outpatient departments. Access to education and training should be made available to hospital staff, including health care professionals and non-medical staff, to reduce instances of pressure ulcer-related, post-discharge adverse events.

**Diagnostic errors**

Diagnostic error-related, post-discharge adverse events have extreme consequences and are usually caused by human error. According to a medical record review, most of these events are completely preventable. Diagnostic errors usually result in patient medical injury as an error in diagnosis usually leads to at least a delay in appropriate medical treatment and covers a smorgasbord of possible injuries. Previous studies have shown that instances of medical injury caused by diagnostic errors largely vary because of differences in medical specialties.

In a study conducted across different medical specialties to understand the causes and rates of diagnostic error-related post-discharge preventable adverse events, it was found that they were experienced by 0.4% of all discharged patients, accounting for nearly 6.4% of all post-discharge adverse events. Of these, nearly 83% were completely preventable – the predominant cause (96%) was human failure. Organizational-related factors accounted for 25% of the diagnostic errors, while 30% were patient-related factors.

When diagnostic errors were compared with other adverse events, the mortality rate was 8% and 29%, respectively. However, diagnostic errors represent an extremely important error type, and the consequences are extremely severe because they are usually caused by human error, e.g., information transfer problems and knowledge-based mistakes. Thus, prevention strategies in hospitals should focus on training physicians for better information transfer and better organization of knowledge.

For almost three decades in the United States, researchers have tried to understand the causes behind these diagnostic errors. Numerous studies were conducted in California, Colorado, and New York. These studies generally used the chart review method (expert physician in the respective field does a retrospective review of the patient’s medical chart comibing for errors), followed by multiple physician implicit reviews (blinded team of expert physicians review the patient’s medical chart for possible errors), to understand the causes of diagnostic errors. Zwaan et al., found that nearly 6% of all adverse events were actually diagnostic error-related, post-discharge adverse events in hospitals. Most of these errors were associated with sepsis, pulmonary embolism, appendicitis, and myocardial infarction.

Diagnostic error adverse events have been long recognized and defined as injuries sustained by patients due to unintentional delays in medical intervention, or wrong or missed diagnosis. To understand how to prevent these errors, Kassiser et al., found that using the checklist method, where a task during work-up and differential diagnosis is checked off after it is completed, seemed to be too simple for the complex task of diagnosis. However, another study discovered that most of these adverse events occurred due to simple oversight, as well as lack of communication between the outpatient and inpatient health care providers.

An intervention system that addresses system-related factors that contribute directly to diagnostic errors could help health care providers reduce diagnostic errors post-discharge, but it has not been implemented in most hospitals. Hospital governing bodies feel that there is very little business rationale in implementing the intervention method because the cost of diagnostic error-related, post-discharge adverse events has never been covered and these costs actually are quietly absorbed by patients, especially those on Medicare. Basically,
hospital administration feels that the cost of an intervention system is not a smart business decision.

However, providing a financial incentive-based system in the health care industry might help reduce diagnostic error-related adverse events in patients after discharge. Considering the aging population in many countries, health care industries will not be able to ignore diagnostic errors.

**Misdiagnosis**

Health practitioners make medical diagnoses using efficient cognitive processes and automatic response thinking, meaning that they are trained to produce an automatic answer from a scientific algorithm based on the patient’s clinical condition and medical test results. However, in general, health care practitioners tend to underappreciate the likelihood that using efficient cognitive processes and automatic responses increases the chances of misdiagnosis/diagnostic errors. This attitude stems from the fact that with experience, many health care practitioners become overconfident, which is the main contributing cause of misdiagnoses and diagnostic errors (Eta S. Berner et al.).

Large-scale surveys of health care scenarios have found that patients say they have experienced misdiagnosis/diagnostic errors because of the overconfidence of the attending health care practitioner. For example, in a survey of health care practitioners and patients about the extent patients or a member of their family experienced medical errors that were defined as serious harm, causing disability, prolonged treatment, or death. Approximately 35% of all health care practitioners and almost 45% of patients reported misdiagnosis/diagnostic errors.

In a recent survey of hospitalized patients in the United States, nearly 35% experienced misdiagnosis or diagnostic error in the 5 years following a medical intervention. Half of these diagnostic errors were completely preventable and occurred because of the health care practitioner’s overconfidence. It was also observed that close to 55% of hospitalized patients are concerned about misdiagnosis after perceiving overconfidence in the attending health care practitioner, while 23% listed organizational errors as the cause of misdiagnosis.

The surveys and studies have shown that patients frequently experience concerns about misdiagnosis during medical intervention. However, patients cannot always accurately identify a misdiagnosis, adverse event, or diagnostic error.

Misdiagnosis or diagnostic errors occur in every medical specialty, but are generally lower for two specialties: pathology and radiology – most likely because these two medical specialties generally rely on visual interpretation of the medical complications of the patient. Thus, the error rates in anatomic pathology and clinical radiology range between 2% and 6%.

The most common misdiagnoses occur in the most complex of medical presentations. These low error rates cannot be expected in medical specialties in which x-rays had to be interpreted by another health care practitioner who was not a trained radiologist. For example, in cases in which x-rays are interpreted by an emergency department practitioner because a staff radiologist is unavailable, the error rates can rise to 16%, and in some cases even 35%.

**Statistics**

In aggregate studies, it has been consistently shown that diagnostic errors range between 5% and 10%, or 15% in most medical specialties. The lower rates of diagnostic errors are typically observed in perceptual specialties, such as dermatology, radiology, and pathology. The higher rates are observed in complex medical specialties such as the emergency department, where health care practitioners are expected to make complex decisions under great stress.

Taking this into consideration, it also should be noted that clinical diagnosis accuracy might be completely different from what has been suggested in most surveys and studies that have assessed diagnostic error rates. Many times, differences in the estimates of diagnosis error can also take place because researchers first evaluate diagnostic errors that caused adverse events and do not take into consideration diagnostic errors that did not cause any significant injury or re-hospitalization.

Additionally, differences in estimates of diagnosis error can occur if the surveys or studies have taken into account autopsy data that have
shown diagnostic errors, but have not taken into account deaths of patients that occurred because of diagnostic errors.

Statistics have shown that a considerable number of diagnostic errors occur because of overconfidence. In many studies conducted since 2009, it has been found that about 40% of health care practitioners avoid asking too many simple, yet extremely helpful, questions due to overconfidence.

In a study, about 60% of cases, health care practitioners deviated from recommended best practices, e.g., though 95% of practitioners were aware of the guidelines for lipid treatment, they only followed the guidelines 20% of the time. Even though decision support tools have been provided by hospitals for better care delivery, only a small fraction of health care practitioners use them.

This disregard not only results in diagnostic errors, but also reflects an inherent belief of many physicians that their practice actually conforms to consensus recommendations. In reality, they do not. A study found that almost half of health care practitioners are adamant about an incorrect diagnosis, even when they have been suggested the correct diagnosis by the diagnostic decision support system. It was also observed that experienced dermatologists were confident about the diagnosis in more than 70% of the test cases; however, they were found to be wrong in at least 40% of their decisions. Thus, definite and concrete evidence of the impact of overconfidence by health care practitioners on diagnostic errors has been demonstrated.

The most explosive research on this topic was conducted by Podbregar et al., on 126 patients who died in the intensive care unit and subsequently underwent autopsy. Health care practitioners were asked to provide the clinical diagnosis and the level of uncertainty they experienced about the clinical diagnosis. The levels included level I, complete certainty; level II, mild to moderate uncertainty; and level III, major uncertainty. The results showed that physicians who were completely certain of the clinical diagnosis were actually wrong approximately half of the time. Similar findings were also reported in other studies.

### Types of diagnostic errors

Considering the extremely high rates of diagnostic errors that occur, it is extremely important to understand the types of diagnostic errors or misdiagnoses that can occur in both inpatient and outpatient settings.

There are several types of diagnostic errors:

- **Wrong diagnosis**, also known as misdiagnosis, which occurs when a health care professional diagnoses the medical complication as a wrong illness. For example, a practitioner might diagnose a patient with a gastrointestinal problem when, in fact, the patient is suffering from a heart attack.
- **Missed diagnosis** occurs when the practitioner tells the patient he or she is completely free of any medical complications when the patient is actually suffering from mild, acute, or severe disease or illness.
- **Delayed diagnosis** occurs when the practitioner does make the correct diagnosis in a timely manner. Late diagnosis is considered one of the most common types of misdiagnosis or diagnostic error.
- **Failure to recognize medical complications** occurs when the practitioner makes the right diagnosis, but fails to identify factors or medical complications that have the potential to aggravate or change the condition or illness.
- **Missed diagnosis of a related disease** occurs when the practitioner correctly diagnoses one medical condition but fails to diagnose a related condition. A related medical condition is a disease that often goes hand-in-hand with the primary disease and often has a higher risk of incidence in patients who are already suffering from aggravated symptoms of the primary disease.
- **Missed diagnosis of an unrelated disease** occurs when the practitioner correctly diagnoses one medical complication but fails to notice the presence of another medical complication that is completely unrelated to the primary disease.

High rates of misdiagnosis or diagnostic errors have been observed in the emergency room because of increased time pressure – the health care practitioner has very little time to investigate all the patient’s medical complications. In an extreme case, the severe nature of any emergency room illness or injury also means that the practitioner is more likely to misdiagnose, causing more injury or harm to the patient.

It is also possible that in an emergency room setting, less common medical conditions and illnesses are more likely to escape the attention of the physician. Uncommon conditions in a given patient population are also less likely to be correctly diagnosed. For example, a young woman who is experiencing chest pain, which is one symptom of a heart attack, is less likely to be diagnosed as experiencing a heart attack in comparison to an overweight middle-aged man who is experiencing the same symptoms.

Examples of conditions that are usually misdiagnosed in an emergency room setting include alimentary embolism, stroke, meningitis, and heart attack. Appendicitis in the emergency room has been misdiagnosed in 28% to 57% of cases in children less than 12 years of age, and close to 90% in patients less than 2 years of age.

Understanding the types of diagnostic errors is also important because they are extremely common and remain an understudied area in improving patient safety. To help hospitals understand the various types of diagnostic errors, a six-item written survey was conducted in 20 hospitals across the United States. In the survey, respondents were asked to report at least three cases of diagnostic errors they had experienced when seeking medical intervention.

Missed or delayed diagnoses, even though frequent, are extremely underappreciated and often lead to acute or serious patient injury. Despite such alarming findings, very few studies have been conducted to examine the different types of diagnostic errors in detail because the costs of the occurrence of diagnostic errors have never been covered. Hospitals are justifiably reluctant to implement practices to reduce diagnostic errors.

### Clinical scenarios of inpatient and post-discharge adverse events/medical errors

Adverse events in hospitalized patients, as well as discharged patients, have been generally associated with the discontinuity of health care that occurs during the transfer of patients from one hospital department to another, including patient transfer from the inpatient department to the outpatient department.

Adverse events also occur because of a lack of communication between the inpatient and outpatient departments. However, very little attention has been paid to the spectrum of adverse events and medical errors that are caused by the overconfidence of health practitioners and inadequate communication between the attending physicians.

Discontinuity occurs when inpatient physicians caring for hospitalized patients formulate discharge plans that might include follow-up tests and medication regimens that have to be continued after discharge. However, outpatient physicians sometimes fail to instruct the patient on the medication regimen and procedures that have to be conducted post-discharge. The IOM defines clinical setting and post-discharge medical errors as the failure to act as initially intended.

Based on this definition, the failure to implement the post-discharge diagnostic work-up and to instruct the patient on the medication regimen to be followed post-discharge is considered a medical error.
Studies have shown that even though 60% of inpatient primary-care providers transfer all the necessary information to the outpatient care providers, 40% of hospitalized patients do not receive the appropriate instructions or information on medication regimen and a follow-up diagnostic work-up to prevent discontinuity of health care.

A study reviewed a 900-bed urban teaching hospital in Manhattan, NY, which provided adult primary care and was staffed with 128 internal medicine residents and 25 full-time attendants. The attendants were responsible for the care of patients during the course of hospitalization, while some of the internal medicine residents were responsible for health care of outpatients or hospitalized patients after discharge.

The study found three types of medical errors that occurred in both inpatient and outpatient settings – medication continuity error, work-up error, and test follow-up error. The study also found that among hospitalized patients, nearly 49% experience one or more medical error during hospitalization or post-discharge. In most cases, these were due to discontinuity of care of the patient from the inpatient or outpatient setting.

Non-preventable adverse events

Non-preventable adverse events cause varying amounts of medical injury to the patient. Of all adverse events taking place in a medical setting, few of them are unavoidable. They include medication side effects not observed in the patient and procedure-related complications that could not have been foreseen.

Because of the high rates of preventable adverse events, patient safety has become an extremely important attribute of providing quality health care in medical settings. Studies in several countries found the risk of experiencing a preventable adverse event to range between 3% and 11% in all hospitalized patients.

Although nearly 60% of adverse events are completely preventable, 20% to 25% are unavoidable. Collection of such data can help implement methods to improve patient safety and quality of health care provided in medical settings.

The highest instances of unavoidable adverse events are observed in the emergency department, where only 2.9% are preventable. The Harvard Medical Practice Study found that patients who were discharged from the emergency department were at a higher risk of unavoidable adverse events because of the nature of health care provided in that department. Health care practitioners in the emergency department do not personally know these patients, and hence, do not have access to critical information, such as allergic reactions of the patient to certain medications. Furthermore, the emergency department is often chaotic and overcrowded, which results in therapeutic and diagnostic interventions having inherent risk.

Very few studies have been conducted to understand the rates of occurrence of unavoidable adverse events in patients following hospitalization or following a visit to the emergency department. However, one study found that approximately 20% of all hospitalized patients are expected to experience an adverse event within 30 days following discharge from the hospital or emergency department. At least 80% of these patients experienced an unavoidable adverse event while seeking medical intervention in an emergency department where, many times, health care practitioners have to make a decision under stress and time pressure. This study has helped hospitals understand the rates of occurrence of unavoidable adverse events, which will help determine strategies and practices to improve patient safety and quality of health care to ultimately reduce adverse events.

Many studies have also provided hospitals with methods for measuring adverse events in various departments in the hospital. The preliminary estimates of these methods can be used to improve patient safety practices, and the data from these studies can be useful for multicenter and large hospitals to find ways to get to minimum rates of adverse events.

Preventable adverse events

Several studies conducted over the years have shown a substantial rate of preventable adverse events in hospitals and other medical settings. Preventable adverse events result in unintended medical injuries to a patient caused by medical intervention instead of the underlying disease present in the patient.

The Harvard Medical Practice Study found that almost 4% of all medical intervention cases lead to preventable adverse events. Nearly 70% of patients who experience preventable adverse events experienced mild to moderate or short-lived disabilities. However, 7% of the preventable adverse events resulted in permanent disabilities, while 14% resulted in the death of the patient.

Findings of studies conducted in Colorado and Utah were also supported by studies of the Australian health care industry, which identified that almost 16% of all hospital admissions lead to preventable adverse events. The Australian study also included a wide range of mild or moderate severity of preventable adverse events and estimated that these events cost the Australian health care industry almost $5 billion every year.

Moreover, medication-associated errors were composed of 13% pulmonary medication, 27% gastrointestinal medication, and 36% cardiovascular medication. Eight percent of hospitalized patients were discharged with their tests pending, and no follow-up was performed to complete the tests required for the continuity of care of the patient. Approximately 12% of all hospitalized patients had scheduled an outpatient work-up, and nearly 45% of the medical errors occurred because the outpatient primary-care provider failed to follow-up the work-up schedule.

Most studies recommend the use of electronic medical records in real time to allow attending physicians of various departments to communicate with each other to prevent discontinuity of care that might result in medical errors. The studies also recommend that outpatient attending physicians record the hospitalization or occurrences of medical error irrespective of the severity of the medical error for effective reduction in errors in both clinical and outpatient settings.
care suffer serious complications or die because of a preventable adverse event.

These adverse events can include misdiagnosis, delayed diagnosis, and missed diagnosis. They can also be caused by treatment errors including incorrect drug administration, incorrect dosage, and omitted or delayed administration.

Preventable adverse events can occur because of diagnostic errors, preventive services errors, or treatment errors. Here is a case scenario of how preventable adverse events occur:

A 53-year-old man with a known history of stroke displayed multiple resistances to Staphylococcus aureus infection, heart failure, and leg ulcers was admitted to a hospital for treatment of cellulitis and venous ulceration in both legs. This man suffered two preventable adverse events that included failure of the hospital staff to manage the leg ulcers, which subsequently led to the development of osteomyelitis. The patient had to undergo amputation of both legs below the knee.

Recommendations for improvement

Health care practitioners cannot guarantee that patients will not be susceptible to the risk of preventable adverse events within the health care system. Stories of suffering caused by preventable adverse events have emerged across several countries, revealed by the patients themselves, their family members, or the medical staff.

The epidemiology of preventable adverse events started unraveling with the IOM report that showed that many hospitalized patients were susceptible to these events that resulted in mild disability (18%), permanent disability (6%), and in some cases, even death (8%). In the United States alone, 98,000 patients experience preventable adverse events every year, and 5000 of them die.

Individual horror stories and high-profile cases have jolted hospitals out of complacency and alerted them to concerns about patient safety and preventable adverse events. However, the problem of patient safety and preventable adverse events is much deeper than the stories that make headlines. There are many of these events that go unreported because they result in mild to moderate temporary disability in a patient. This is the reason that the rise in preventable adverse events and patient safety practices have been a cause of concern for health care systems worldwide.

Inappropriate patient safety practices also result in preventable adverse drug reactions that often compound medical complications already present in a patient. Various studies have shown that adverse drug events cause 6% of all hospital admissions, of which 66% are completely avoidable. Preventable adverse drug events are one of the leading causes of deaths in the United States.

Ensuring patient safety in inpatient and outpatient settings is extremely important in the health care industry today. The first step toward improving patient safety practices to reduce preventable adverse events is to learn from experience. This includes not responding to these events by placing the blame on the hospital, non-medical staff, and health care practitioners.

If something goes wrong during the course of medical intervention, the hospital, non-medical staff, and health care practitioners must learn from the experience, and through this learning, place emphasis on reducing the risk to future patients. The learning experience must also include understanding the causes of the preventable adverse events using the method of root-cause analysis and then developing solutions to completely eradicate these causes to provide better health care to future patients.

Medical staff providing health care to a patient who has experienced a preventable adverse event must remember that the learning experience is not about blaming individuals for the event, but gathering the appropriate information while trying to understand why the event took place. It is also about understanding organizational and management factors – collectively known as systemic factors – that allowed the preventable adverse event to occur. Several studies have shown that a majority of these adverse events occurred not because of poor performance of the medical staff or health care professional, but because of systemic factors. Hence, it is extremely important to concentrate on improving dysfunctional systems rather than focusing on blaming an individual who was involved in providing health care to the patient.

Improving patient safety practices is a major health care priority, and it should be implemented to reduce unintended harm to hospitalized patients and unnecessary cost to the hospital. Many studies have also outlined key requirements that are essential to reducing preventable adverse events in medical settings. They include:

- Complete understanding of what constitutes a preventable adverse event by all individuals involved indirectly or directly in providing health care to patients.
- Proper management and reporting of preventable adverse events in accordance with the local arrangements of the hospital.
- Immediate reporting of serious preventable adverse events to the person designated, while providing complete information on how the event occurred.
- Gradation of preventable adverse events that can take place in a medical setting to understand the potential risk for future patients.
- Providing local investigational support to understand the causes of the preventable adverse events.
- Extremely serious preventable adverse events must be reported to the concerned state or national authorities immediately, or at least within 7 days of the date of the event. Serious preventable adverse events include events that have resulted in permanent disability of the concerned patient or death.
- For severe preventable adverse events, the hospital must undertake a full root-cause analysis, and the results must be communicated immediately to state or national authorities so the results can be given to other hospitals and medical institutions to reduce the risk of such events.
- In cases where required, hospitals must coordinate with the department of health to establish an inquiry into the occurrence of the preventable adverse event and cooperate with the person heading the investigation.
- Reviews of all medical intervention must be carried out periodically to assess the potential for preventable adverse events in any medical intervention. Aggregate review reports must be sent regularly to the local and national authorities.
Lessons learned from preventable adverse events that have occurred in the past must be shared with medical settings across the country to help in the overall reduction of preventable adverse events in the health care system. Medical staff involved in providing health care to the patient who experienced the preventable adverse event must be encouraged to interact with the medical staff of other hospitals for the overall reduction of the preventable adverse events.

**System failures**

Patient safety practices are an essential component of providing quality health care and reducing preventable adverse events in medical settings. However, despite the best efforts of hospitals, health care practitioners, and other medical staff, preventable adverse events still occur, often resulting in moderate or severe disability and sometimes even death.

Many times, the preventable adverse events occur because of system failures, such as flaws in the basic design of the health care system. System failures are side effects or medical injury that might occur from causes that are completely independent of the individuals providing health care to patients.

To reduce system failure-induced preventable adverse events, hospitals must establish a fair and just working culture that encourages knowledge, practice, commitment, and skills of health care professionals and non-medical staff. In such a framework, patient safety practices take top priority. Hence, health care practitioners and other medical staff can improve the quality of health care provided to patients. To reduce system failures, hospitals can also optimize administrative and clinical processes by asking one simple question, “Are we providing the best quality health care possible?”

A focus on correction, not punishment, embedded in this framework can also help reduce system failures where active analysis of the preventable adverse events takes place without blaming any individual, and instead focuses on eliminating the causes of these events to improve patient safety practices and quality of health care provided.

In this framework, the interest of health care providers and patients are protected. A fair and just framework can also help leaders understand the context and circumstances of decision-making during the course of hospitalization and especially at the time when the preventable adverse event occurred. This keeps the focus on the analysis of system failures that contributed to the events and allows hospitals to trust initial responses in the reduction of the events while respecting the rights of all the individuals involved in the event.

**Improving transitional care**

Reducing discontinuity in health care is extremely important because it is one of the major contributing causes of preventable adverse events in inpatient and outpatient settings. Care transitions refer to the transfer of patients from one health care department to another. For example, people with complex and serious illnesses often have to be transferred from a nursing home to a hospital or from a community-based health care service to a multi-specialty hospital.

At least two in 10 patients discharged from the hospital have to be readmitted within 30 days following the discharge, costing the health care system $26 billion every year. Poor communication, medication errors, and poor coordination between the inpatient and outpatient departments are causing an increase in preventable adverse events. Thus, the main priority of most hospitals is to ensure that discharges are standardized and accomplished appropriately so that transitions in health care can occur safely and effectively.

The goal is to avoid re-hospitalization. For effective and safe care transitions, cooperation between health care providers in social, medical, and other support services is essential. Elements of efficient, effective, and safe care transitions must also include patient-centered discharge plans that have been carefully explained to patients and their family members, accurate and standardized communication between the receiving and transferring health care providers during the discharge process, safe medication practices and reconciliation, and safe transportation of the patient for any travel related to health care.

Communication between inpatient and outpatient health care providers and with patients must include information about major health problems, primary diagnosis, goals of care, emergency plan, medication reconciliation list, advance directives, and the functional and cognitive status of the patient.

**Medication reconciliation**

Medical reconciliation involves developing a list of current and future medications administered to the patient, comparing both lists, and ultimately making a clinical decision based on the comparison. Medical reconciliation is extremely important during the discharge process, and communication is essential to patients or their caregivers so the proper medications will be administered at the right time and in the right dosage.

Proper medical reconciliation can help reduce instances of preventable adverse events. The first step toward improving medical reconciliation is to prepare a comprehensive medication history of the patient and completely understand his or her allergic reactions to certain medications, if there are any. The next step is to categorize the risk of the patient based on the history of medication. Risk factors include the inability of the patient to provide a history of medication usage, as well as a relatively high-index of suspicion that a possible medication complication exists.

The third step to improve medical reconciliation is extremely critical because it can affect patient safety and the chances of re-hospitalization. This step includes providing medical reconciliation information to the inpatient and outpatient health care providers during the discharge process. The information should include details such as old medications, new medications, frequency, and dosage.

The fourth and final step toward improving medical reconciliation involves educating the patient and his or her family members about the medications that have to be administered. Education can be done verbally, but many notable authors have suggested providing education to the patient and family members in written form to reduce occurrences of preventable adverse events.

**Improving electronic health record strategic use**

For years, electronic health record (EHR) systems had hospitals store and retrieve detailed patient information that can be used by hospital staff and health care providers for medical intervention in inpatient and outpatient settings. Both EHR systems and clinical decision support systems have helped hospitals provide quality health care, and have been much more effective than paper charts and memory recall.
However, despite the utility of EHR systems, many hospitals still record increasing incidences of preventable adverse events. For this reason, it is extremely important to improve these systems in hospitals. The Office of the National Coordinator for Health Information Technology has promoted the “meaningful use” of EHR systems. Meaningful use can include providing incentive payments to health care providers and medical staff. But emphasis must also be placed on adding new functions and new modules to the EHR system over a period of time that will support requirements of everyday workflow in a medical setting. Emphasis is also placed on improving the ability of the EHR systems to provide custom data queries based on the parameters provided by the user.

The EHR system must be used with performance reporting and accountability systems of hospitals to reduce incidences of preventable adverse events. It must also be used with other practices that have been established to improve communication between hospital departments.

Using improved screening methods

Promoting patient safety practices is extremely important, especially to reduce adverse events in hospital settings, both in inpatient and outpatient settings, and also during transition of care. For this, it is essential to evaluate screening methods that help medical staff and health care practitioners identify patients with potentially adverse events. Several methodologies are currently being used by medical staff for the detection of adverse events in patients, but every methodology is governed by its own advantages and limitations.

Current screening methods used to identify patients with adverse events include voluntary reporting methods, such as incident reporting and spontaneous reporting systems. Other screening methods include involuntary reporting methods, such as chart reviews, observations by a specially trained team, patient interviews, interviews of the health care professionals, interviews of the medical staff involved in health care, and the use of combined modalities. The screening methods are governed by their own limitations, such as identifying only the reported preventable adverse events in patients, and impracticality of certain screening methods in routine medical settings.

Improvement in screening methods must include the use of a cognitive framework that will help provide a deeper insight into the process of error generation. This will help to detect errors and develop interventions. Many times, even though hospitals have screening methods, they have very rarely used a framework to develop solutions for preventable adverse events. Improvements in screening methods will help hospitals screen faster and more effectively for preventable adverse events in patients, and also help develop solutions to completely eradicate these events in medical settings.

Conclusions

Data from several studies, such as the Colorado Medical Practice and Harvard Medical Practice Study, have shown that preventable adverse events in medical settings are the leading cause of permanent disabilities and even death in the United States. The Harvard Medical Practice Study also found that preventable adverse events commonly occurred in elderly patients and was more common in emergency departments.

Therefore, improvement of patient safety practices to reduce preventable adverse events is extremely important. This can be achieved by adopting well-established recommendations of patient safety, especially successful practices and recommendations that have been used previously.

Lapses in patient safety are an increasingly global problem in the health care industry, resulting in mortality, morbidity, and extremely high economical cost. This was reported by the IOM in 1999 in its landmark report, To Err is Human, which not only shocked the health care industry because of the estimates of the number of patients who die every year due to preventable adverse events, but also helped develop several patient safety practices that have since reduced preventable adverse events.

Zero tolerance for accidental injury must be the goal of every hospital in order to provide high-quality health care to individuals seeking medical intervention. Many health care organizations have made important breakthroughs in the performance and design of safer health care systems by focusing on lessons learned, especially where extremely serious preventable adverse events have occurred.

Examples of these improvements include decreasing complexity, standardizing approaches, and incorporating human factors into design. Redesigning the health care system is extremely important to continuously provide high-quality health care and reduce preventable adverse events.

Hospitals must also understand that reducing preventable adverse events and improving patient safety practices is an applied science. Hence, the work of doctors, as well as technical staff, must be addressed to sustain improvements in patient safety practices. Patient safety and reduction of preventable adverse events is still a nascent science. However, a framework can be established to help continuous improvement in this field. Development of valid measures that can be used to evaluate progress in the field of patient safety and the continuous study of patient outcomes, hospital staff behavior, and hospital culture can be used to reduce preventable adverse events.

The severity of medical errors in most clinical and outpatient settings is quite severe. Efforts to develop a standardized system that encourages communication between inpatient and outpatient departments and also the use of a standardized discharge process are recommended.

At the same time, periodical review of leadership behavior and teamwork, as well as coordination at the state and national levels are required so that overall progress can be made in reducing preventable adverse events in health care settings.

Adverse event clinical definitions

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. Medical errors are usually classified as errors of omission or commission. Both types of errors reflect the deficiencies that are present in health care systems.

A _preventable adverse event_ is an adverse event or medical injury that could have been avoided but occurred as a result of an error or system design flaw.

An _adverse event_ is a medical injury caused by the hospital management rather than by the underlying condition or disease of the patient, which may or may not have been present during the time of hospital admission. Medical management includes all aspects of health care, such as treatment, diagnosis, failure to provide the correct diagnosis or treatment, and the failure to provide the required medical equipment required for diagnosis or treatment. Depending on the contributing cause, adverse events can be preventable or non-preventable.
Many adverse events are neither ameliorable nor preventable. In most cases, the medical errors do not result in any mild, acute, or severe medical injury, though some medical errors do cause injuries of varying degrees, and such medical errors are called preventable adverse events.

**An ameliorable adverse event** is a medical injury whose severity could have been considerably reduced if different actions or medical procedures had been performed or followed.

**Errors of omission** occur when a necessary medical procedure or intervention was not performed, leading to mortality or morbidity, on the patient involved.

**Negligence** is medical care that fails to meet the standard of high-quality care that is reasonably expected of an average health care practitioner qualified to take care of the patient in question.

A **close call** is defined as a mishap or serious error that has a potential to result in an adverse event. However, the close call or serious mishap does not result in the adverse event because it is, by chance, intercepted. Close call is also called a **potential adverse event**.

An **adverse drug event** is a medical injury that takes place when a health care practitioner prescribes the wrong medication to which the patient has known allergies or prescribes the wrong medications at the wrong time in the wrong dosage. A **hazard** is any threat to the safety of the patient, such as inappropriate conduct, unsafe practices, improper names, labels, or equipment.

**System** is a set of elements that are interdependent, such as processes, people, and equipment that have to interact to achieve a common aim.

**An event** is any deviation from the preplanned or defined medical care that results in a medical injury and also increases the risk to the patient of sustaining an injury. Thus, an event includes preventable adverse events, errors, and hazards.

A **latent error** is the defect in organization, design, maintenance, or training in the health care system that results in operational errors. However, the effects of these operational errors may be delayed.

Many terms have been used in purview of preventable adverse events in the clinical settings and outpatient settings. The WHO has also commissioned the development of taxonomy for practices associated with patient safety so that standardization of classification and terminology can be achieved.

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1. According to the World Health Organization (WHO), the chance of being harmed while receiving health care is 1 in 300.  
   - True  - False

2. There are four root causes of errors: latent failures, active failures, organizational system failures, and technical failures.  
   - True  - False

3. According to the RAND study of Medicare mortality, the root cause of lapses in patient safety, is simply disrespect for patients.  
   - True  - False

4. Every year, as many as 98,000 patients die in developed countries because of medical errors.  
   - True  - False

5. James Reason categorized errors into errors in action and errors due to lack of knowledge.  
   - True  - False

6. The HPSIs module consists of two area-level indicators and 10 hospital-level indicators that will help reflect the quality of health care provided by each hospital.  
   - True  - False

7. The discontinuity in the care provided by inpatient and outpatient health care providers is not one of the major contributing causes of preventable adverse events.  
   - True  - False

8. One study by Thomas Hanslik et al., found that only 30% of physicians provided information to patients regarding medications and instructions to be followed after discharge.  
   - True  - False

9. System failures are side effects or medical injury that might occur from causes that are completely independent of the individuals providing health care to patients.  
   - True  - False

10. Current screening methods used to identify patients with adverse events include voluntary reporting methods, such as incident reporting system and spontaneous reporting systems.  
    - True  - False