



System Safety in Healthcare

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The No. 1 Quality Initiative — Preventing Human Errors and Patient Harm

“You can’t cross the sea merely by standing and staring at the water,” said Rabindranath Tagore, Nobel Prize recipient for literature. Not preventing harm is a practical application of this quote, which serves as an inspirational reminder that people achieve nothing unless they take purposeful action that has measurable results. Taking action on potential human errors so that harm never reaches patients is a productive goal because its impact is highly significant.

Some errors can be prevented with safeguards, barriers and forcing functions. Many are unpreventable without such barriers in place. Way et al. from the Department of Surgery at University of California in San Francisco [Ref. 1] analyzed 252 laparoscopic bile duct injuries according to the principles of the cognitive science of visual perception, judgment and human error. They found that the primary cause of error in 97% of cases was a visual perceptual illusion. No one seems to be an exception to human errors. This article discusses the human factors engineering principles and some techniques for preventing harm.

Principles of Human Factors Engineering (HFE)

At Tripler Army Medical Center, a newborn baby went into a coma with severe brain damage. Reports indicated that medical personnel mistakenly gave him carbon dioxide immediately after birth instead of oxygen. Sources stated the operating room may have been set up incorrectly [Ref. 2]. This accident highlights the vulnerability of humans, as well as systems. Use of human factors engineering can prevent or minimize the impact of such events. “Human factors engineering is to patient safety as microbiology is to infection control,” said Dr. John Gosbee of the Veterans Administration (VA) National Center for Patient Safety, and the author of the source above.

Human factors engineering focuses on how people interact with tasks, machines (or computers) and the environment, considering that humans have limitations and capabilities. It evaluates “Human to Human,” “Human to Group,” “Human to Organizational” and “Human to

Machine (Computers)” interactions to better understand these interactions and to develop a framework for evaluation [Ref. 3]. But HFE in practice goes beyond this definition, attempting to mitigate mishaps after evaluation.

Even the most knowledgeable and experienced professionals, such as doctors who diagnose illnesses, also make their share of mistakes. “The best evidence suggests that physicians are wrong 5 to 10% of the time,” according to Mark Graber, chief of medical service at the Northport, New York VA Medical Center [Ref. 4]. Fortunately, there is an opportunity for system-wide improvement. As suggested by Deming, in about 85% of the time, the system is improperly designed [Ref. 5]. Therefore, improving systems should be the focus for preventing harm. But first, we must understand the sources of human errors.

Examples of major sources of human error include [Ref. 6]:

- **Errors of Substitution** — This includes errors such as turning on the hot water instead of cold during a shower.
- **Errors of Selection** — A caregiver may select carbon dioxide for a patient instead of oxygen as mentioned in the beginning of this article.
- **Errors of Reading** — A nurse may read “1.0 mg” as “10 mg.”
- **Errors of Oversight and Omissions** — A nurse may simply forget to give an antibiotic after a surgery.
- **Errors of Irritation** — A caregiver may perform a task wrong when irritated by too many alarms and interruptions.
- **Errors of Warning** — Mistakes can occur when warning signs are not clear or instructions have too many steps.
- **Errors of Alertness** — These may include the dangers of residents working multiple shifts without sleep.
- **Errors of Interchangeability** — These include, for example, connecting an oxygen hose to the nitrous oxide source in anesthesia equipment because the fittings on both sources are identical.



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- **Errors of Lack of Understanding** — An improperly trained staff may make mistakes during emergencies.
 - **Errors of Haste** — A caregiver unable to perform tasks in an allocated time may skip seemingly minor tasks, such as hand sanitization, prior to surgery or a surgeon may leave a sponge inside a patient.
 - **Errors of Sequencing** — A medical technician, for instance, may not perform the work in the recommended sequence of a checklist and overlook an activity.
 - **Errors of Overconfidence** — These may happen in diagnosis when a physician sees a very familiar symptom. This was the motivation for the television show *Miami Medical*. As a teenager, the wife of Jeffery Lieber, the show's producer, went to an emergency room because of flu symptoms. The doctor told her she had the flu and sent her home. She soon went into a coma at home. Luckily her mother was at home, and managed to get her daughter back to the emergency room. She survived after being admitted to the trauma unit for treatment for endocarditis and a prolapsed mitral valve.
 - **Errors of Reversal** — A caregiver may increase a parameter instead of decreasing it because they are not aware of whether to turn the control clockwise or counter-clockwise.
 - **Errors of Unintentional Activation** — A caregiver may inadvertently flip a life support switch to “OFF” instead of “ON.”
 - **Errors of Physical Limitations** — Equipment and supplies stocked too high may be hard to reach and cause an accident when the staff member falls off a step stool.
 - **Errors of Casual Behavior** — A caregiver might not take a task seriously and may spend time chatting with other staff members instead of focusing on assisting the surgeon with the operation.
- To prevent inadvertently leaving a sponge in a patient during an operation, some hospitals use a bar-coded sponge count system, where sponges are accounted for before and after each surgery.
 - To prevent wrong gas attachments, anesthesia equipment was modified so the oxygen and nitrous oxide fittings are not identical, as they used to be. Instead, many hospitals have equipment where the fittings are uniquely designed for each gas supply. Even if a human error were about to occur, the system and equipment design prevents it from actually happening and harming the patient.

Some Techniques for Harm Prevention

Methods for harm prevention can include [Ref. 6]:

- Crew Resource Management (CRM)
- Management Oversight and Risk Tree (MORT)
- Swiss Cheese Model for Error Trapping
- Change analysis
- Mistake proofing

Here, we discuss the first method, Crew Resource Management (CRM), which has been widely used in hospitals.

This technique came from the commercial aviation industry and was designed to overcome barriers to poor communication, a leading cause of adverse events. CRM, which includes checklists and other safety tools, has recently found a home in healthcare because of its quick ability to reduce patient infection rates and other key measures in many hospitals. Hospitals have found that a simple checklist, which a team can use to check each other such that no critical step is overlooked, makes CRM an easy-to-use solution. The World Health Organization is using a surgical checklist to save millions of lives.

David Marshall, CEO of Safer Healthcare and author of the book *Crew Resource Management* [Ref. 7],

With challenges come opportunities for improvement. Examples of system improvements include:

defines CRM as a “flexible systemic method for optimizing human performance in general, and increasing safety in particular, by (1) recognizing the inherent human factors that cause errors and the reluctance to report them, (2) recognizing that in complex, high-risk endeavors, teams rather than individuals are the most effective fundamental operating units, and (3) cultivating and instilling customized, sustainable and team-based tools and practices that effectively use all available resources to reduce the adverse impacts of those human factors.” The Joint Commission has continuously monitored the path of CRM and has consistently reinforced its support, according to Marshall. He adds: No matter how educated or careful healthcare professionals are, errors will occur. So, the natural question to ask is: “How do we prevent those errors from ever impacting a patient?”

The essentials of CRM, according to Marshall [Ref. 8], are to provide a concrete set of skills to teams with the following goals:

- **Team Building** — Conduct a briefing in 30 to 60 seconds with an overview of what is about to happen.
- **Team Debriefing** — Capture what went well, what did not go well and how the process can be improved for next time.
- **Assertiveness** — Describe how and when to speak up if you see a problem.
- **Situational Awareness** — Stay aware of what is going on and what is about to happen, and identify red flags. If a team member falters, the rest of the

team picks up the slack and brings it to the attention of stakeholders.

- **How to Use Critical Language** — Know how to use buzz words that the entire team knows, and how to encourage focused attention so the whole team stops and pauses during task description.
- **Decision Making** — Demonstrate how to work together and make effective decisions.

The CRM methodology is one of the biggest gifts to healthcare from the aviation industry. It has worked beyond anyone’s expectations in bringing central line-associated bloodstream infections down to almost zero in many hospitals. It has saved millions of dollars and hundreds of lives [Ref. 9]. As a result, healthcare has created the equivalent of the Commercial Aviation Safety Teams (CAST), a public/private partnership intended to reduce hazards throughout aviation. At the time of this writing, Dr. Peter Pronovost and his colleagues are exploring a healthcare version of CAST with an ad hoc group whose stakeholders include AHRQ, the FDA, the Joint Commission, ECRI Institute and more than 15 large health systems. They call this approach the Public Private Partnership to Promote Patient Safety (P5S) [Ref. 10].

Conclusion

There are many strategies to prevent patient harm and improve patient safety. The opportunity lies in understanding human behavior and healthcare processes while embracing system-wide solutions that are simple, efficient and effective. ●

References

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