



## Our Journey to Zero Patient Harm

BY M. MICHAEL SHABOT, M.D., AND MICHAEL WARNEKE, M.D.

In 1999, the Institute of Medicine's landmark report, *To Err Is Human*, sounded an alarm with the statistic that up to 98,000 Americans die each year from preventable medical errors. That rate of medical harm is equivalent to a jumbo jet crashing every day, with 268 passengers aboard, prompting Dr. Charles Vincent to write in his 2005 book, *Patient Safety*, "If health care was an airline, only dedicated risk takers, thrill seekers, and those tired of living would fly on it."

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### What If?

The prevailing belief in medicine has long been that a certain level of errors and even "never" events is unavoidable. But is that really true? What if physicians, group practices, and hospital administrators decided that such serious safety risks as accidentally collapsing the patient's lung (iatrogenic pneumothorax) during central line insertion simply weren't an option? What if our goal wasn't just to reduce this medical error, which has a documented incidence of up to 15% in multiple studies, but to eliminate it?

If that goal sounds impossible, consider this: A randomized study of 450 critical care patients reported

that real-time ultrasound-guided catheterization of the internal jugular vein reduced rates of collapsed lung to zero percent compared to a rate of 2.4% when landmark-based techniques were used. The study also found that use of ultrasound visualization powerfully reduced rates of unintentional carotid artery puncture (1.1% in the ultrasound group, versus 10.6% in the landmark group) and hematoma (0.4% in the ultrasound group, versus 8.4% in the landmark group), while also significantly improving the average speed and first-pass success of the procedure.

A recent prospective, randomized, controlled study of ultrasound versus "blind" landmark technique for insertion of subclavian lines had similar findings. Patients who had central lines inserted with real-time ultrasound guidance had a zero percent rate of pneumothorax and hemothorax, compared to 4.9% and 4.4%, respectively, when the landmark technique was used. All other types of complications were reduced or eliminated, and central lines were inserted quicker using ultrasound and with significantly fewer sticks. One hundred percent of ultrasound-guided insertions were successful compared to 87.5% in the landmark group. Based on these findings, it would no longer be ethical to have a control group of blind landmark technique patients in further studies of ultrasound guidance for subclavian line insertion.

Significantly lower rates of bloodstream infection were also observed in the ultrasound group, possibly

because those patients didn't have to be stuck repeatedly, thus reducing the risk of skin pathogens being injected into the bloodstream. Pennsylvania, one of the first states to mandate reporting of hospital-acquired infections (HAIs), has calculated the average hospital bill for a patient who develops a bloodstream infection at \$370,738, compared to \$37,625 for a patient who doesn't. In addition, Pennsylvania showed that hospital patients contracting a central line blood stream infection had a 20X risk of dying compared to patients without such an infection.

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The safety benefits of ultrasound visualization are so overwhelming that in 2001, the Agency for Healthcare Research and Quality (AHRQ) in the U.S. Department of Health and Human Services (HHS) identified ultrasound-guided central venous access as an important safety practice meriting widespread use, and many leading hospitals have adopted it as a best practice. In the United Kingdom, National Institute of Clinical Excellence (NICE) guidelines advise ultrasound visualization to reduce the risk of pneumothorax, arterial puncture, arteriovenous fistula, nerve injuries, and other complications during central line insertions. Based on an analysis of seven randomized trials comparing landmark-based central line placements to ultrasound-guided placements, NICE also concluded that ultrasound guidance reduces the relative risk of failed catheterization attempts by 86%, thus improving both efficiency and patient comfort.

Iatrogenic pneumothorax also has financial risks. Not only does it increase hospital charges by \$17,000–\$45,000, the randomized study of critical care patients reported, but costs can also go far higher if the patient sues. An analysis of closed malpractice claims reported a median payment of \$143,250 for pneumothorax, with awards ranging up to \$208,750. Starting in 2015, this complication will become one of AHRQ Patient Safety Indicators (PSIs) used in Medicare's Hospital Value-Based Purchasing (HVBP) program, structured to provide financial incentives to hospitals that meet certain performance standards. In addition, in 2012 CMS made iatrogenic pneumothorax with central line insertion a "Hospital-Acquired Condition," which means that Medicare will not pay hospitals for the additional costs incurred by this complication.

## **Making Every Day a Safe Day**

Located in Houston, Texas, Memorial Hermann Healthcare System includes 11 hospitals, 19 ambulatory surgery centers, 3 heart and vascular institutes, 25 sports medicine and rehabilitation centers, 25 diagnostic labs, a retirement/nursing center, and a home health agency. In 2010, 138,350 patients were admitted to our hospitals, 411,591 patients were treated in our emergency departments, and 26,731 babies were delivered by affiliated obstetricians. With such a high volume of patients, we administer over one million doses of medication per month.

Our journey toward high reliability began in 2006. We asked, "What would it take to achieve zero events of harm? How can we make every day a safe day for our patients?" We brought in a consulting firm, Healthcare Performance Improvement (HPI), which teaches principles from high-reliability industries such as commercial and naval aviation, nuclear power plants, and the American nuclear submarine fleet. Our goal was to make our health care as safe as Qantas Airlines, which hasn't had a fatal crash since 1951, or our nation's nuclear submarine fleet. Since the launch of the USS Nautilus, the first atomic-powered submarine, in 1954, the fleet has never had a reactor accident in its combined 3,200 years of service to our country.

These success stories helped inspire an ongoing, system-wide initiative at Memorial Hermann called Operation Breakthrough in Patient Safety (BIPS) aimed at reducing the rate of medical errors to zero. To make this initiative a success, we recognized that physician leadership was crucial. As stated by Kerry Johnson, chief innovation officer of HPI, "No hospital can achieve a state of high reliability without the full engagement of the medical staff. True physician leadership from the onset is required to achieve and sustain a safe environment," due to these factors:

- Physicians make a significant contribution to errors that can cause patient injury, and also play a key role in reducing errors.
- Physicians have an unequaled impact on hospital morale, through their influence on hospital staff and executives.
- Physicians have a profound impact on long-term hospital culture; thus, sustained improvements in quality and safety require physician support.

## **The Journey**

Operation BIPS was based on three steps:

### **Step 1. Define Safety Behaviors and Tools**

With safety as the core value, we targeted serious

safety risks, including iatrogenic pneumothorax, central line-associated bloodstream infections, ventilator-associated pneumonia, surgical site infections, retained foreign bodies after surgery, accidental punctures and lacerations, Stages III and IV pressure sores, hospital-associated injuries, birth trauma, deep vein thrombosis and pulmonary embolism, and deaths among surgical inpatients with serious, treatable complications.

For each safety indicator, it was key to create one standard of care across medical specialties and hospital departments, so the same high-reliability safety protocols were consistently followed, such as ultrasound guidance for central line insertions, whether the patient was treated in the emergency department, the critical care unit, or the operating room. Other safety behaviors and tools included barcoded medication administration, consistent hand hygiene, head-to-toe draping for invasive procedures, rapid response teams, and use of checklists similar to a pilot's preflight safety checks.

### **Step 2. Educate Staff**

On aircraft carriers, each sailor has a personal safety plan. Similarly, we began our journey to high reliability in 2007 by asking each member of our staff to make a personal commitment to patient safety as our core value. We trained all 20,000 employees—not just physicians, nurses, and pharmacists, but also maintenance workers, cafeteria staff, volunteers, and everyone else—about our behavioral expectations and safety tools.

Part of the training we provided was teaching the acronym, STAR, which stands for “Stop, Think, Act, and Review.” It's been shown in other industries that if you stop and think for as little as one second before acting, that tiny pause can reduce errors by as much as 90%. No emergency is so great that a one-second time-out will harm the patient. For example, a physician properly ordered a medication for a baby in the neonatal intensive care unit (NICU) using our computerized order entry system. The pharmacist properly handled the medication, which was dispensed by the computerized system with the correct barcode. But when the nurse took the vial out of its packaging, stopped and thought, she saw that the medication was adult strength, not the pediatric version. Had she administered it, the baby might have died.

### **Step 3. Reinforce and Build Accountability**

We created a safety culture in which medical errors were discussed openly to understand how they occurred, learn from mistakes, and develop a solid action plan to prevent future occurrences. Preventing medical harm starts with a focus on the patient. Was

the patient's outcome expected, based on the illness or underlying condition? If a medical error hastened or caused morbidity or mortality, to demonstrate patient safety as a core value, we needed to investigate any human or system failures and assess the behaviors or actions involved in the patient's care.

Memorial Hermann uses root cause analysis (RCA) that includes the 5 Whys technique developed by Sakichi Toyoda, founder of Toyota Industries, to uncover system problems. The technique involves asking, “Why?” at least five times to delve into underlying causes of a problem. Memorial Hermann asks the healthcare team and leaders to gather within hours of a serious safety event and use the 5 Whys methodology to pinpoint the systems and behaviors that contributed to the patient's harm and identify all evidence-based or nationally recognized preventive measures used or omitted. While frank discussion of preventable harm may be uncomfortable, our system's RCA facilitators are trained in respectful disclosure of human and system failures, so we can learn from them.

### **Did We Make a Difference?**

It was an extraordinary milestone. After we adopted system-wide ultrasound guidance for central line placement with nearly 100% compliance by physicians, six of our hospitals—Memorial Hermann Southeast, a large community hospital that inserts about 1,200 central lines annually; Memorial Hermann Sugar Land, Memorial Hermann Katy, Memorial Hermann Northeast, Memorial Hermann Northwest and Children's Memorial Hermann Hospital—achieved a rate of zero cases of iatrogenic pneumothorax for a full year—the first time in our system's history. Physicians at eight community hospital emergency departments across our system also achieved this unprecedented level of safety, while also rapidly delivering life-saving care to critically ill or injured patients.

So far, all 11 of our hospitals have been recognized 77 times for going 12 or more consecutive months without the occurrence of a targeted safety indicator. In one hospital, it's literally been years since there was a ventilator infection. They used to occur frequently. To celebrate these unprecedented successes, we created the Memorial Hermann High Reliability Certified Zero Award, presented to each of these hospitals. The awards have sparked a friendly competition, as the medical staff and hospital staff strive to eliminate more of the targeted events of harm.

Results have been so dramatic that it's frightening to think what would have happened without this campaign. Our journey toward high reliability is ongoing.

ing, and much work remains to be done, but we're on our way to transforming our healthcare practice into a high-reliability operation. We want our physicians and staff to operate on par with airline safety, with confidence guided by the right techniques and technologies to navigate safely—instead of flying blind.

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