



Improving the Safety of Patient Care by Looking at the Airline Industry

Applying methods from commercial aviation to improve safety, reliability, efficiency and effectiveness of patient care

SUMMARY

Can a process that dramatically improved the safety of air travel help uncover and curb the hazards in health care?

In 1997, after a spate of crashes, the U.S. government challenged the airline industry to significantly reduce fatalities over the next 10 years.¹ In response, government and industry formed the [Commercial Aviation Safety Team \(CAST\)](#), and developed a step-by-step process for identifying the source of the highest risks in air travel and implementing solutions. By 2007, fatalities had dropped 65 percent.²

From 2009 to 2011, researchers at the Johns Hopkins School of Medicine worked to improve patient safety by applying the CAST model to health care hazards. The project focused on devices used by hospitals that account for a disproportionate share of medical error.

“I love this approach because it is both scientifically grounded and ruthlessly feasible,” said Project Director Peter J. Pronovost, MD, PhD, medical director of the [Center for Innovation in Quality Patient Care](#) at Johns Hopkins.

Key Results

Pronovost reported the following results to RWJF:

- Project staff created the Public-Private Partnership Promoting Patient Safety (P5S) composed of representatives from government, industry, and nonprofit organizations to address health care hazards.
- The Joint Steering Committee analyzed P5S databases for medical errors, and tackled two of the most common hazards:

¹ White House Commission on Aviation Safety and Security, *Final Report to President Clinton, 1997*. Available [online](#).

² Wald ML. “Fatal Air Crashes Drop 65%.” *New York Times*. October 1, 2007. Available [online](#).

- Syringes used to administer U-500, a concentrated form of insulin given to patients with severe diabetes
- Infusion pumps used to administer nutrients and medications to patients in hospital emergency rooms, recovery rooms, and intensive care units

Funding

The Robert Wood Johnson Foundation (RWJF) supported this project from February 2009 to January 2011 with a \$217,450 grant to the Johns Hopkins University School of Medicine.

CONTEXT

Medical errors cause 44,000 to 98,000 preventable deaths each year and cost the nation \$17–29 billion, according to the Institute of Medicine’s 1999 report *To Err Is Human: Building a Safer Health System*. That report called for a 50 percent reduction in preventable patient harm within five years. However, although awareness of patient safety has grown, examples of sustained progress have been rare, according to Pronovost.³

This record contrasts with remarkable improvements in aviation safety. After the public-private [Commercial Aviation Safety Team \(CAST\)](#) formed in 1997, one of its efforts entailed promoting the development and adoption of altitude warning systems, which prevent airplanes from flying into mountains. From 1995 to 2003, 2,261 “controlled-flight-into-terrain” fatalities occurred worldwide. In 2004 there were none.

The CAST approach to safety entails several key steps:

- Choose a type of accident on which to focus based on those that cause the highest number of fatalities, and reconstruct the chain of events leading to each accident, as well as near-misses.
- Identify the problem (what went wrong) and contributing factors (why things went wrong) for each incident.
- Rate the role of each problem and contributing factor on a 0 to 6 scale, and estimate the probability that they will contribute to future accidents.
- Develop possible interventions, and evaluate how well each will address the problem and contributing factors on a scale of 0 to 6.
- Calculate the effectiveness of each intervention based on its technical, financial, operational, regulatory, and sociological feasibility, and devise a plan to implement it.

³ Pronovost P, Goeschel C, Olsen K, Pham J, Miller M, Berenholtz S, Bryan Sexton J, Marsteller J, Morlock L, Wu A, Loeb J and Clancy C. “Reducing Health Care Hazards: Lessons From the Commercial Aviation Safety Team.” *Health Affairs*, 28(3): w479–478, May/June, 2009. Abstract available [online](#).

Health care also needed a national organization and clear strategic plan to identify and prioritize hazards and evaluate interventions, according to Pronovost.

RWJF's Interest in This Area

RWJF has supported a number of programs to improve the quality of hospital care. The programs include:

- *Pursuing Perfection: Raising the Bar for Health Care Performance.* It supported efforts by seven health care organizations to dramatically improve their care processes and patient outcomes. It ran from 2001 to 2008. The funded sites—four hospitals and three organizations predominantly outpatient in focus—implemented a series of projects aimed at redesigning condition-specific processes of care and units of operation. See the [Program Results Report](#) for more information.
- *Transforming Care at the Bedside (TCAB).* This national initiative sought to improve hospital patient care and the hospital work environment by empowering front-line nurses to implement innovative new practices on their units. Developed by RWJF in collaboration with the Institute for Healthcare Improvement (IHI), TCAB differed from the traditional hospital quality improvement program by emphasizing a bottom-up approach to change. The [Program Results Report](#) provides additional information.
- *Expecting Success: Excellence in Cardiac Care.* The program aimed at improving the overall quality of cardiac care while reducing racial, ethnic and language disparities. The 10 participating hospitals developed and shared tools for improving care for all heart attack or heart failure patients. Teams within each hospital worked together via a learning network. They used evidence-based guidelines to improve and track the quality of inpatient cardiac care and also worked on community demonstration projects to improve care as heart patients transitioned from inpatient to outpatient care. See the [Program Results Report](#) for more information.

THE PROJECT

From 2009 to 2011, researchers at the Johns Hopkins University School of Medicine worked to improve patient safety by applying the CAST model to health care hazards. The project focused on devices used by hospitals that account for a disproportionate share of medical errors.

RESULTS

The project director reported the following results to RWJF:

- **Project staff created the Public-Private Partnership Promoting Patient Safety (P5S) to address health care hazards.** P5S was composed of representatives from government, industry, and nonprofit organizations, including:
 - Food and Drug Administration (FDA)

- U.S. Department of Defense
- Joint Commission, a nonprofit that accredits and certifies health care organizations and programs
- Institute for Safe Medication Practices, a nonprofit that aims to reduce medication errors

Project staff also established a joint steering committee composed of representatives of some of those organizations as well as others, including the Joint Commission, Harvard School of Public Health, the U.S. Department of Veterans Affairs, and the Applied Physics Laboratory at Johns Hopkins.

See the [Appendix](#) for a list of the original P5S members.

- **The joint steering committee analyzed databases of medical errors from P5S participants, and tackled two of the most common hazards:**

- *Syringes used to administer U-500, a concentrated form of insulin given to patients with severe diabetes.* To administer U-500, providers often use syringes commonly used to administer U-100—the standard insulin concentration—which requires them to calibrate the dose. The National Center for Patient Safety and the Institute for Safe Medication Practices have identified U-500 as a high-risk medication, with some patients receiving a fivefold overdose.
- *Infusion pumps used to administer nutrients and medications to patients in hospital emergency rooms, recovery rooms, and intensive care units.* The FDA has received numerous reports of serious injuries and deaths associated with the use of these pumps. The reports suggest problems with the human-machine interface, as well as mechanical and electronic malfunction. For example, nothing on a pump indicates which medication a patient is receiving.

- **The joint steering committee developed techniques for improving those two devices.**

- The team developed and tested a prototype syringe specifically to calibrate U-500. Allison Medical has commercialized the syringe, and the FDA is now evaluating it for approval.
- Clinicians from Johns Hopkins and engineers from its Applied Physics Laboratory observed clinicians using the infusion pumps in hospitals as well as simulated environments.

“We watched how clinicians pushed the knobs, saw where their eyes went, what they paused on, what was difficult, where they made mistakes,” said Pronovost. “Before that we had a lot of data on where reported errors occurred, so we knew some of the common mistakes, but we uncovered a bunch of new ones.”

The group then developed a framework for improving the pumps and testing new ones. (See [Afterward](#) for more information.)

Communication Results

- **Project staff presented findings from their analyses at the Infusion Pump Workshop, hosted by the FDA and the Association for the Advancement of Medical Instrumentation in 2010 (proceedings available [online](#)).** They also presented to meetings of the American Society of Anesthesiologists, the Society of Cardiovascular Anesthesiologists, and the Society of Thoracic Surgeons.

LESSONS LEARNED

1. **Finding funding to sustain a CAST-type organization for the health care sector is challenging.** “P5S requires a permanent source of unbiased funding to perform its functions,” said Pronovost. “In our current financial atmosphere, obtaining such funding has proven difficult.” For example, P5S sought core funding from the Veterans Administration’s National Center for Patient Safety, the FDA, and Congress, but did not receive it.
2. **Use peer pressure to expand a coalition to improve health care safety.** Although P5S enlisted the support of key players, Pronovost looks to CAST as a model to broaden the collaboration. “Once the airlines were on board, the pilots union joined, and then the air traffic controllers. It happened over time.”
3. **Sustaining active participation in such a coalition is vital.** “Enthusiasm for P5S waned during periods when participants did not interact through meetings, partly because we focused on only one project at a time,” said Pronovost. He intends to ask participants to commit more time and effort, and to try to tackle more than one hazard at once.

AFTERWARD

P5S received a three-year, \$350,000 grant from the Agency for Healthcare Research and Quality to continue to work on infusion pumps. That work, which began in September 2011, includes holding a focus group on user challenges with the pumps, creating a prototype improved pump, and testing it with nurses and doctors. P5S has also submitted a proposal to the FDA to investigate mechanical ventilators, another priority hazard.

At a P5S member meeting in October 2011, GE Medical agreed to be the organization’s industry chair—a significant development, according to Pronovost. Both the Veterans Administration and the Department of Defense have expressed interest in co-chairing the group. P5S hopes to initiate another round of evaluating health care hazards in spring 2012.

Prepared by: **Brian McDonald**

Reviewed by: Sandra Hackman and Molly McKaughan

Program Officer: Paul Tarini

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Program area: Pioneer

APPENDIX

Original Participants in P5S

(Current as of the time of the grant; provided by the grantee organization; not verified by RWJF.)

James P. Bagian, MD

Chief Patient Safety Officer, Director
National Center for Patient Safety
Department of Veterans Affairs
Washington D.C.

Paula Beard, ACP

Director of Operations
Canadian Patient Safety Institute
Edmonton, Alberta, Canada

Doug Bonacum, MBA, CSP

Director
National Environmental, Health Safety and
Patient Safety
Kaiser Permanente
Oakland, Calif.

Steven Brotman, MD

Senior Vice President
Advanced Medical Technology Association
(AdvaMed)
Washington, D.C.

Jay Crowley

Senior Advisor, Patient Safety
Center for Devices and Radiological Health
U.S. Food and Drug Administration
Washington, D.C.

Loran Hauck, MD

Senior Vice President
Clinical Effectiveness
Chief Medical Officer
Adventist Health Systems Sunbelt
Winter Park, Fla.

Edward Kelley, PhD

Head
Strategic Programmes for WHO Patient Safety
World Health Organization
World Alliance for Patient Safety
Geneva, Switzerland

Heidi B. King, MS, CHE

Deputy Director
DOD Patient Safety Program
U.S. Department of Defense
Washington D.C.

Jerod M. Loeb, PhD

Executive Vice President
Quality Measurement and Research
The Joint Commission
Oakbrook Terrace, Ill.

Ronald Luman, PhD

Acting Director
Strategic Planning National Security Analysis
Department
Johns Hopkins Applied Physics Laboratory
Laurel, Md.

William Marsella, MBA

Director
Patient Safety Reporting Systems
ECRI Institute
Plymouth Meeting, Pa.

Margaret E. O’Kane

President
National Committee for Quality Assurance
(NCQA)
Washington, D.C.

David B. Pryor, MD

Senior Vice President
Clinical Excellence
Chief Medical Officer
Ascension Health
Saint Louis, Mo.

Marion M. Robinson

Vice President, Marketing
Baxa Corporation
Englewood, Colo.

Allen J. Vaida, PharmD

Executive Vice President
Institute for Safe Medication Practices (ISMP)
Horsham, Pa.

Tim Vanderveen, PharmD, MS

Vice President
Center for Safety and Clinical Excellence
CareFusion
San Diego, Calif.

Sam R. Watson, MSA, MT

Executive Director
Keystone Center for Patient Safety & Quality
Michigan Health & Hospital Association
Lansing, Mich.

Pamela E. Windle, MS, RN, CNA

President
American Society of PeriAnesthesia Nurses
(ASPAN)
Cherry Hill, N.J.

BIBLIOGRAPHY

(Current as of date of the report; as provided by the grantee organization; not verified by RWJF; items not available from RWJF.)

Communication or Promotion

Blog

Pronovost, P. “Radiation Hazards Illustrate Need for Industry-Wide Safety Response.” *HealthAffairs* website. Posted March 10, 2010. Available [online](#).