THE ROLE OF HUMAN FACTORS

Gavin Huntley-Fenner, PhD

NAS Gain of Function Symposium

December 16, 2014

Copyright © 2014

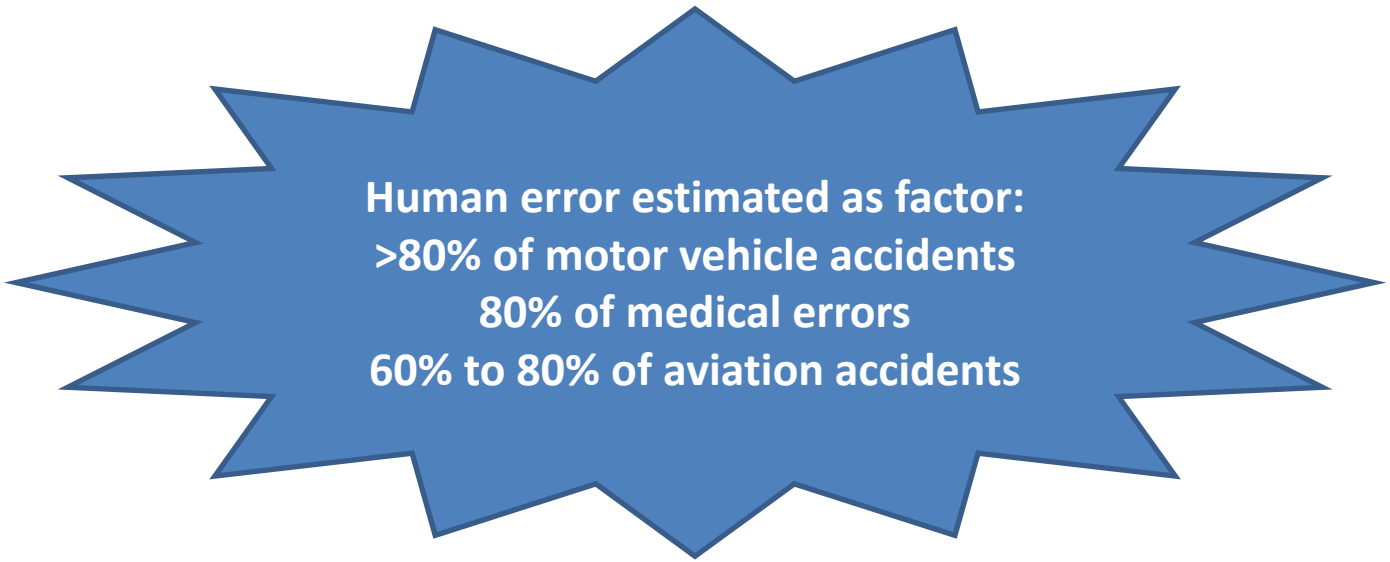
Human Factors in Risk Analysis

- What is “Human Factors”?
- Human Factors in Risk Analysis
- Some characteristics of effective hazard analyses

Copyright © 2014

WHAT IS HUMAN FACTORS?

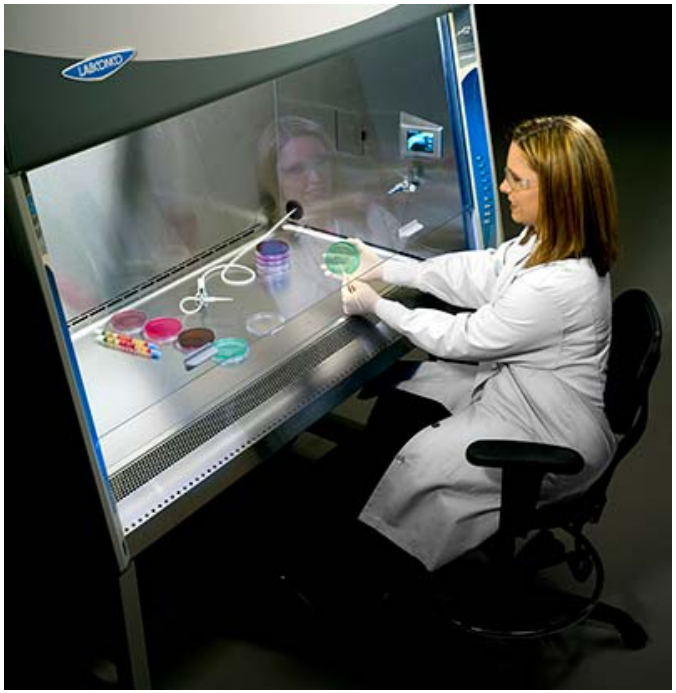
Study of the interrelationships between humans, the tools they use, and the environment in which they live and work.



Copyright © 2014

Sources: Kohn, Linda T., Janet M. Corrigan, and Molla S. Donaldson, eds. *To Err Is Human:: Building a Safer Health System*. Vol. 627. National Academies Press, 2000. Foushee, H. Clayton. "Dyads and triads at 35,000 feet: Factors affecting group process and aircrew performance." *American Psychologist* 39.8 (1984): 885. Cooper, Jeffrey B., et al. "Preventable anesthesia mishaps: a study of human factors." *Anesthesiology* 49.6 (1978): 399-406. As reported in the FHWA "Highway Safety Improvement Program Manual, EC/IRU Study;

PHYSICAL AND COGNITIVE STRESSES UNDERMINE HUMAN RELIABILITY



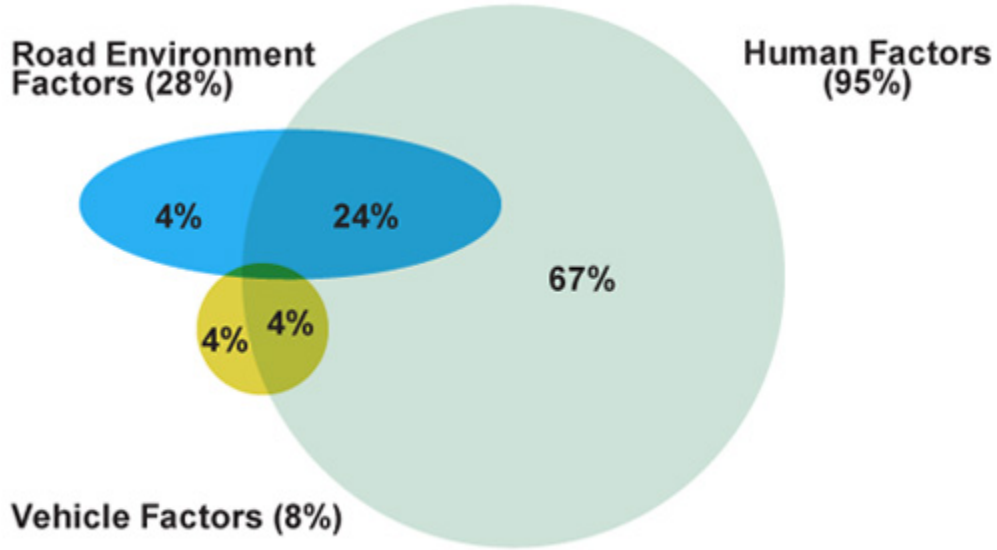
- **Poor Working Posture**
- **Load – Working with sharp, hot, cold or toxic/hazardous objects**
- **Personnel protective equipment may make work more taxing.**

- **Fatigue**
- **Reduced cognitive functioning in an emergency**

Copyright © 2014

Sources: “Maximizing User Safety Through Human Factors Design”, Labconco whitepaper by Brian Garrett (2013)

HUMAN ERROR CAN'T BE ELIMINATED AND HAS INCREASED AS CONTRIBUTOR



Source: NSW Roads and Traffic Authority, 1996.

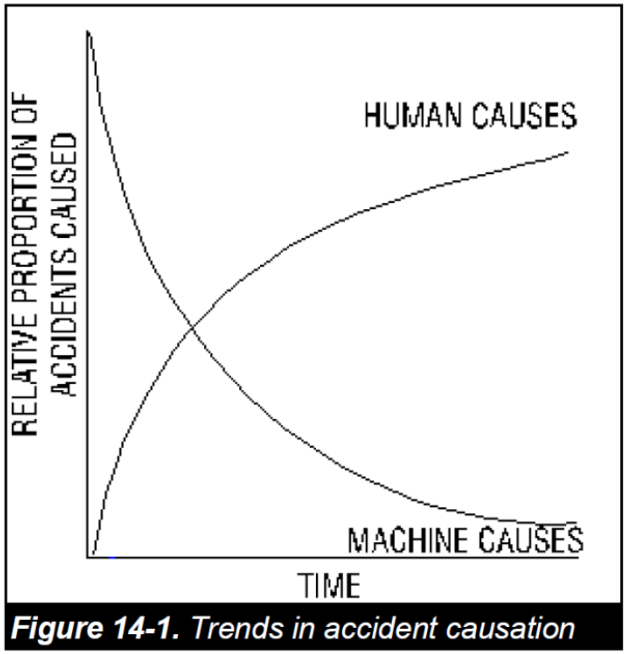


Figure 14-1. *Trends in accident causation*

Copyright © 2014

Sources: As reported in the FHWA "Highway Safety Improvement Program Manual, EC/IRU Study; Hollnagel, E. (1993). The reliability of cognition: Foundations of human reliability analysis, London, UK: Academic Press

HUMAN RELIABILITY/ERRORS ANALYSIS DRAWS ON HUMAN FACTORS

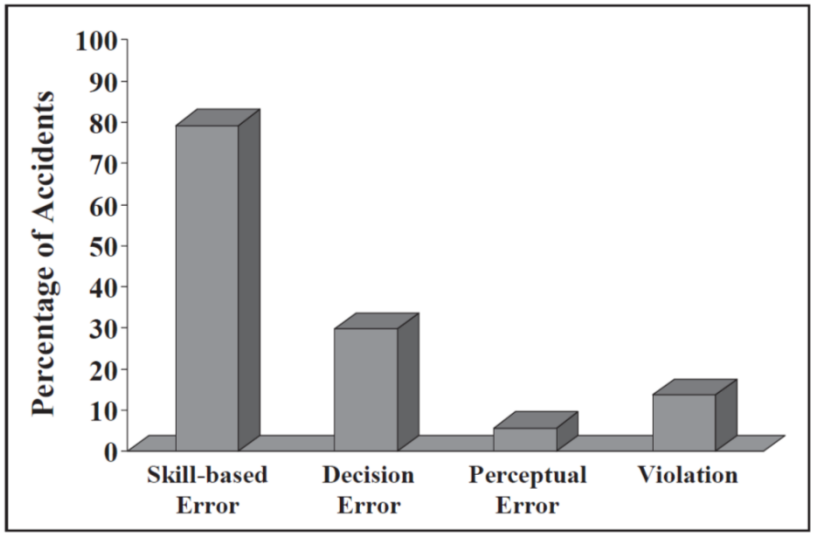


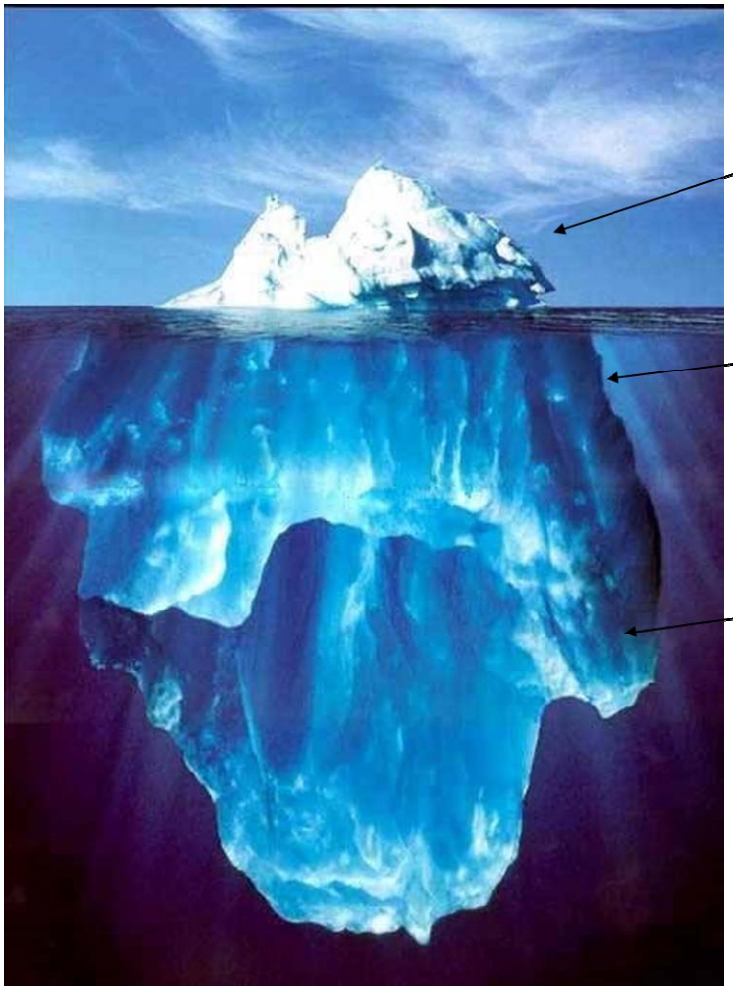
Figure 2. *Percentage of aircrew-related accidents by unsafe act category.*

- **Identify critical areas that are incompatible with human capabilities**
- **Identify areas where system is vulnerable to human error**

Copyright © 2014

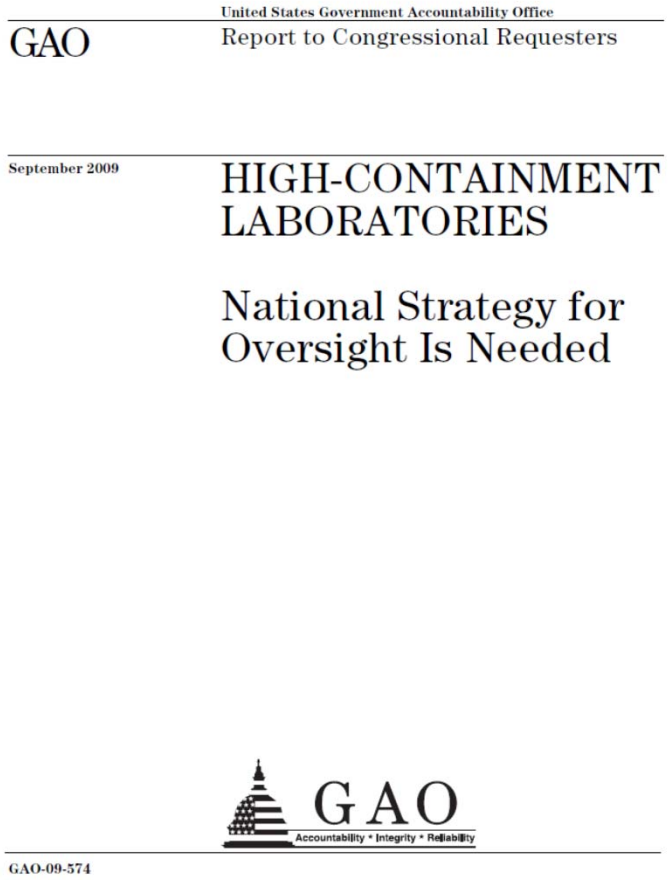
Sources:Wiegmann, D., Faaborg, T., Boquet, A., Detwiler, C., Holcomb, K., & Shappell, S. (2005). *Human error and general aviation accidents: A comprehensive, fine-grained analysis using HFACS* (No. DOT/FAA/AM-05/24). Hobbs, A. L. A. N., et al. "Three principles of human-system integration." *Proceedings of the 8th Australian Aviation Psychology Symposium. Sydney*. Vol. 1. 2008.

ERROR DATA OF INTEREST IS OFTEN HIDDEN OR LATENT



Copyright © 2014

2009 GAO INVESTIGATION HIGHLIGHTED UNDERAPPRECIATED HUMAN ERROR


United States Government Accountability Office

GAO

Report to Congressional Requesters

September 2009

HIGH-CONTAINMENT LABORATORIES

National Strategy for Oversight Is Needed

GAO

Accountability * Integrity * Reliability

GAO-09-574

"… many other incidents and accidents have occurred, mainly as a result of human error or equipment failure. Fortunately, most incidents/accidents do not have serious consequences …"

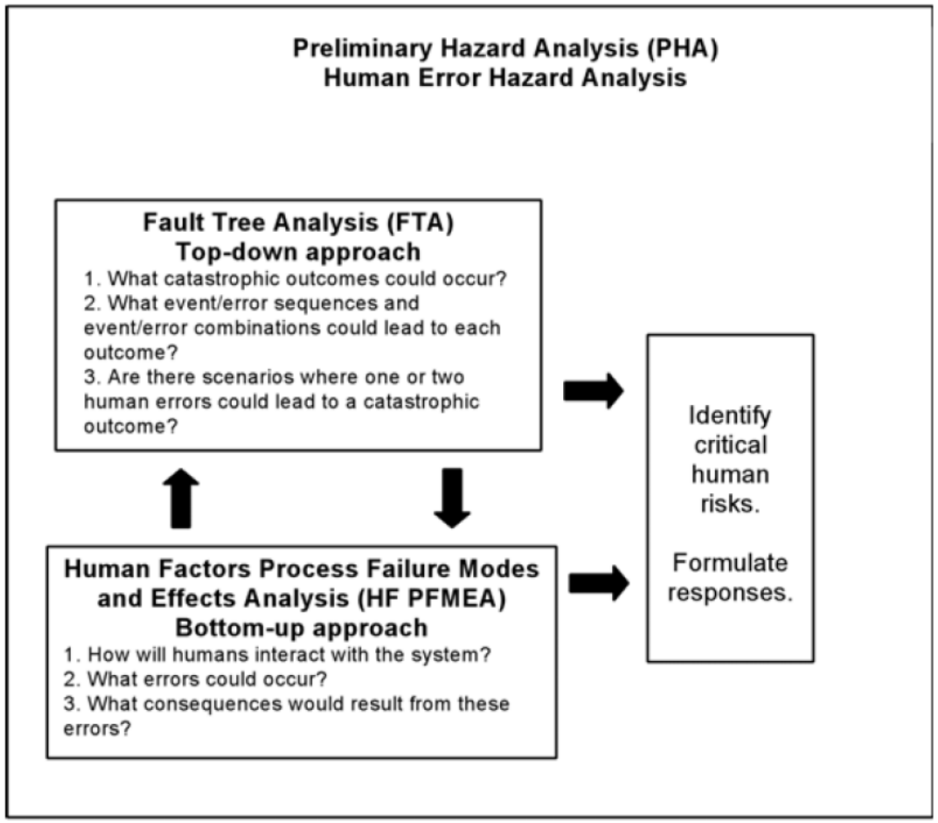
Copyright © 2014

BEST HAZARDS ANALYSIS PROCESS INCLUDE…

1. Multi-disciplinary teams
2. Incorporate qualitative and quantitative data
3. Structured and unstructured approaches to developing scenarios
4. Consider human capabilities as well as limitations
5. Expect disproportionate number of HF scenarios vs environment or mechanical

Copyright © 2014

TEAM SHOULD BE ABLE TO TOGGLE BETWEEN TOP-DOWN & BOTTOM-UP ANALYSIS

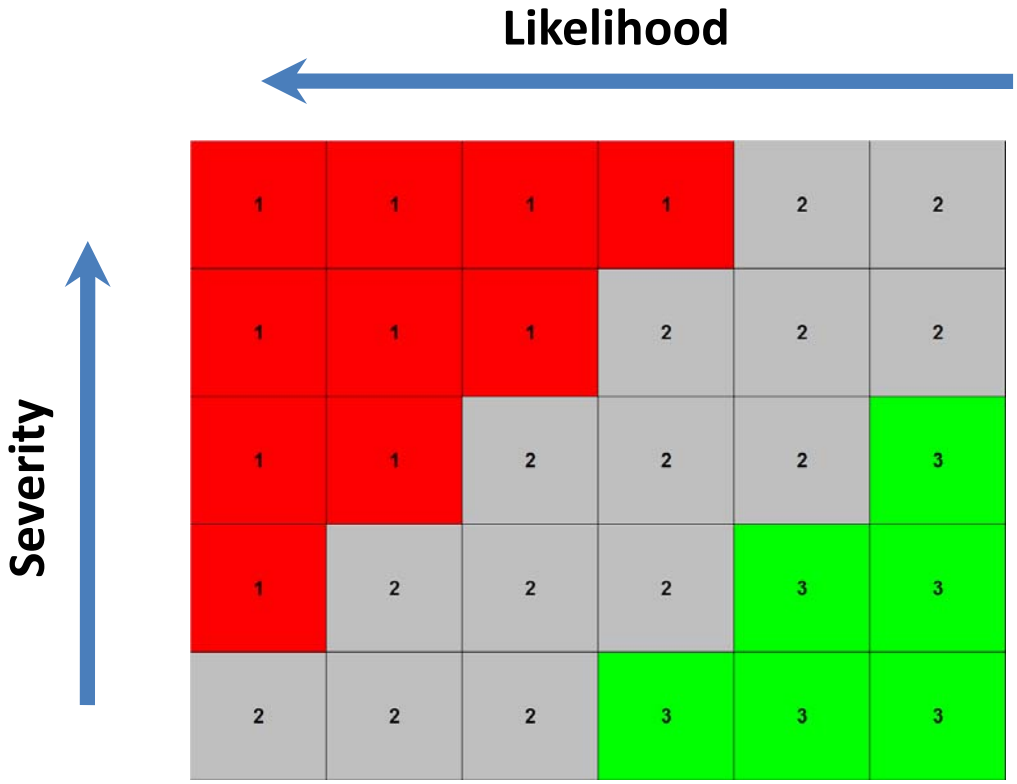


- **Are task demands compatible with human capabilities and characteristics?**
- **Has the system been designed to cope with the inevitability of human error?**
- **Does the system take advantage of unique human capabilities?**

Copyright © 2014

Hobbs, A., Adelstein, B., O'HARA, J., & Null, C. (2008, April). Three principles of human-system integration. In Proceedings of the 8th Australian Aviation Psychology Symposium. Sydney (Vol. 1).

RISK RANK MATRIX REFLECTS RISK TOLERANCE & VALUES



Rank Allowed varies

- **Toys**
- **Medical device**
- **Consumer electronics**

Copyright © 2014

BENEFITS OF A RISK ASSESSMENT GUIDED BY HUMAN FACTORS INCLUDE …

- Enhance preparedness
- Prevent significant accidents
- Mitigate consequences
- Improve problem solving after adverse events
- Identify data needed to support rigorous analysis
- Support decisions regarding allocation of limited resources
- Sunshine implicit risks adopted by a team
- Sunshine hidden or underappreciated benefits of existing practice
- Robust biosafety environment can “harden” biosecurity target

Copyright © 2014

SIMPLE APPROACHES CAN YIELD SIGNIFIANT REDUCTION IN ERRORS

The NEW ENGLAND JOURNAL of MEDICINE

SPECIAL ARTICLE

A Surgical Safety Checklist to Reduce Morbidity and Mortality in a Global Population

Alex B. Haynes, M.D., M.P.H., Thomas G. Weiser, M.D., M.P.H., William R. Berry, M.D., M.P.H., Stuart R. Lipsitz, Sc.D., Abdel-Hadi S. Breizat, M.D., Ph.D., E. Patchen Dellinger, M.D., Teodoro Herbosa, M.D., Sudhir Joseph, M.S., Pascience L. Kibatala, M.D., Marie Carmela M. Lapitan, M.D., Alan F. Merry, M.B., Ch.B., F.A.N.Z.C.A., F.R.C.A., Krishna Moorthy, M.D., F.R.C.S., Richard K. Reznick, M.D., M.Ed., Bryce Taylor, M.D., and Atul A. Gawande, M.D., M.P.H., for the Safe Surgery Saves Lives Study Group*

ABSTRACT

BACKGROUND

Surgery has become an integral part of global health care, with an estimated 234 million operations performed yearly. Surgical complications are common and often preventable. We hypothesized that a program to implement a 19-item surgical safety checklist designed to improve team communication and consistency of care would reduce complications and deaths associated with surgery.

METHODS

Between October 2007 and September 2008, eight hospitals in eight cities (Toronto, Canada; New Delhi, India; Amman, Jordan; Auckland, New Zealand; Manila, Philippines; Ifakara, Tanzania; London, England; and Seattle, WA) representing a variety of economic circumstances and diverse populations of patients participated in the World Health Organization's Safe Surgery Saves Lives program. We prospectively collected data on clinical processes and outcomes from 3733 consecutively enrolled patients 16 years of age or older who were undergoing noncardiac surgery. We subsequently collected data on 3955 consecutively enrolled patients after the introduction of the Surgical Safety Checklist. The primary end point was the rate of complications, including death, during hospitalization within the first 30 days after the operation.

RESULTS

The rate of death was 1.5% before the checklist was introduced and declined to 0.8% afterward (P=0.003). Inpatient complications occurred in 11.0% of patients at baseline and in 7.0% after introduction of the checklist (P<0.001).

CONCLUSIONS

Implementation of the checklist was associated with concomitant reductions in the rates of death and complications among patients at least 16 years of age who were undergoing noncardiac surgery in a diverse group of hospitals.

From the Harvard School of Public Health (A.B.H., T.G.W., W.R.B., A.A.G.), Massachusetts General Hospital (A.B.H.), and Brigham and Women's Hospital (S.R.L., A.A.G.) — all in Boston; University of California–Davis, Sacramento (T.G.W.); Prince Hamzah Hospital, Ministry of Health, Amman, Jordan (A.-H.S.B.); University of Washington, Seattle (E.P.D.); College of Medicine, University of the Philippines, Manila (T.H.); St. Stephen's Hospital, New Delhi, India (S.J.); St. Francis Designated District Hospital, Ifakara, Tanzania (P.L.K.); National Institute of Health–University of the Philippines, Manila (M.C.M.L.); University of Auckland and Auckland City Hospital, Auckland, New Zealand (A.F.M.); Imperial College Healthcare National Health Service Trust, London (K.M.); and University Health Network, University of Toronto, Toronto (R.K.R., B.T.). Address reprint requests to Dr. Gawande at the Department of Surgery, Brigham and Women's Hospital, 75 Francis St., Boston, MA 02115, or at safesurgery@hsph.harvard.edu.

*Members of the Safe Surgery Saves Lives Study Group are listed in the Appendix.

This article (10.1056/NEJMsa0810119) was published at NEJM.org on January 14, 2009.

N Engl J Med 2009;360:491-9.

Copyright © 2009 Massachusetts Medical Society.

The New England Journal of Medicine
Downloaded from nejm.org on December 14, 2014. For personal use only. No other uses without permission.
Copyright © 2009 Massachusetts Medical Society. All rights reserved.

World Health Organization — SURGICAL SAFETY CHECKLIST (FIRST EDITION)

Before induction of anaesthesia ▸▸▸▸▸▸▸▸▸ Before skin incision ▸▸▸▸▸▸▸▸▸▸▸▸▸ Before patient leaves operating room

SIGN IN

- ☐ PATIENT HAS CONFIRMED
  - IDENTITY
  - SITE
  - PROCEDURE
  - CONSENT
- ☐ SITE MARKED/NOT APPLICABLE
- ☐ ANAESTHESIA SAFETY CHECK COMPLETED
- ☐ PULSE OXIMETER ON PATIENT AND FUNCTIONING
- DOES PATIENT HAVE A:
- KNOWN ALLERGY?
  - ☐ NO
  - ☐ YES
- DIFFICULT AIRWAY/ASPIRATION RISK?
  - ☐ NO
  - ☐ YES, AND EQUIPMENT/ASSISTANCE AVAILABLE
- RISK OF >500ML BLOOD LOSS (7ML/KG IN CHILDREN)?
  - ☐ NO
  - ☐ YES, AND ADEQUATE INTRAVENOUS ACCESS AND FLUIDS PLANNED

TIME OUT

- ☐ CONFIRM ALL TEAM MEMBERS HAVE INTRODUCED THEMSELVES BY NAME AND ROLE
- ☐ SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE VERBALLY CONFIRM
  - PATIENT
  - SITE
  - PROCEDURE
- ANTICIPATED CRITICAL EVENTS
- ☐ SURGEON REVIEWS: WHAT ARE THE CRITICAL OR UNEXPECTED STEPS, OPERATIVE DURATION, ANTICIPATED BLOOD LOSS?
- ☐ ANAESTHESIA TEAM REVIEWS: ARE THERE ANY PATIENT-SPECIFIC CONCERNS?
- ☐ NURSING TEAM REVIEWS: HAS STERILITY (INCLUDING INDICATOR RESULTS) BEEN CONFIRMED? ARE THERE EQUIPMENT ISSUES OR ANY CONCERNS?
- HAS ANTIBIOTIC PROPHYLAXIS BEEN GIVEN WITHIN THE LAST 60 MINUTES?
  - ☐ YES
  - ☐ NOT APPLICABLE
- IS ESSENTIAL IMAGING DISPLAYED?
  - ☐ YES
  - ☐ NOT APPLICABLE

SIGN OUT

- NURSE VERBALLY CONFIRMS WITH THE TEAM:
- ☐ THE NAME OF THE PROCEDURE RECORDED
- ☐ THAT INSTRUMENT, SPONGE AND NEEDLE COUNTS ARE CORRECT (OR NOT APPLICABLE)
- ☐ HOW THE SPECIMEN IS LABELLED (INCLUDING PATIENT NAME)
- ☐ WHETHER THERE ARE ANY EQUIPMENT PROBLEMS TO BE ADDRESSED
- ☐ SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE REVIEW THE KEY CONCERNS FOR RECOVERY AND MANAGEMENT OF THIS PATIENT

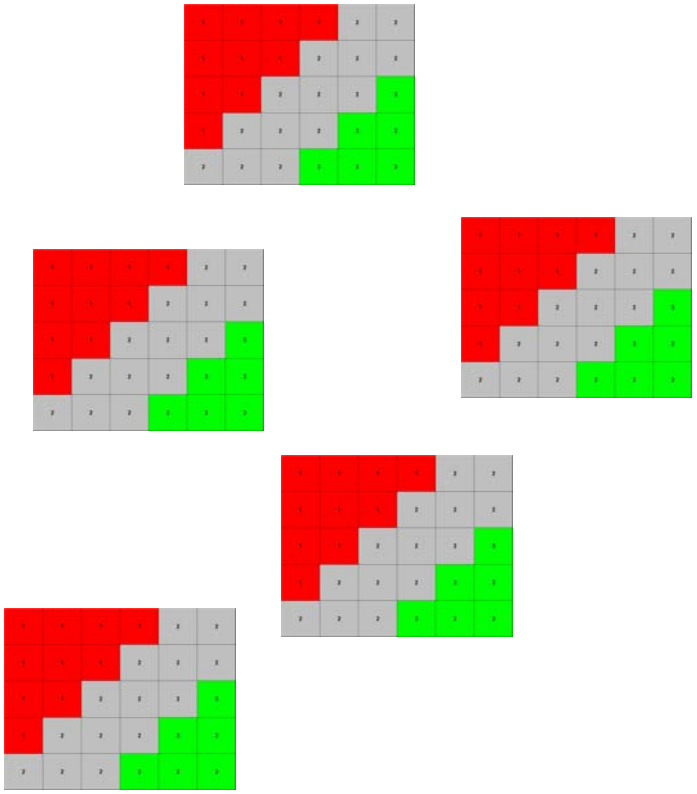
40% reduction in errors

Copyright © 2014

Source: Haynes, Alex B., et al. "A surgical safety checklist to reduce morbidity and mortality in a global population." *New England Journal of Medicine* 360.5 (2009): 491-499.

BEWARE OF OUR LIMITED CAPACITY TO UNDERSTAND AND MANAGE RISK

E.g., acceptable risks are adopted project by project or lab by lab …



- **We tend to underestimate cumulative risk**
- **We are optimistic about our capacity to control local risk**
- **Need to be aware of potential to accrue benefits (science) & externalize risks (public health)**

Copyright © 2014

THE ROLE OF HUMAN FACTORS

Thank You

Copyright © 2014

5319 University Drive, #137, Irvine, California 92612 | 949.682.9887 | gavin@huntleyfenneradvisors.com