Optimizing Healthcare: A Human Factors Approach

A data driven approach to understanding and improving safety outcomes and operational efficiency in the cardiovascular operating room

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Human Factors in Medicine

"If medical errors were a disease, they would be the sixth leading cause of death in America - just behind accidents and ahead of Alzheimer's"

- Marty Makary, MD, Johns Hopkins General Surgeon
WSJ , September 2012

To Err is Human

- Since the 1999 Institute of Medicine Report, which raised concerns regarding patient safety, the medical industry as a whole has come under increasing pressure to reduce adverse patient outcomes.

- In response, the industry is now required to investigate adverse outcomes in an effort to improve patient care.

The Challenge to the Industry

- This directive comes at a time when the industry faces numerous other challenges, including:
    - an ever-changing political landscape
    - rising healthcare costs coupled with diminishing and increasingly restrictive third-party reimbursement
    - delivery of health care to underserved populations
    - rapidly changing technology
    - changing public perceptions and expectations of the industry as a whole
    - the secure and efficient transfer of patient information among an ever-increasing network of medical providers

The Challenge to the CVOR

- The cardiovascular operating room (CVOR) faces it's own challenges in delivering safe and efficient patient care. Among these are:
    - interaction with numerous technical systems
    - effective communication among team members
    - efficient coordination of care
    - the acuity level of the patients undergoing treatment

That's Not All…

- There are intrinsic and organizational challenges facing the caregivers as well:
  - shiftwork
  - fatigue
  - stress
  - extended work hours
  - increased pressure to conserve revenue
  - high levels of workload

Human Factors in Medicine

- In an effort to enhance patient safety and increase efficiency in the CVOR, the industry recently turned to the field of Human Factors for solutions.

- While the application of HF methods to other industries had greatly enhanced safety and efficiency (e.g. aviation), the integration of these principles in the CVOR is not without its challenges.

What Does the Data Say?

- 12.3% of cardiac surgical cases suffer from a preventable error

- 160 interruptions in flow per case

- disruptions have been correlated with surgical errors ($r = 0.67$)

- 17.4 teamwork breakdowns per hour in CT surgery

- 87% of litigated surgical cases had a communication failure between providers

One Size Doesn't Fit All

- Medicine is an outcome-based discipline.

- There is a great deal of data available to assist medical professionals in making well-informed decisions regarding patient care (e.g. signs, symptoms, diagnostic tests, etc.).
  - data is standardized and relates to well-developed protocols for diagnosis and treatment
  - data-driven approach has allowed for remarkable advances in healthcare

- However, the same cannot be said for data gleaned from adverse events.

One Size Doesn't Fit All

- The lack of standardized taxonomies for things such as adverse events, errors, interruptions, and the like, often leads professionals down blind alleys.

- The end result is copious amounts of data of an equivocal nature which makes it difficult to establish causal links to the events under investigation.

- To address this, two taxonomies have been employed that go beyond simple description, thereby avoiding the procedural tunnel vision which often results from typical root cause types of analyses…

    RIPCHORD and HFACS

LENS
Locating Errors through Networked Surveillance

- Health Services Research
- Industrial Psychology
- Human Factors Engineering
- Organizational Sociology
- Cardiovascular Clinical Care
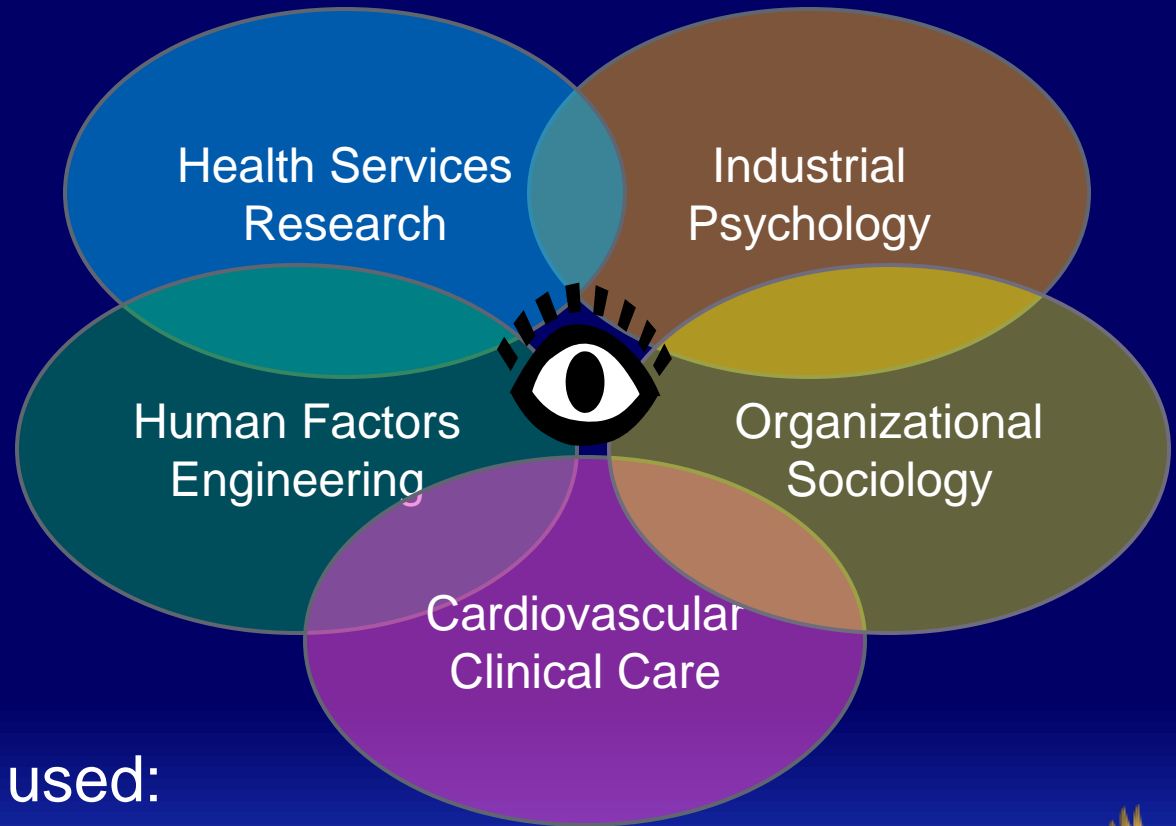
- two frameworks used:
  - RIPCHORD
  - HFACS

RIPCHORD
*Realizing Improved Patient Care
through Human-centered Operating Room Design*

- Disruptions in the "flow" of the procedure precede the majority of errors in the operating room.

- These "flow disruptions" introduce unwanted distractions and open the door for inefficiencies and errors to occur.

- RIPCHORD is a framework for identifying and classifying flow disruptions in the cardiac operating room.

RIPCHORD

Observational Taxonomy

- Communication (verbal and non-verbal)
  - Poor Communication
  - Lack of Response
  - Confusion
  - Simultaneous Communication
  - Non-essential Communication
  - Environmental Noise
  - Poor Coordination

- Usability
  - Computer
  - Equipment
  - Surfaces
  - Barriers
  - Packaging
  - Data Entry (non-computer)

- Layout
  - Connector Positioning
  - Equipment Positioning
  - Furniture Positioning
  - Permanent Structures Positioning
  - Inadequate Use of Space
  - Impeded Visibility

- Interruptions
  - Phone Calls
  - Pages
  - Non-essential Personnel
  - Spilling/Dropping Items
  - Teaching Moments
  - Outside Distractions
  - Shift Changes
  - Searching Activity
  - Common Information
  - Medical Alert
  - Procedural Failure
  - Equipment/Supplies
  - Personnel Not Available
  - Training/Familiarization

- Environmental Hazards
  - Slipping/Falling
  - Sharps
  - Crushing
  - Fluids
  - Contaminated Equipment

- Equipment Failure
  - Surgeons Equipment
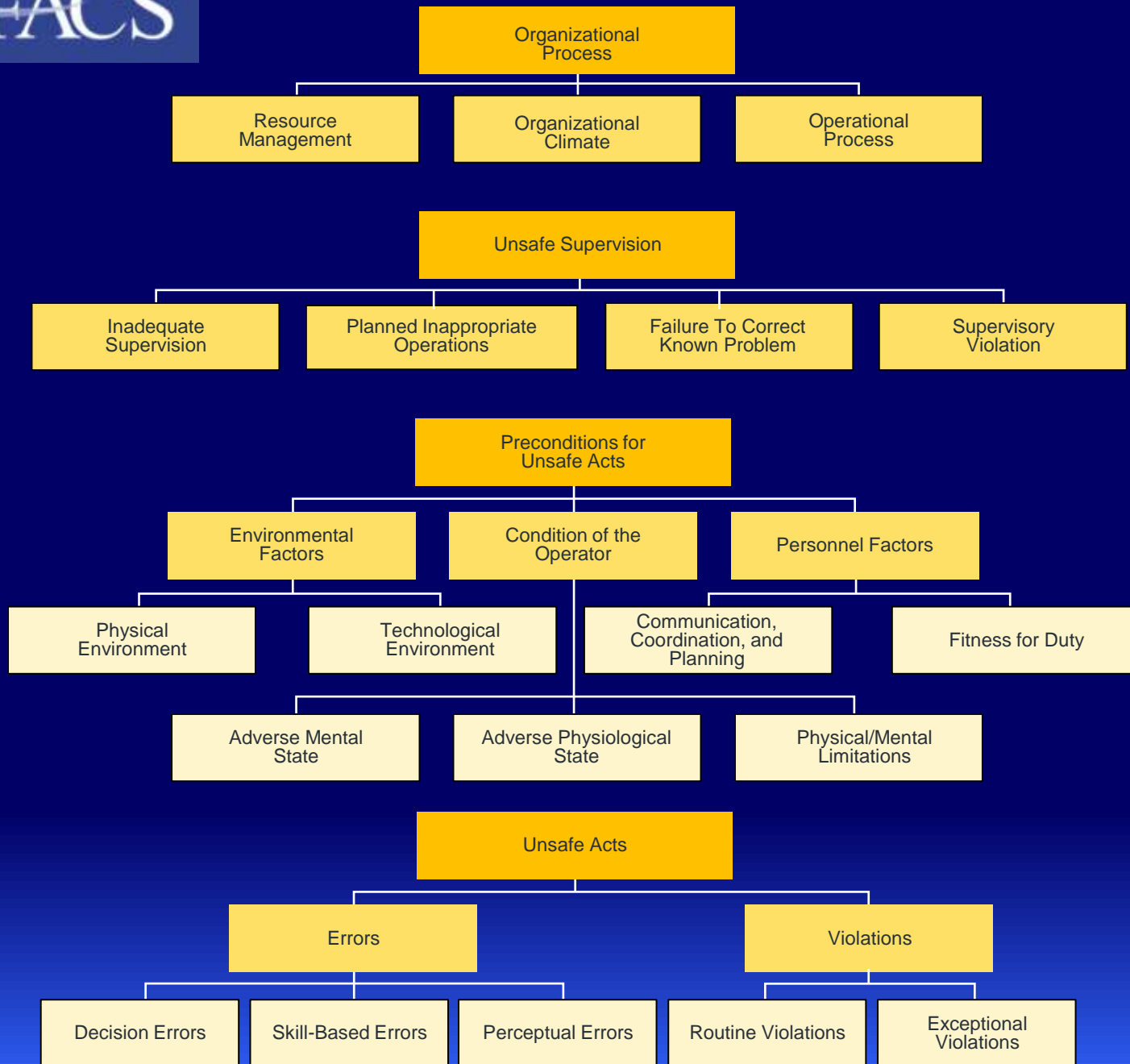 - Anesthesia Equipment
  - Perfusion Equipment
  - General Equipment

HFACS
Human Factors Analysis and Classification System

"Swiss-cheese" Model of Human Error*
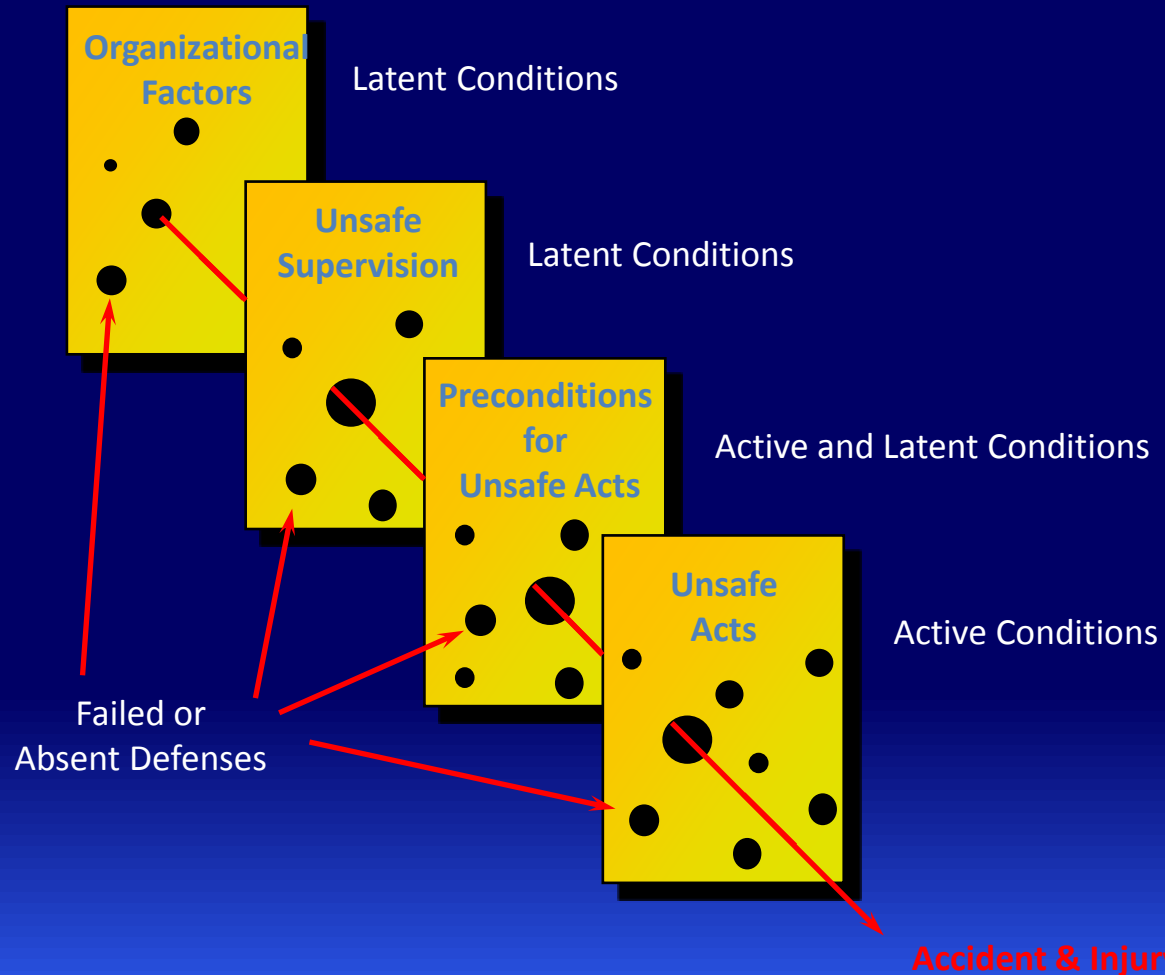
*Adapted from Reason (1990)

Data Management

LENS Database (14,070)
- Good Practices   - Preferences or Variations
- Hazards   - Time

Hazards Analyzed (5,290)

Eliminated Duplicates (1,334)

Categorized/Coded
   - RIPCHORD 24.59% (328)
   - HFACS 39.06% (521)

Considerations…

…non-disruptions and non-active failures

"Surgeon to scrub tech " You did not give me a Kelly! There is no Kelly here" Where is the Kelly? The tech turned to the nurse Kelly, not her a Kelly clamp."

"The placement of the perfusionists in the OR is problematic. They set up the heart/lung machine close to the main OR door. As a result, the door can become a problem for the perfusionists due to a risk that they may be hit by the door when it opens during a case."

Considerations…

…non-disruptions and non-active failures

"One sponge was missing but had 2 extra needles."

"The level of air detection on the oxygenator can be seen by a small monitor which is at the furthest end of the machine compared to the location of oxygenator (which does not fit with the principle of things/controls/ knobs related to each other should also be designed to be close to each other)."

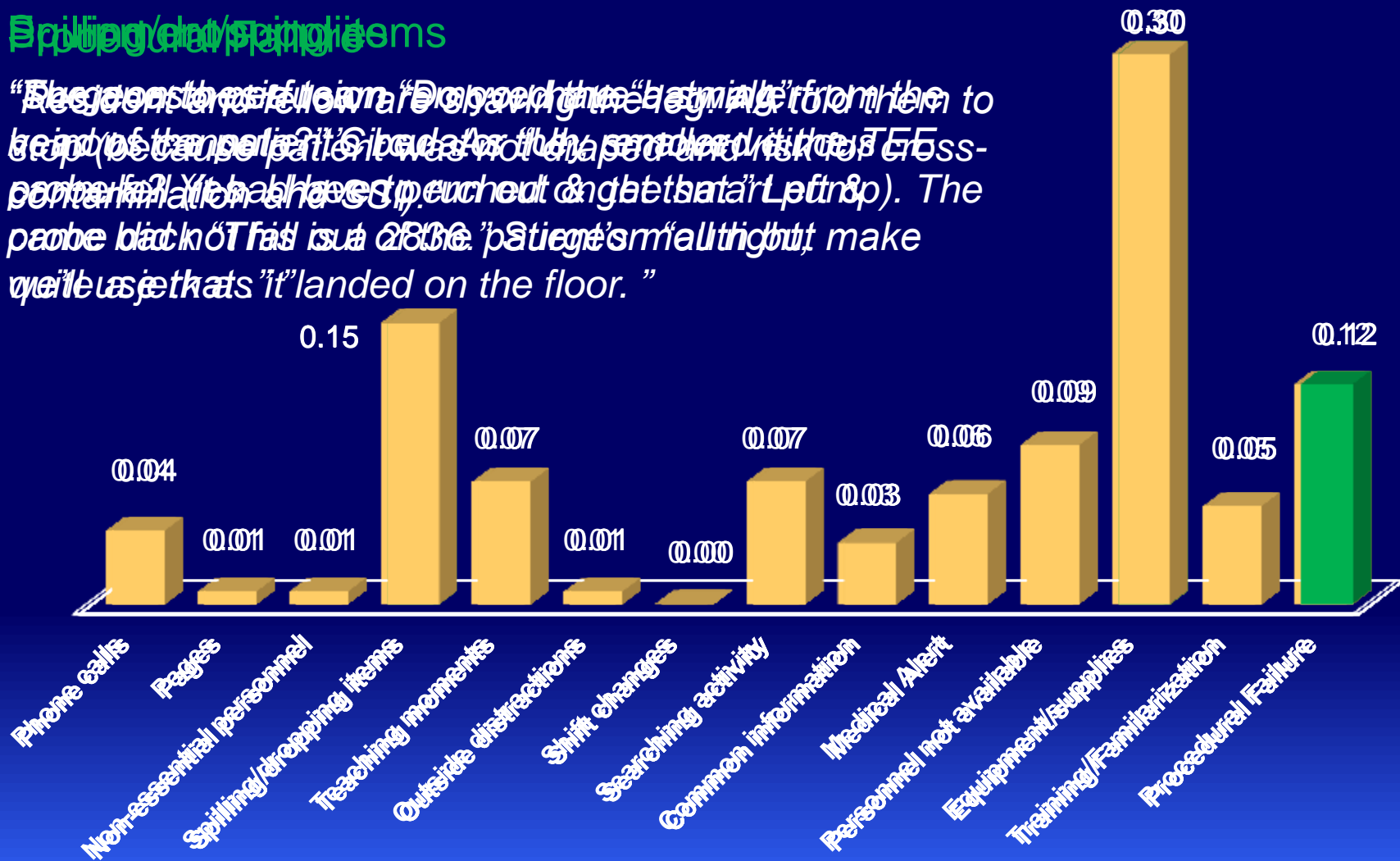# Results - RIPCHORD

Frequency of Flow Disruptions by Major Categories
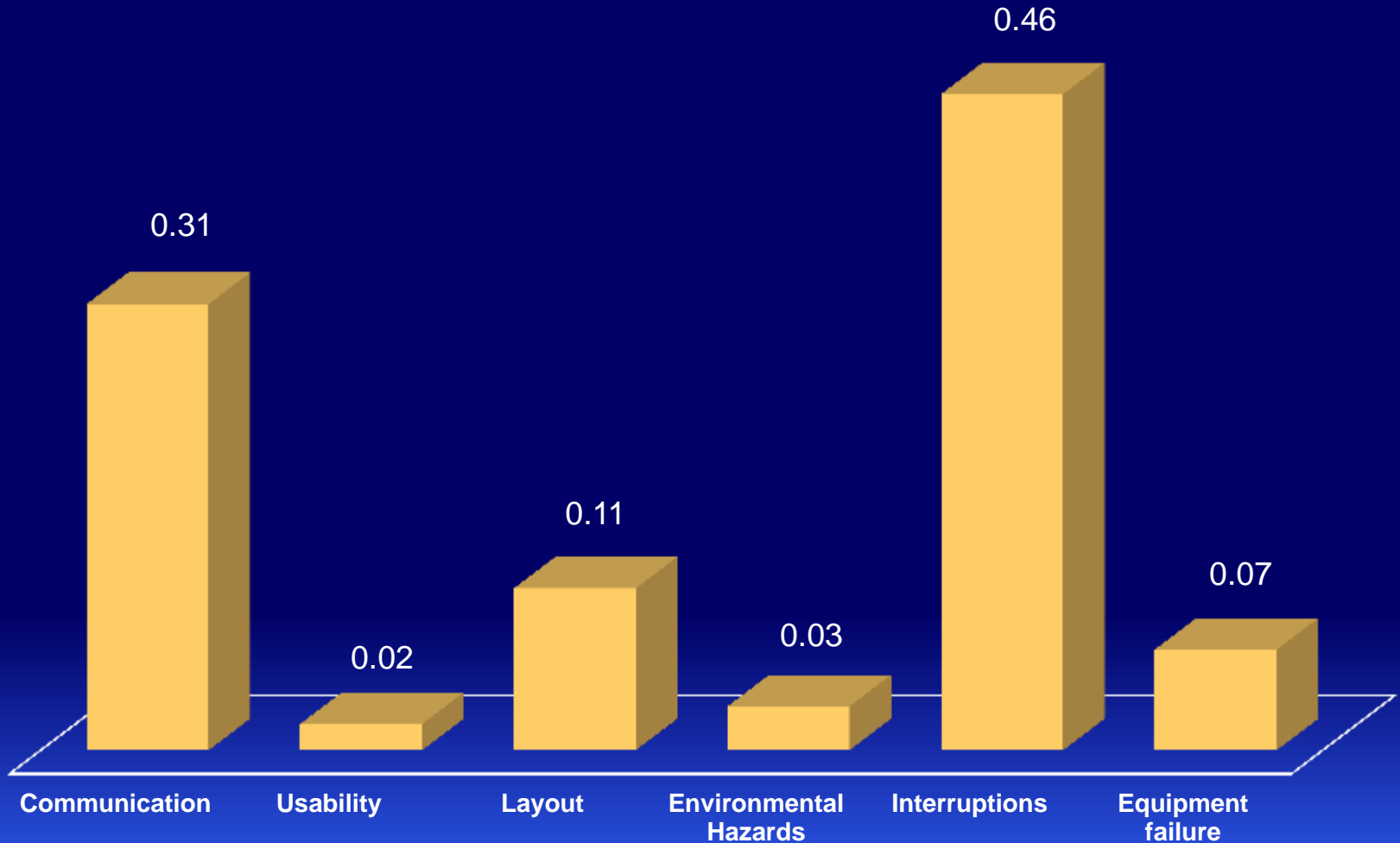
Results - RIPCHORD

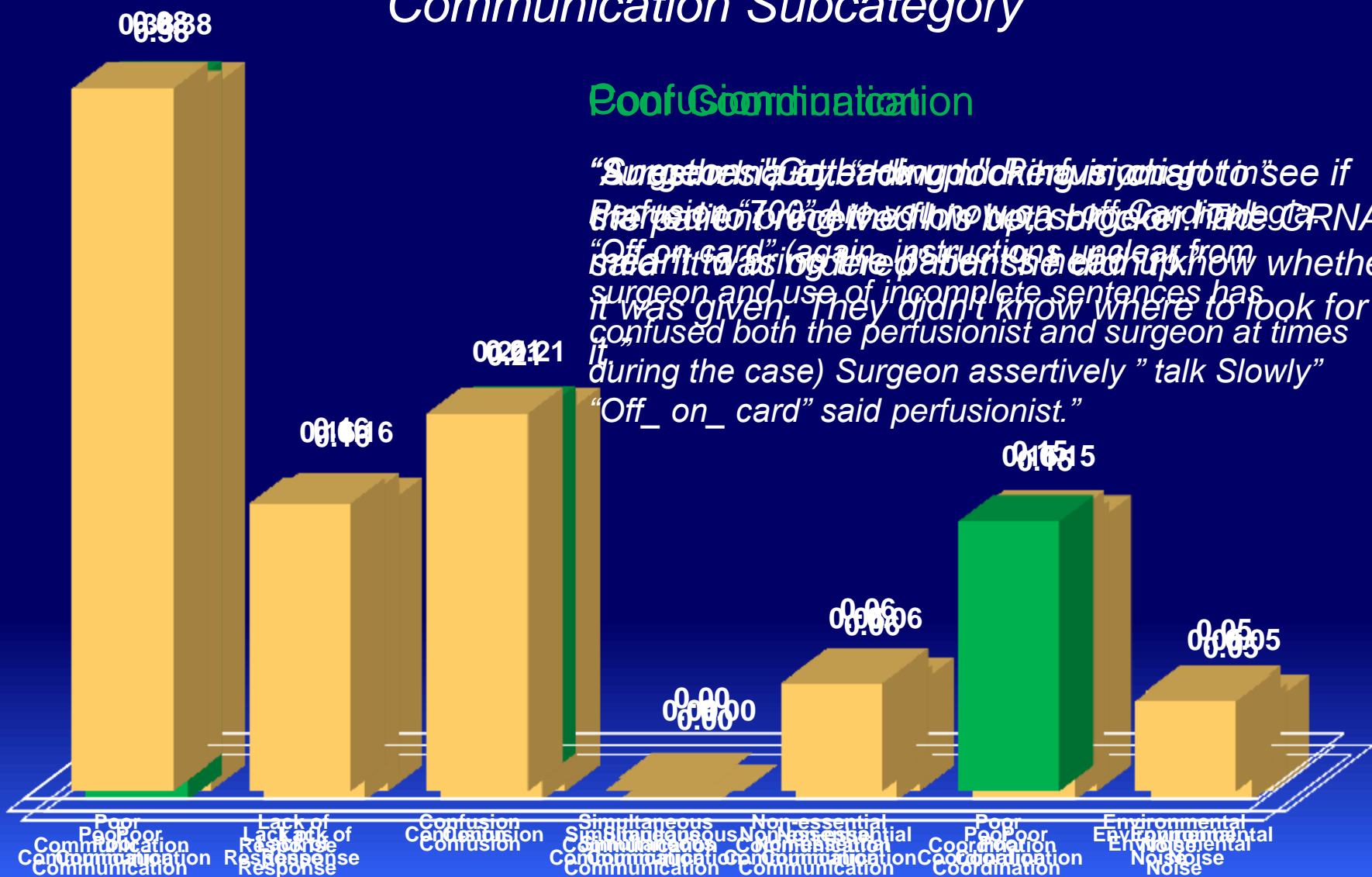*Frequency of Flow Disruptions by Interruption Subcategory*

Bar chart values (left to right):
Phone calls: 0.04
Pages: 0.01
Non-essential personnel: 0.01
Spilling/dropping items: 0.15
Teaching moments: 0.07
Outside distractions: 0.01
Shift changes: 0.00
Searching activity: 0.07
Common information: 0.03
Medical Alert: 0.06
Personnel not available: 0.09
Equipment/supplies: 0.30
Training/Familiarization: 0.05
Procedural Failure: 0.12

Results - RIPCHORD

Frequency of Flow Disruptions by Communication Subcategory
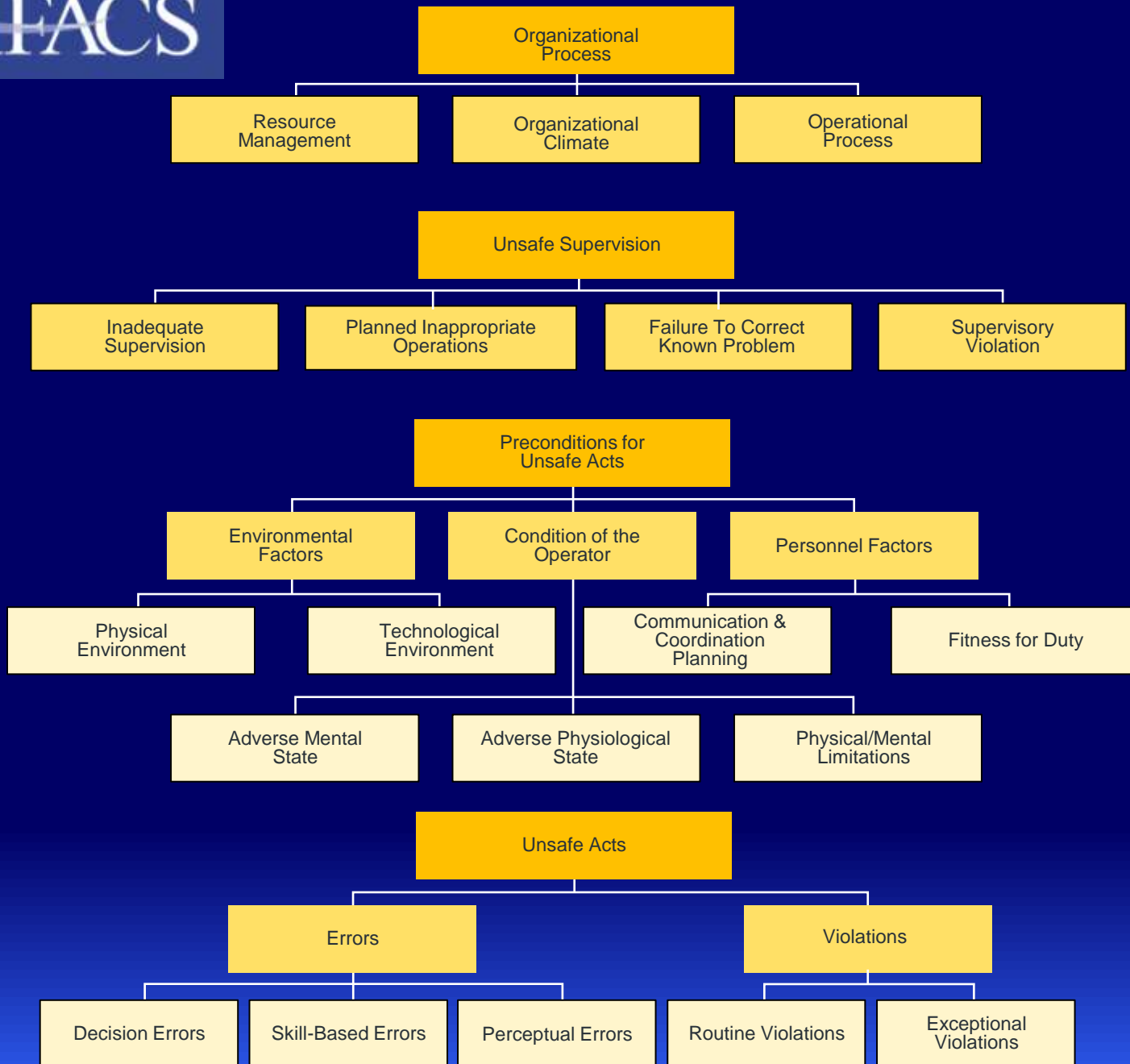
Results - HFACS

Frequency of Errors by Unsafe Acts and Preconditions
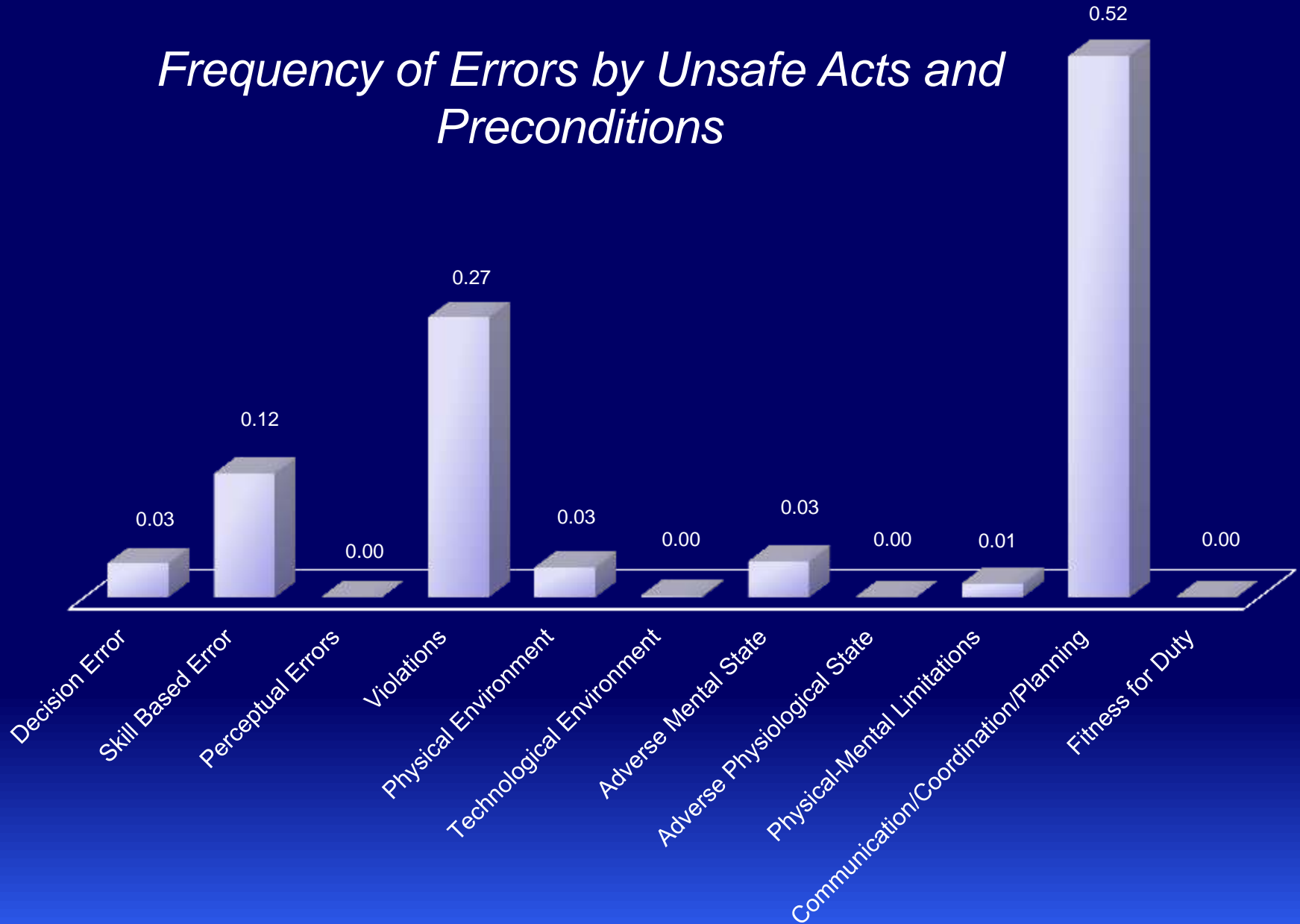
Results - HFACS

Communication, Coordination, and Planning

"ABG was sent in the incorrect syringe so no ABG was completed. This was not mentioned to the Anesthesiologist who had to ask what the ABG was. The perfusionist then said, "you use a heparinized syringe and I'll run an ABG." ABG delayed by 40 minutes."

Violations

"Anesthesiologist did not wear gloves for intubation."

Skill-Based Errors

"A second aline was needed and the anesthesiologists added the Aline to original. He did not place a stopcock to obtain ABG. Had to disconnect, add stopcock, draw lab which was very cumbersome."

Conclusions

- Some commonalities between HFACS and RIPCHORD exist and are particularly noteworthy.

- Communication represented major portions of adverse events in both taxonomies.

- Coordination and planning failures are heavily represented in both HFACS and RIPCHORD as well.

- From an intervention standpoint, training (both initial and recurrent) have been shown to be effective in addressing these issues in complex systems.

Conclusions

- Procedural failures and skill-based errors also overlap between the two taxonomies. These typically represent failures in technique.

  - Given the "procedure rich" environment in the OR, this is not surprising and also provides a good place for cost-effective interventions.

- On the other hand, there were some differences noted in the outcomes between RIPCHORD and HFACS.

Conclusions

- Violations, which were the second largest category of HFACS, were comprised largely of breaks in sterile protocol.

  - While these were certainly adverse events, they did not represent flow disruptions.

  - This underlines the importance of utilizing the two taxonomies in order to better capture adverse events in the OR.

Future Directions

- Author three articles addressing HFACS, RIPCHORD, and communication, coordination, and planning.

- Work with medical SMEs to further develop and refine RIPCHORD.

- Develop protocols to look specifically at flow disruptions and human error in the OR.

- Continue to analyze data - in particular, good practices.

Thank You

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- Questions?