Engineering the future of critical care

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Clinical Intensivist, and proud of it

Other Stuff:
Associate Professor, CCM, UofA
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CRI
criticalcare
EDUCATION NETWORK

Alberta Health Services
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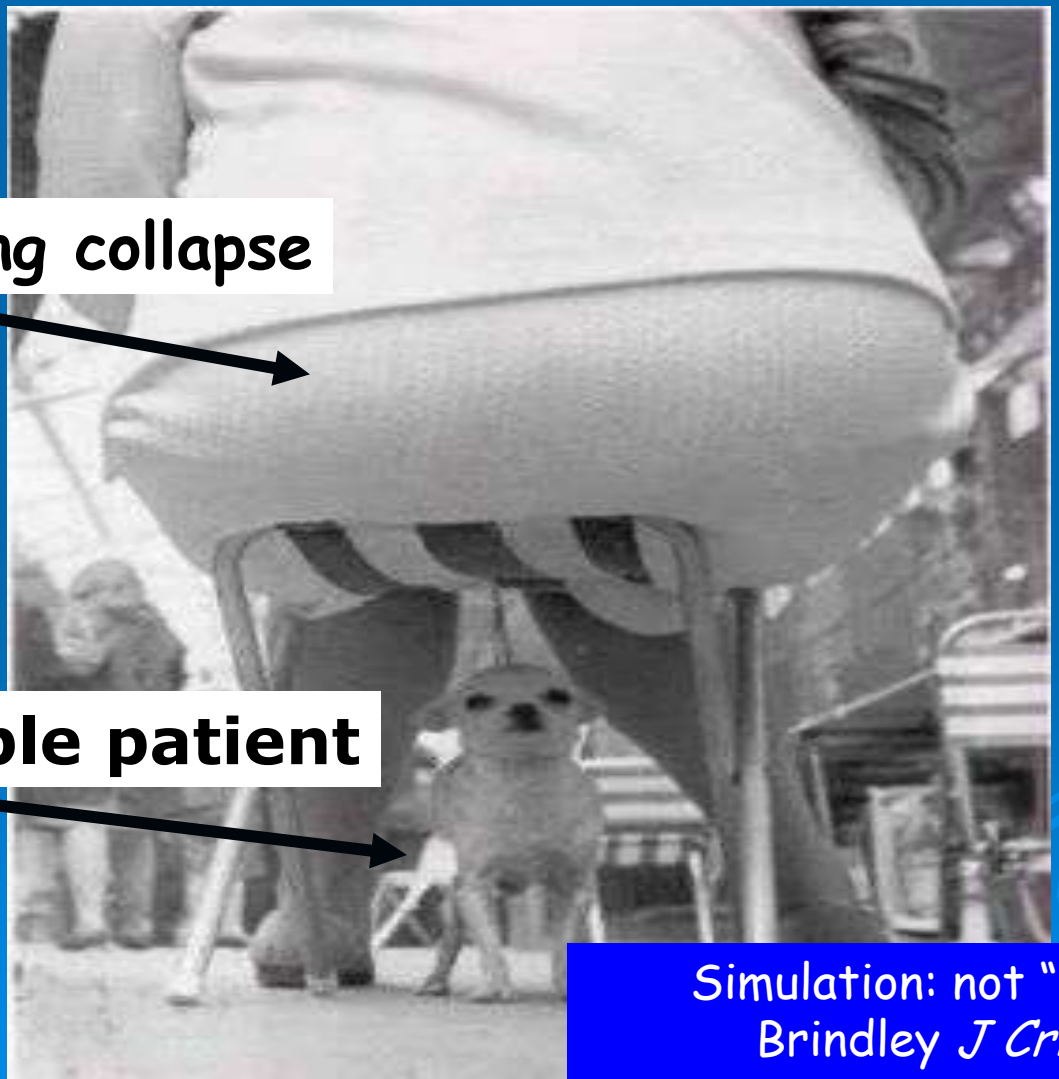
S.T.A.R.T.
SURGERY TRAUMA AND RESUSCITATION TRAINING

UNIVERSITY OF ALBERTA
QUAECUMQUE VERA

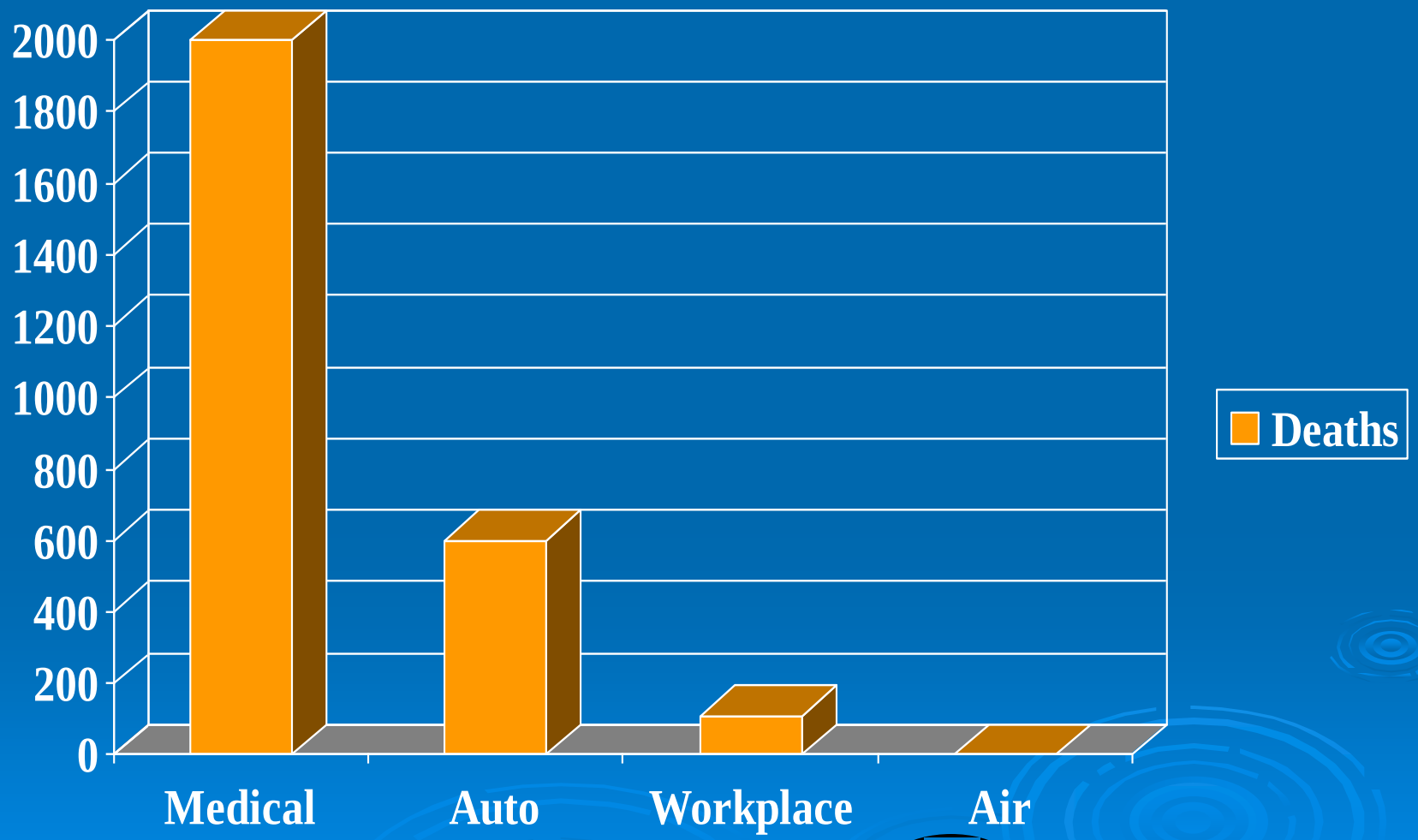
Division of
Critical Care Medicine

*Alternative title…*Crisis Management: what's holding us up!?

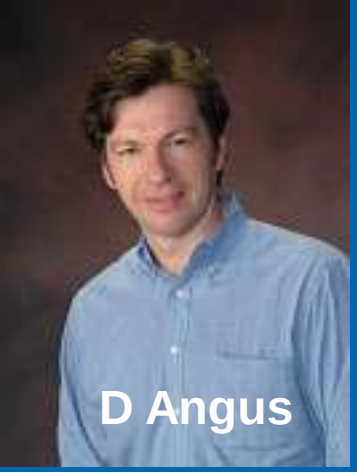


Simulation: not "why" but "how".
Brindley *J Crit Care* 2009

The cold-hard truth (baker CMAJ 2004)



A Ziv
With permission



Is Acute Care Medicine

A. Art?

B. Science?

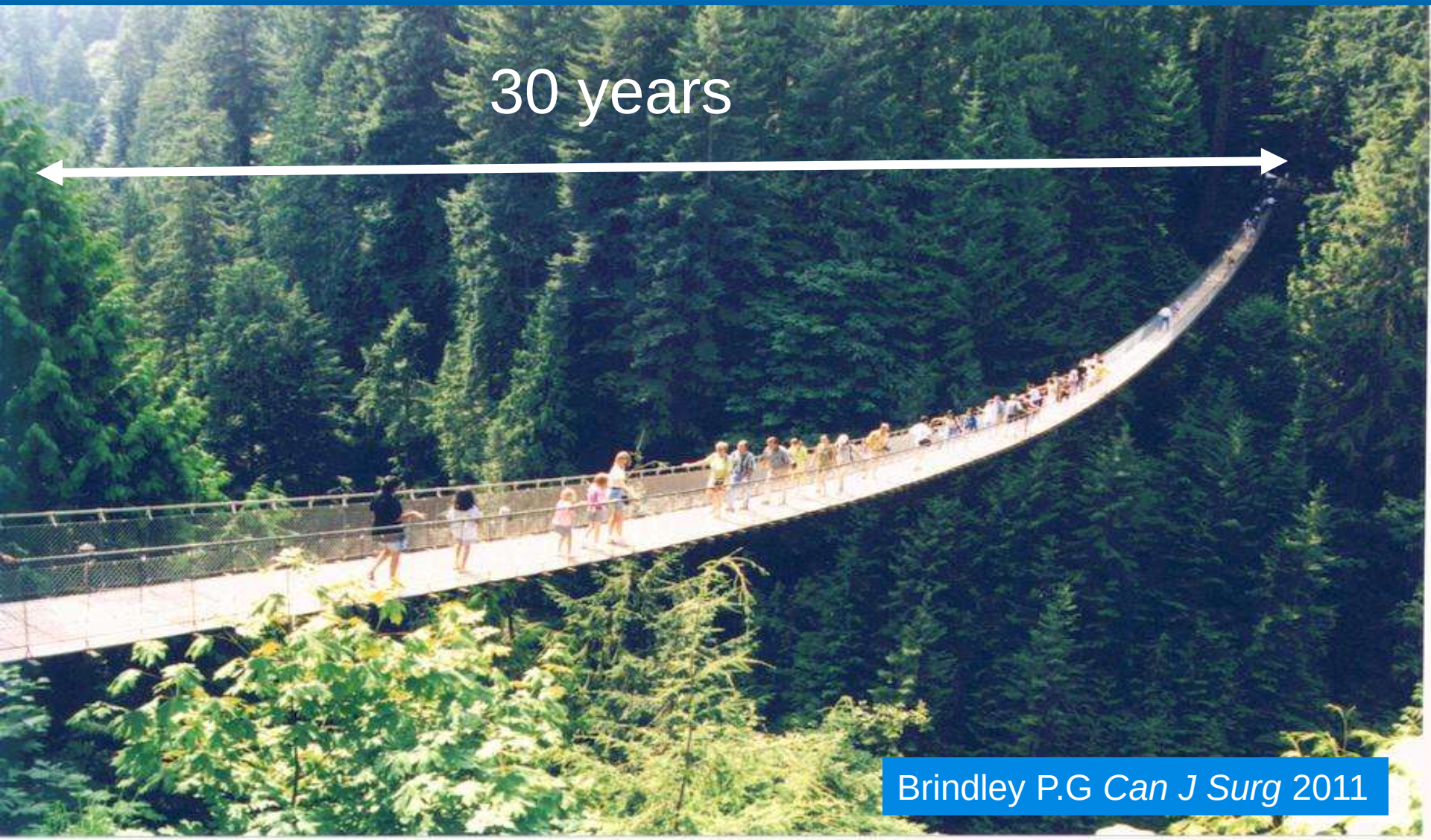
C. Engineering?

Medicine as Engineering

- Most aviation risks are predictable
- Commercial jets protected by engineering
  - Reliance on checks, fail-safes, redundancies, SOPs
- 0.4 (fatal) crashes per 1 million take-offs
  - **Ten fold reduction in 30 years**
- Focus on CRM, Human factors, Team training
- Knowledge exceeds any individual
  - craftsmen→process engineers (Dunn WF)
- Get travelers safely & efficiently from A->B

Brindley P.G *Crit Care* 2010
Brindley P.G ISICEM Yearbook 2010
W Dunn Chest/ D Angus/N Gibney communication

Bridging the "care gap"



Brindley P.G *Can J Surg* 2011

Bridging the Care Gap:
A modest proposal

- 1) Reasons why we "screw up"
  - Innovation versus implementation
    - M Gladwell
  - Willful Blindness
    - M Heffernan
- 2) The need to create
  - "The science of performance"
  - "The science of managing complexity"
    - A Gawande
- 3) Medicine's entrenched culture
  - Geert Hofsteede

The science of managing complexity

Too much plane for one man to fly

B17: Boeing 1935

Simulation: not "why" but "how".
Brindley *J Crit Care* 2009

Errors with multiple tasks

# Steps	Probability entire process correct
1	0.95
25	0.28
50	0.08
100	0.06

LL Leape 1994;
IHI. Preventing errors: the role of complexity.
Pronovost PJ

Science of managing complexity

- 13000 different diseases/syndromes/injuries
  (13,000 planes to land)
- 6000 drugs; 4000 procedures
- 180 steps/pt/day

A Gawande

Complexity in flight (technology)

ECMO and H1N1

Complexity (distance)

Complexity in Medicine (people)

Human Factors & Crisis Resource Management

Brindley. Preventing Medical Crashes: Psychology Matters
J Crit Care 2010

Fixation Errors

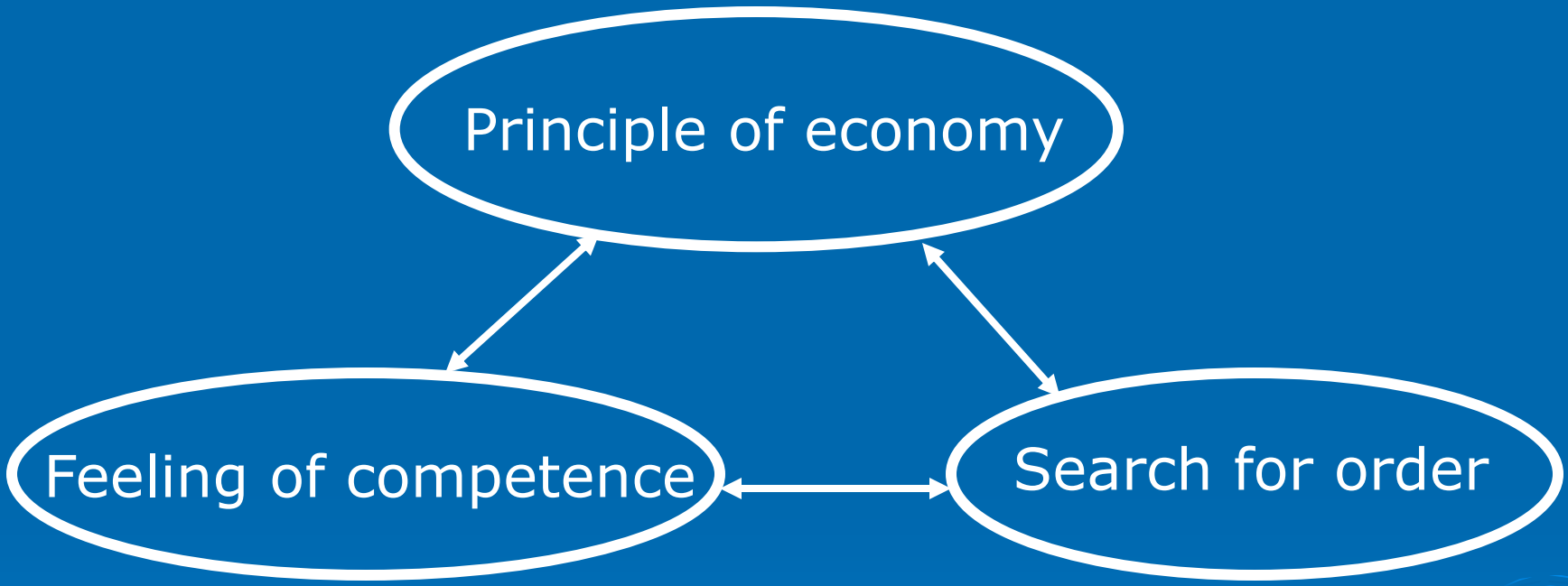
- Fixation of diagnosis
  - Failure to question diagnosis
    - "It can't be an aortic tear- that's rare"
  - Failure to admit there's a problem
    - "I *don't want* it to be an aortic tear"
- Fixation of task
  - Difficult airway, miss the profound hypotension
- Fixation on other factors
  - Doesn't need ICU 'cause there are no beds

Brindley et al. CJRT 2007

Fixation Errors in medicine

P Brindley, S Taylor *Resuscitation* 2008

Why else do fixation errors occur



Crisis Management in Acute Care Settings. St Pierre et al. Springer Press 2008

Focus of predator

(incl[illegible]ance of prey

You need both

Agnotology: Proctor & Schiebinger
Brindley *Crit Care* 2010

Teamwork bwtn Humans & Machines?

Garry Kasparov (aka Human)

Deep Blue (aka Technology)

Brindley and Berger: *J Crit Care* 2009

The Daily Telegraph

J Orr Aug 2011

- *"airline pilots so reliant on computers…they are forgetting how to fly"*
- *"automation addiction"*
  - Rory Kay Co-Chair FAA

- 60% accidents; 30% major incidents
  - Pilots had trouble manually flying or
    kes with automated control (FAA)

Personal comm Dr C Shultze

Cognitive Paralysis:
"Fight or flight…or freeze"

- 1) **Automatic:**

  Appropriate response cognitively embedded
  Immediate(100 ms)

- 2.) **Simple Decisions**

  More than one possible response available
  Choosing takes 1-2 s.

- 3.) **Complex decisions**

  No appropriate response in personal database,
  Response has to be created (8-10 s)

- 4) **Inability to make decisions**

  No behavioral schema in database
  No temporary schema can be created

Leach J, Aviat Space Environ Med 2004

"Fight or flight..or freeze"

- 10% lead
- 10% freeze
- 80% neither lead nor freeze-
  - *but can be led*

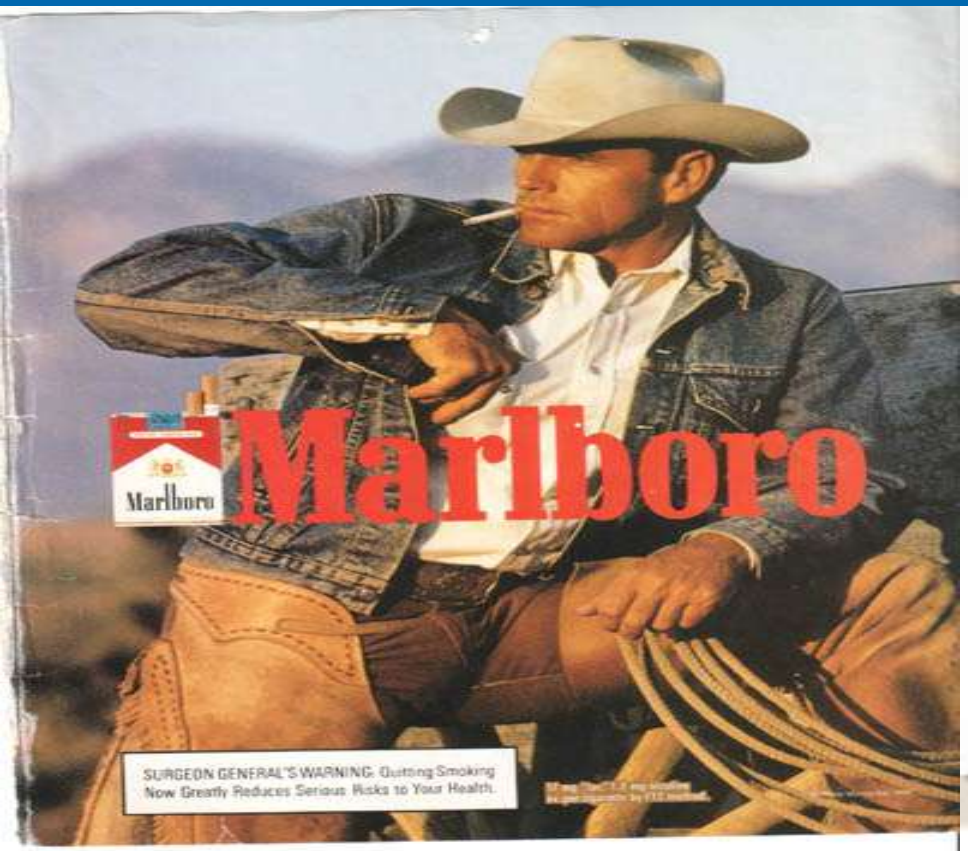
Leach J; Aviat Space Environ Med 2004

Teamwork in Critical Care: "there's no 'I' in ICU"

A little experiment

- Who makes the finest car engine?
- Who makes the safest car chassis?
- Who makes the best brakes?
- Who makes best looking car?

Can teamwork be left to chance?

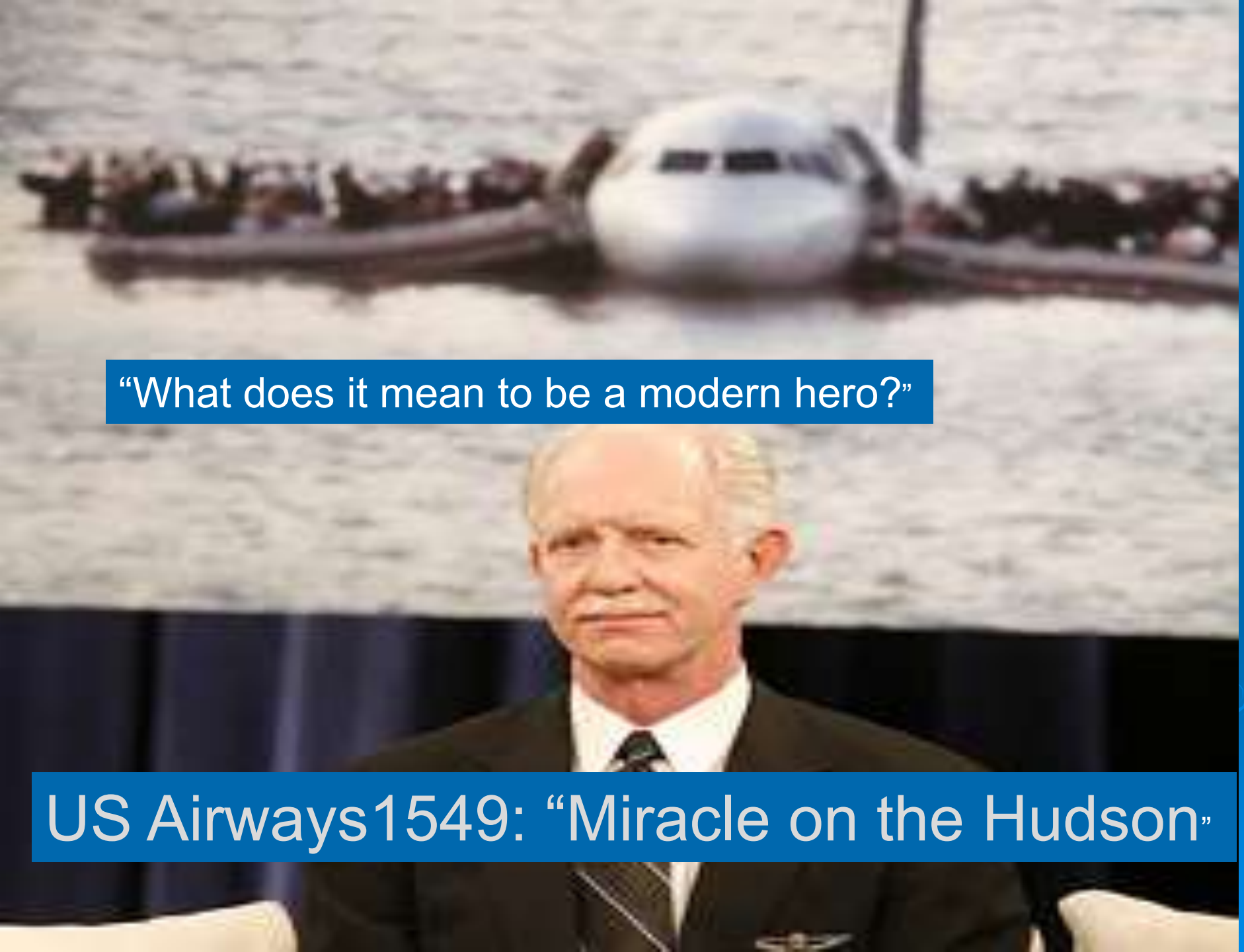


Culture

Reinforcement

Who are these people?

A Gawande 2009, Dunn WF 2010


“What does it mean to be a modern hero?”
US Airways1549: “Miracle on the Hudson”

"Sully"

- "Captain America"
- "Hudson River Hero"
- "Le Nouveau Heros de l'Amerique"

- The Pilot Not Flying

  fewer planes crash when copilot flies

What's most important in patient safety?

A. **Factual Knowledge?**

B. **Procedural dexterity?**

C. **Communication/team skills?**

Human Errors in Medicine

- Human factors 80%
  - Team factors
  - Communication

Gaba DM, et al. Crisis Management in Anesthesiology. 1994
St Pierre et al. Crisis Management in Acute Care Settings.2008
Sutcliffe KM. Acad Emerg Med 2004
Khan FA et al. Anesthesia 2001
Kohn et al IHI 2000
Dunn WF et al Chest 2010
Pronovost J Crit Care 2009
Gawuande A 2010

And that's just for starters…

1977, Tenerife, KLM,
….largest aviation disaster in history

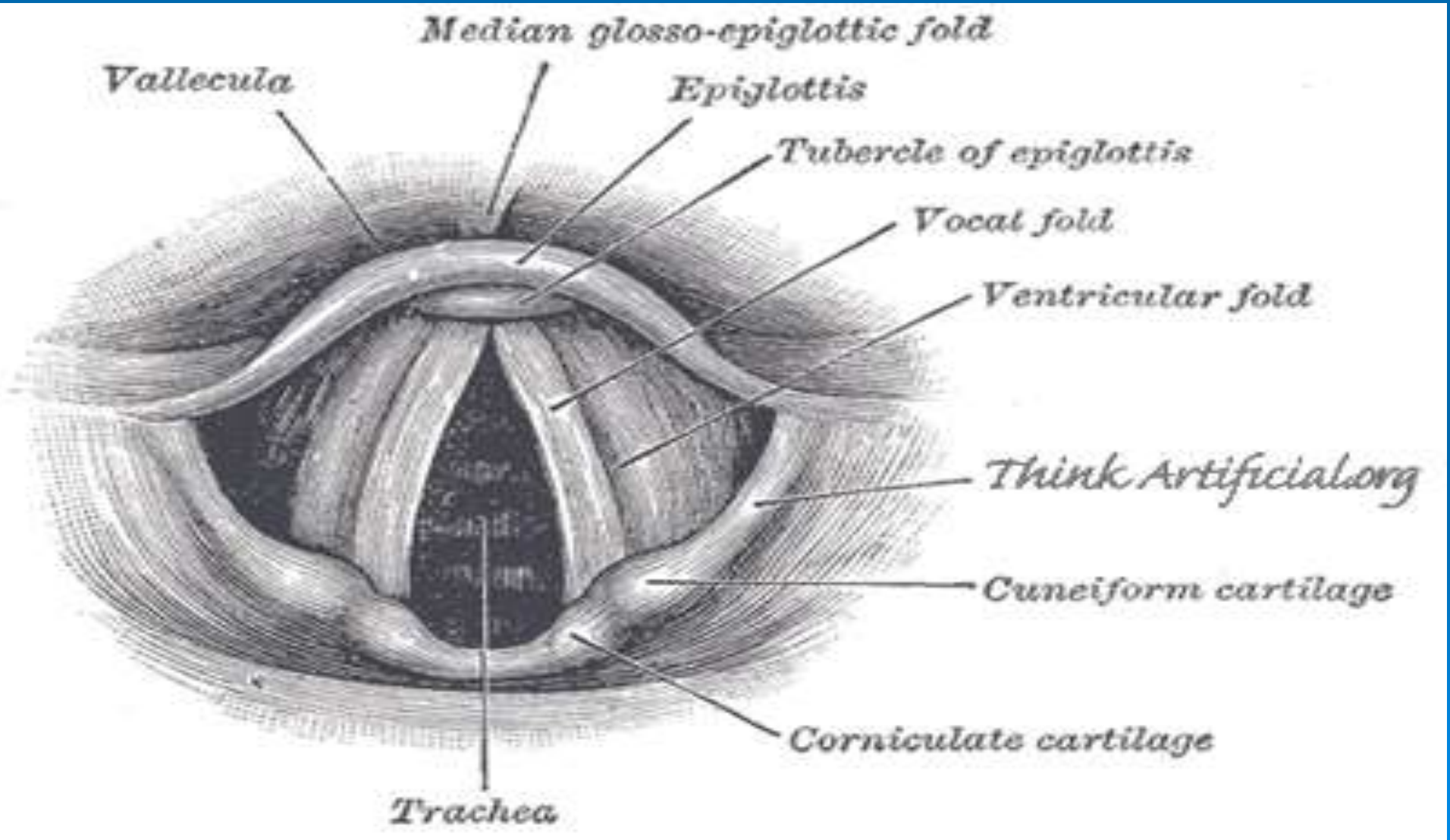
Senior 747 pilot begins taxiing
Copilots know he has not been cleared

Nobody spoke up
Two planes collide- 583 die

……Is your system more like
The "Hudson" or "Tenerife"?

Conclusion:
"Didn't take the time to become a team"

"Verbal Dexterity": Acute Care's most important skill



Communication

- Black box silence is common
- Fewer planes crash when co-pilot flies
- Teamwork means communicating
- Teamwork is how we create a team
  - Present a "shared mental model"
  - Coordinate tasks
  - Control flow of information
  - Stabilize emotions
  - Control interruptions

Brindley and Reynolds J Crit Care 2011

St Pierre 2007
Airbus 1988

Communication in acute care

"Meant is not said

"Avoid mitigating language"

"Resuscitate by voice"

Said is not heard

"Close the loop"

"5 levels of advocacy"

Heard is not understood

"Repeat back method"

"Sterile cockpit rule"

Understood is not done"

Brindley and Reynolds J Crit Care 2011

Rall and Gaba 2007

Practical strategies

Handbook of communication in anesthesia 2011 (Cyna et al)

- **Crisis Resource Management**
  - **Communication**

- Communication loops (challenge-response)
  - 3 Cs
    - Clarity
    - Cite names
    - Close the loop

Brindley et al. J Crit Care 2007

Korean Airlines…
"Excellence in flight"

Communication and culture

M Gladwell Outliers 2008

KA: Dying of Politeness

M Gladwell Outliers 2008

Avoid vague/mitigating language

- "John, please intubate the trachea"
- NOT…"Perhaps it's time to intubate"

- "Dr Smith, get me a surgeon"
- NOT.."maybe we need a surgeon

M Gladwell Outliers 2008

2 secrets to success in life

- 1) Always leave them wanting more
- 2) ……

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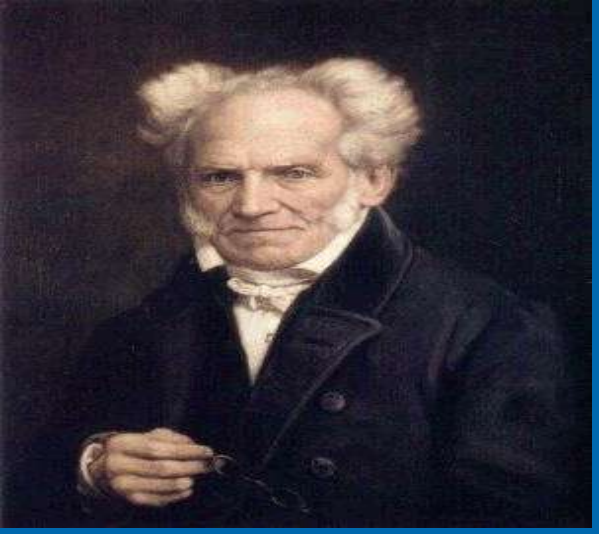

Questions, Comments?

Schopenhauer 1788-1860

"All truth passes through three stages:

First, it is ridiculed.
Second, it is violently opposed.
Third, it is accepted as being self-evident."

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