Understanding Collective Performance: Human Factors and Team Science

Invited Lecture for the Department of Mathematics

Joseph R. Keebler, PhD

Associate Professor

Department of Human Factors

My background

- Originally from New Jersey
- Attended UCF 2003 - 2011, completing BS, MA, & PhD
- Assistant Professorship at Wichita State University 2012 - 2015
- Moved to ERAU in 2015

Laboratories

- Director - Small Team Analog Research Laboratory (STAR)
- Co-Director - Research and Engineering and Applied Collaborations in Healthcare (REACH)

Overview

Understanding work teams

Human Factors Science in Healthcare Systems

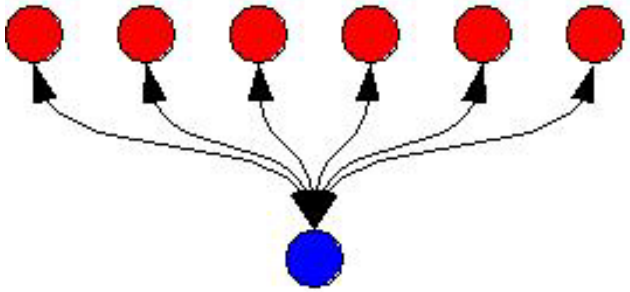
Utilizing Escape Rooms to improve team performance

Understanding Work teams

Groups vs. Teams

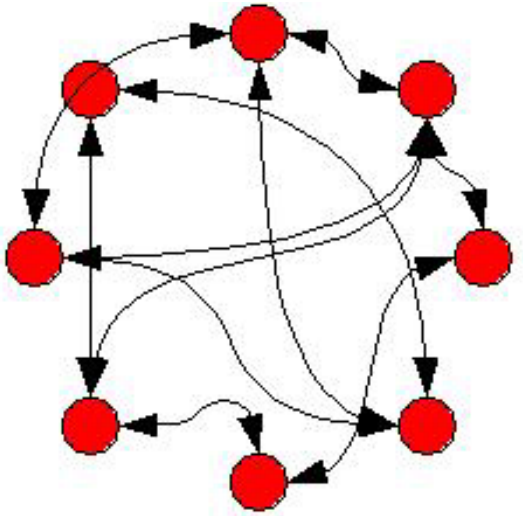
- Mainly different in the way they:
  - share information
  - perform
  - synergize
  - hold individual members accountable
  - acquire and maintain task-relevant skills

Groups vs. Teams



GROUP

people working towards a goal whose work is coordinated by someone else (e.g. a manager) for them



TEAM

people working towards a common goal who coordinate their work amongst themselves

Team Types

Problem solving teams

5-12 employees who meet regularly to improve the org

Self-managed work teams

10-15 employees who perform highly related jobs and take on many of the responsibilities of a supervisor

Not effective at resolving conflict, have higher turnover and absenteeism

Cross functional teams

Team of individuals from same hierarchical level (e.g. managers) but different departments (e.g. production, PR, sales, marketing)

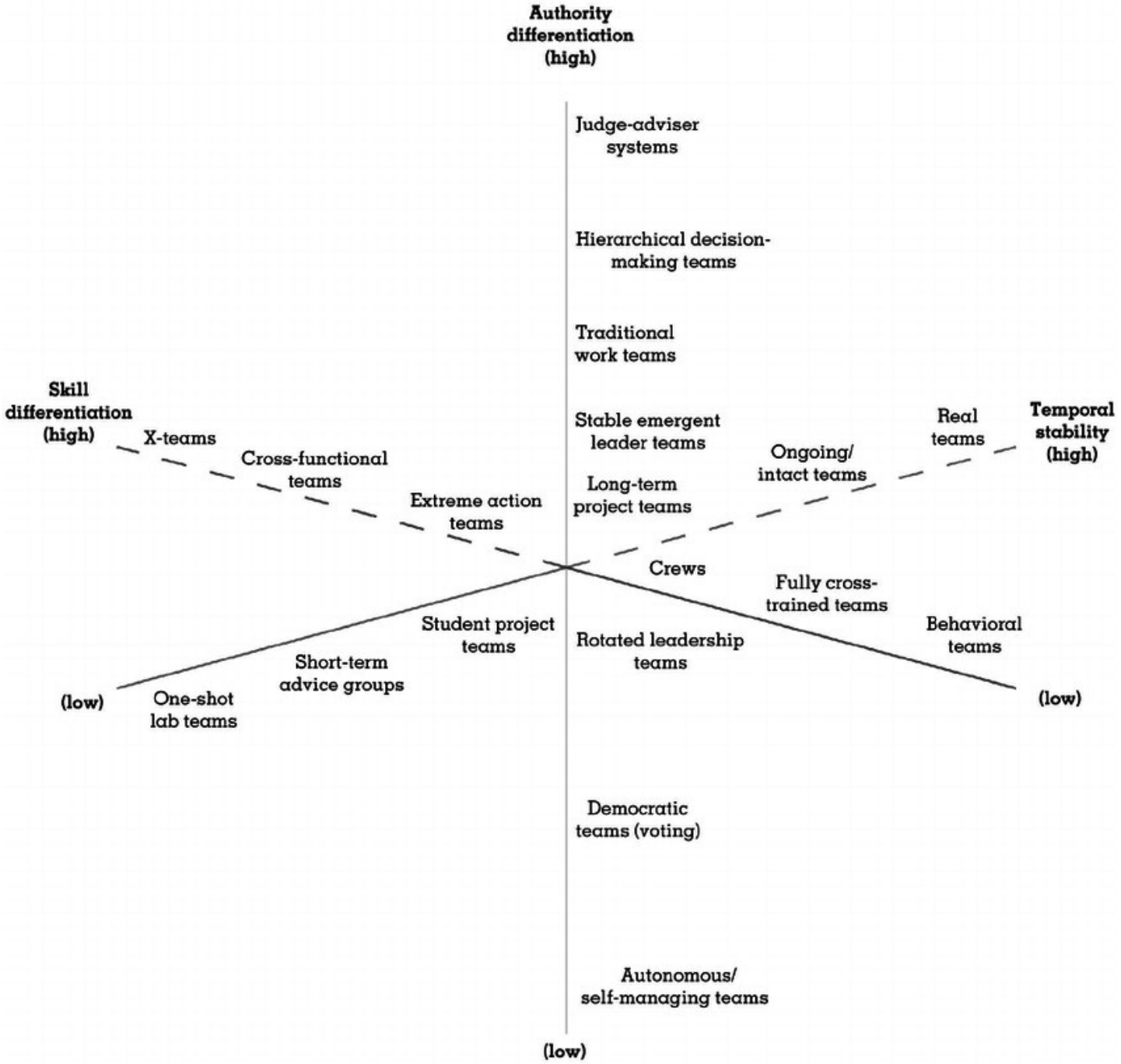
Virtual teams

Teams of individuals working remotely from one another

Multi-Team System

Team of teams. Think Fire + Police + EMS + Hospitals in an emergency or disaster

Team Dimensional Scaling



Creating effective teams

Context

Resources – effective teams have timely info, equipment, staffing, encouragement, and admin assistance

Leadership – effective teams have someone who provides goal orientation and structure (or they do it themselves)

Climate of trust – effective teams trust one another

Performance evaluation and rewards – effective teams have clear reward structures based on performance including profit-sharing, gainsharing, small-group incentives, and group-based appraisals

Composition

Abilities – knowledge, skills and attitudes of team members

Personality – mean levels of C and O are good; eve one person low in A can spoil the entire team

Roles – see next slide

Diversity – demographic diversity unrelated to team performance

Size – smallest number of people needed to complete a task; too many leads to social loafing. Rule of thumb is no less than 2, no more than 10.

Preference – high performing teams are composed of people who like to work on teams; it's bad to put folks who don't like being on a team on a team

Composition - Roles

Linker - coordinates

Creator – initiates creative ideas

Promoter – champions ideas

Assessor – offers analysis/options

Organizer – provides structure

Producer – provides direction/follow through

Controller – Examines details and enforces rules

Maintainer – fights external battles

Adviser – encourages the search for more information

Process

Common plan and purpose – mission analysis and strategy

- Reflexivity – good teams reflect on how things are going and adjust plans as needed

Specific goals

teams have measurable, realistic performance goals

Team efficacy

confidence the team will succeed

Mental Models

shared view of key elements of environment and tasks

Conflict

many types, discussed later. In general some conflict is bad (relationship conflict) while other types are necessary (task conflict)

Social loafing

good teams have too much reliance on one another for anyone to drop the ball. Bad teams can have social loafing due to poorly realized goals, tasking, and communication

Team Outcomes

Performance

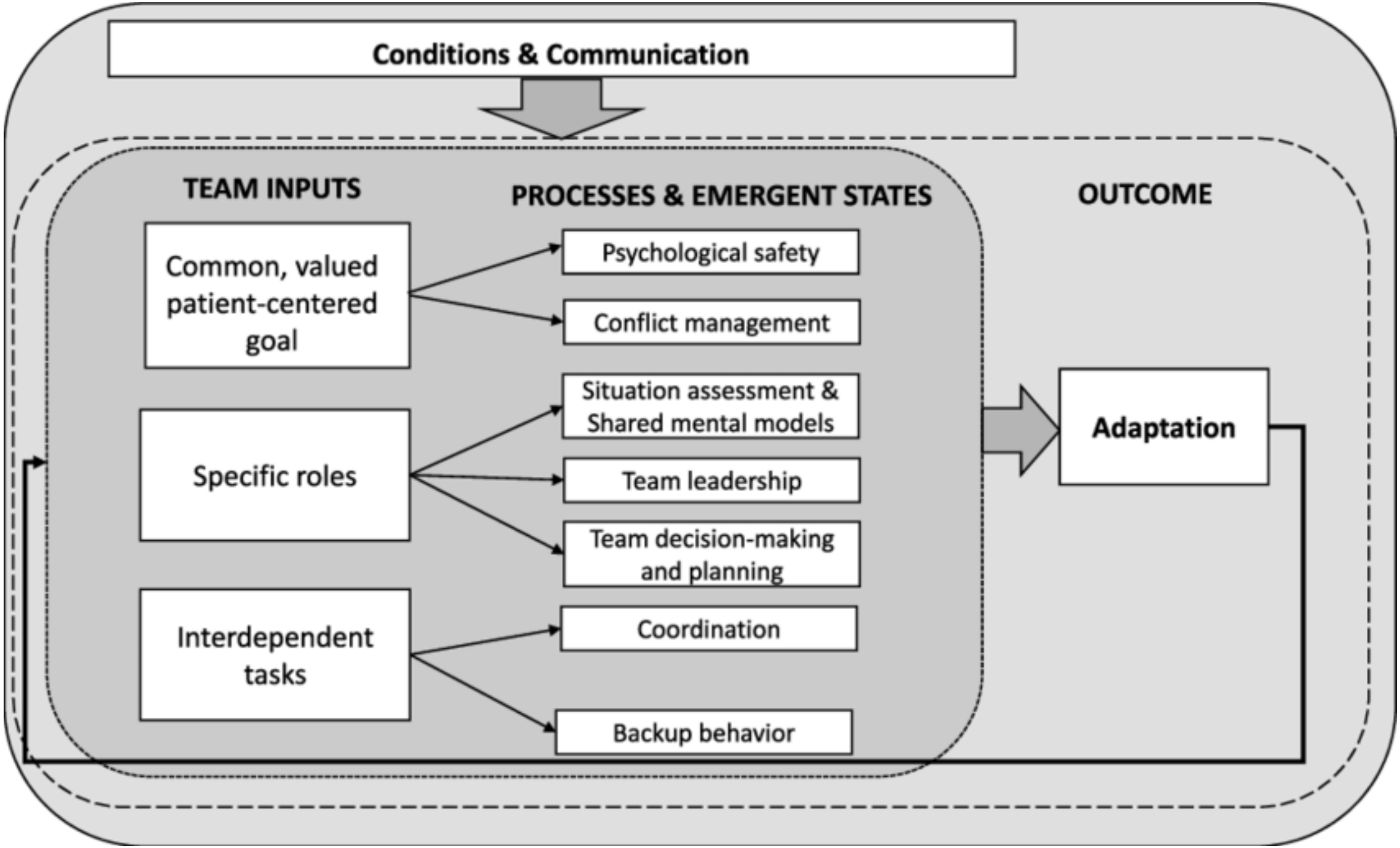
How well the team did in regards to their processes to achieve their goal

- The Pit Crew successfully completed all stops without fail and in a timely manner

Effectiveness

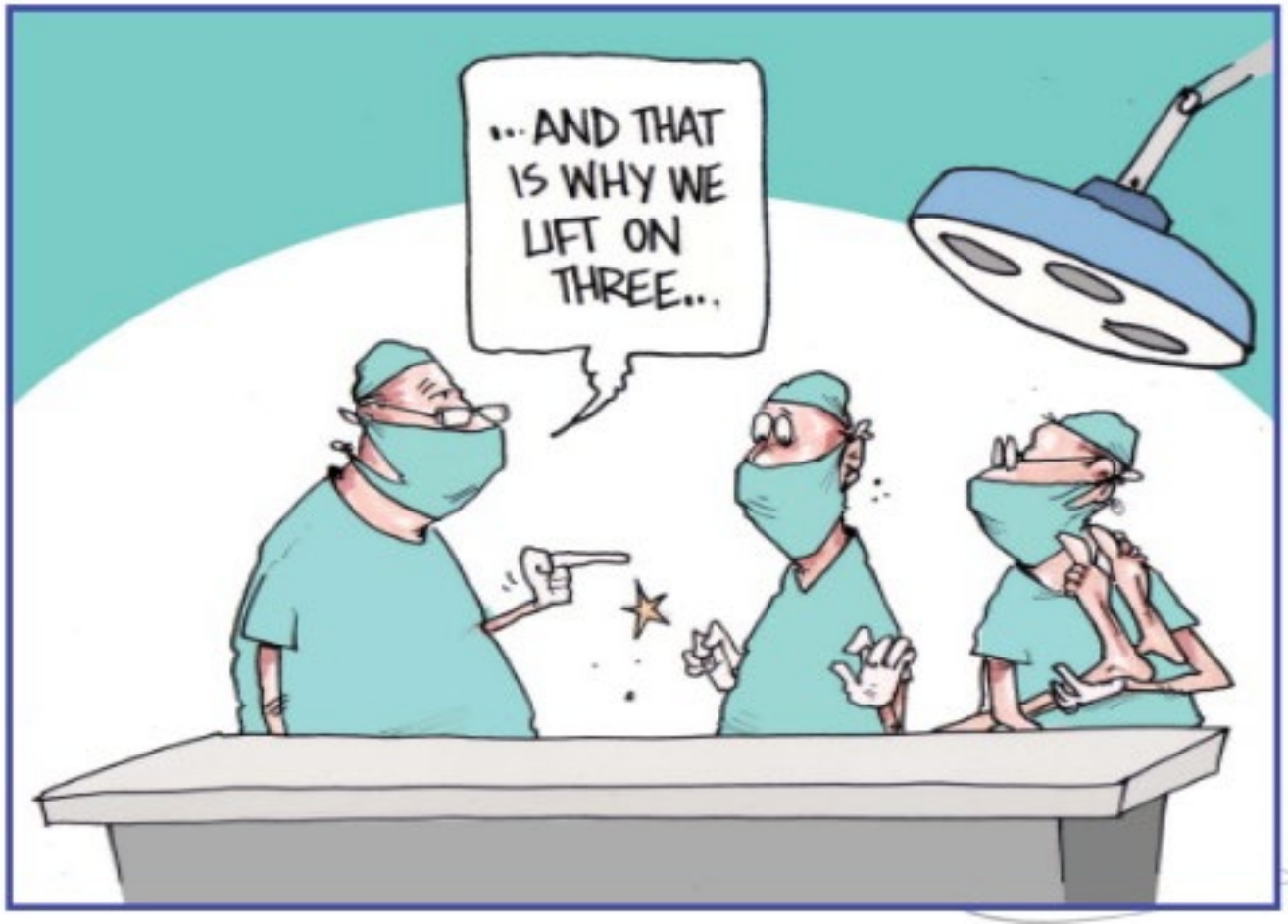
How well the teams goals reach some benchmark or standard

- The car won the race and beat the courses previous best time


Conditions & Communication
TEAM INPUTS
PROCESSES & EMERGENT STATES
OUTCOME
Common, valued patient-centered goal
Specific roles
Interdependent tasks
Psychological safety
Conflict management
Situation assessment & Shared mental models
Team leadership
Team decision-making and planning
Coordination
Backup behavior
Adaptation

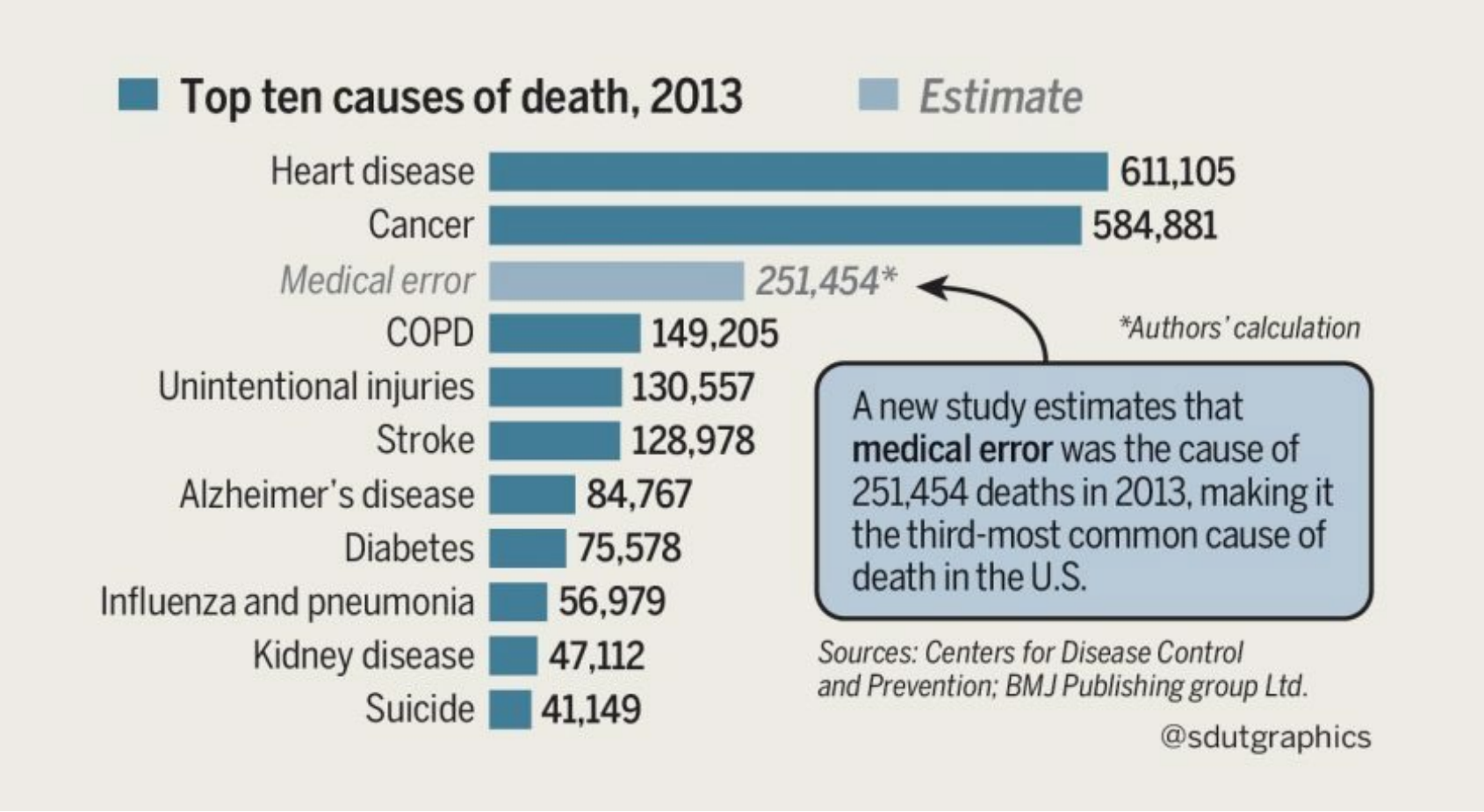
Human Factors in Healthcare

Failures in communication are the most common root cause for near misses and adverse events in the medical domain

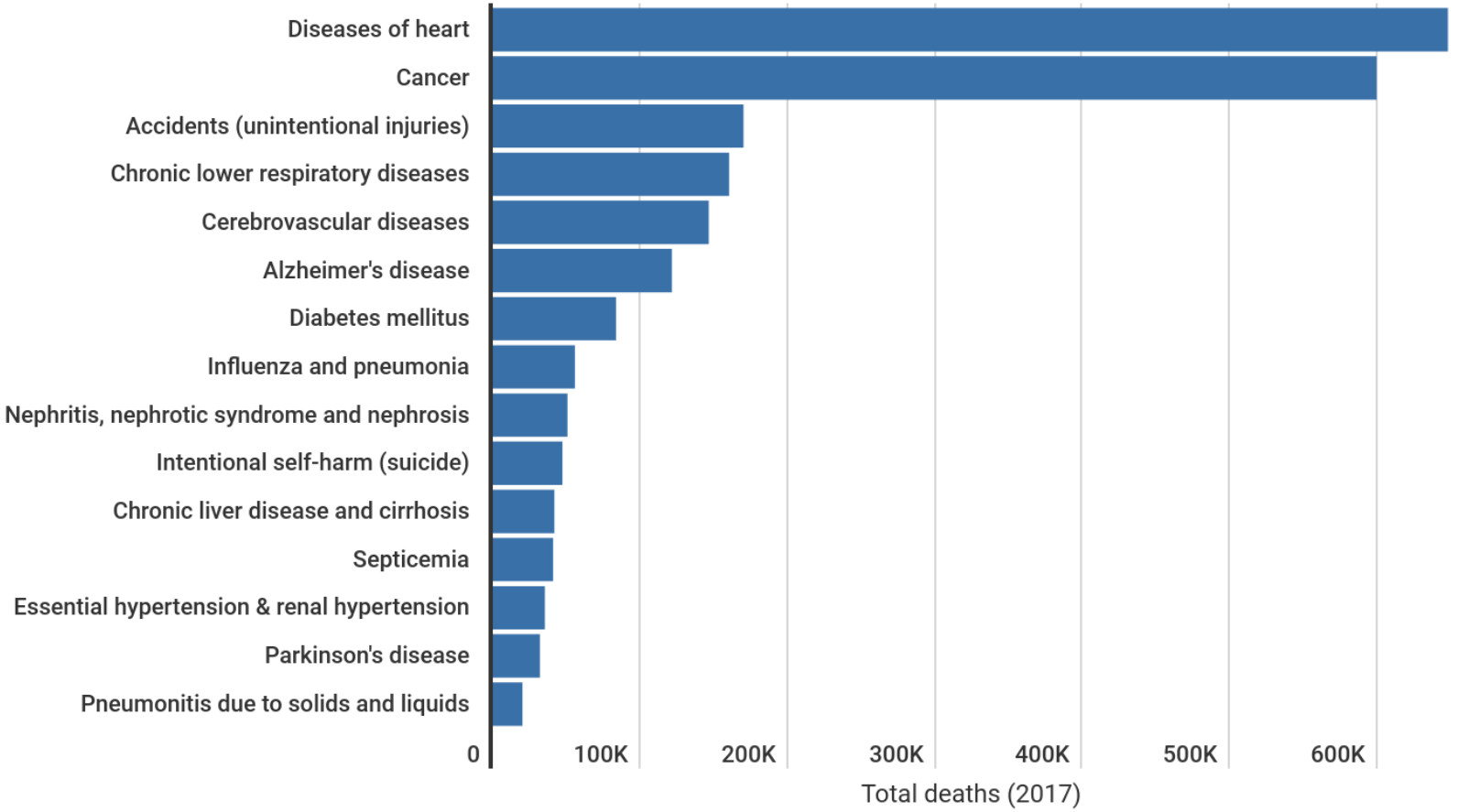


Somewhere between 100,000 to 500,000 individuals per year die or are injured from medical-error related issues in the US, with estimates ranging between $20 billion to $1 trillion in healthcare costs

Top causes of death



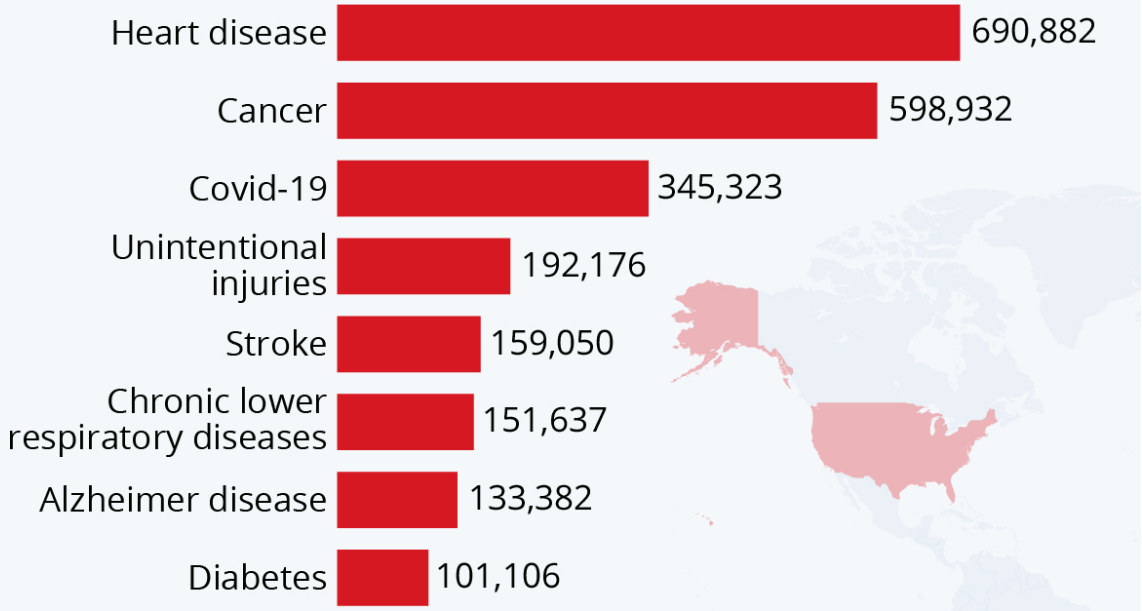
The top 15 leading causes of death in the U.S.



Source: U.S. Centers for Disease Control and Prevention Underlying Cause of Death 2017

Covid-19 Was America's Third Leading Cause Of Death In 2020

Number of deaths for all leading causes of death in the U.S. in 2020

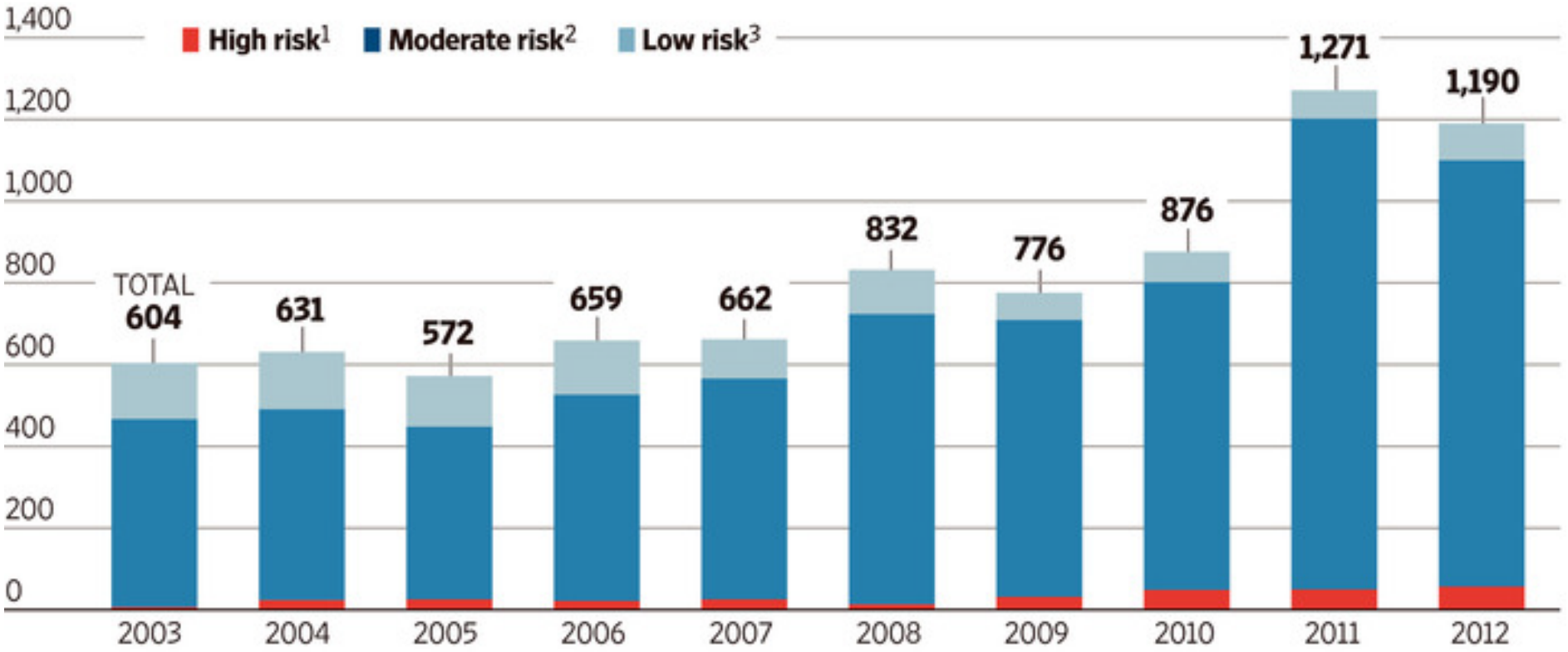


Source: Centers for Disease Control and Prevention

statista

Defective Devices

The number of medical devices recalled from the market nearly doubled in the decade through 2012. Recall counts by fiscal year and potential risk to the public:

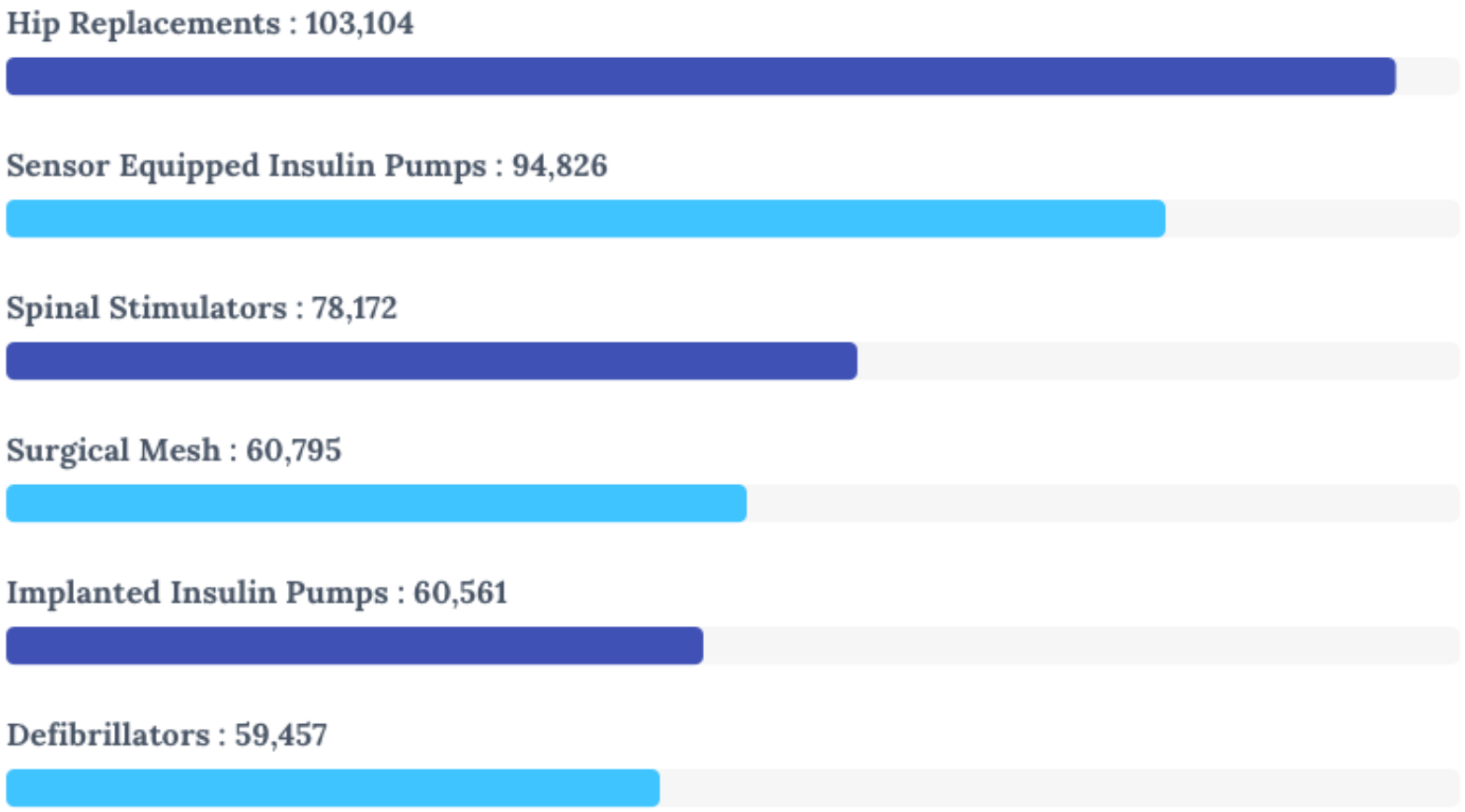


1 Use of or exposure to the device may cause serious health problems or even death 2 Use of or exposure to the device may cause temporary or medically reversible health problems. 3 Device isn't likely to cause adverse health problems, but the product violates government standards

Source: Food and Drug Administration Medical Device Recall Report

THE WALL STREET JOURNAL.

Medical Devices with the Most Injury Reports, 2008 - 2017



“A medical error is defined as the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim” - IOM

Medicine has become incredibly complex yet still grasps an old view of error

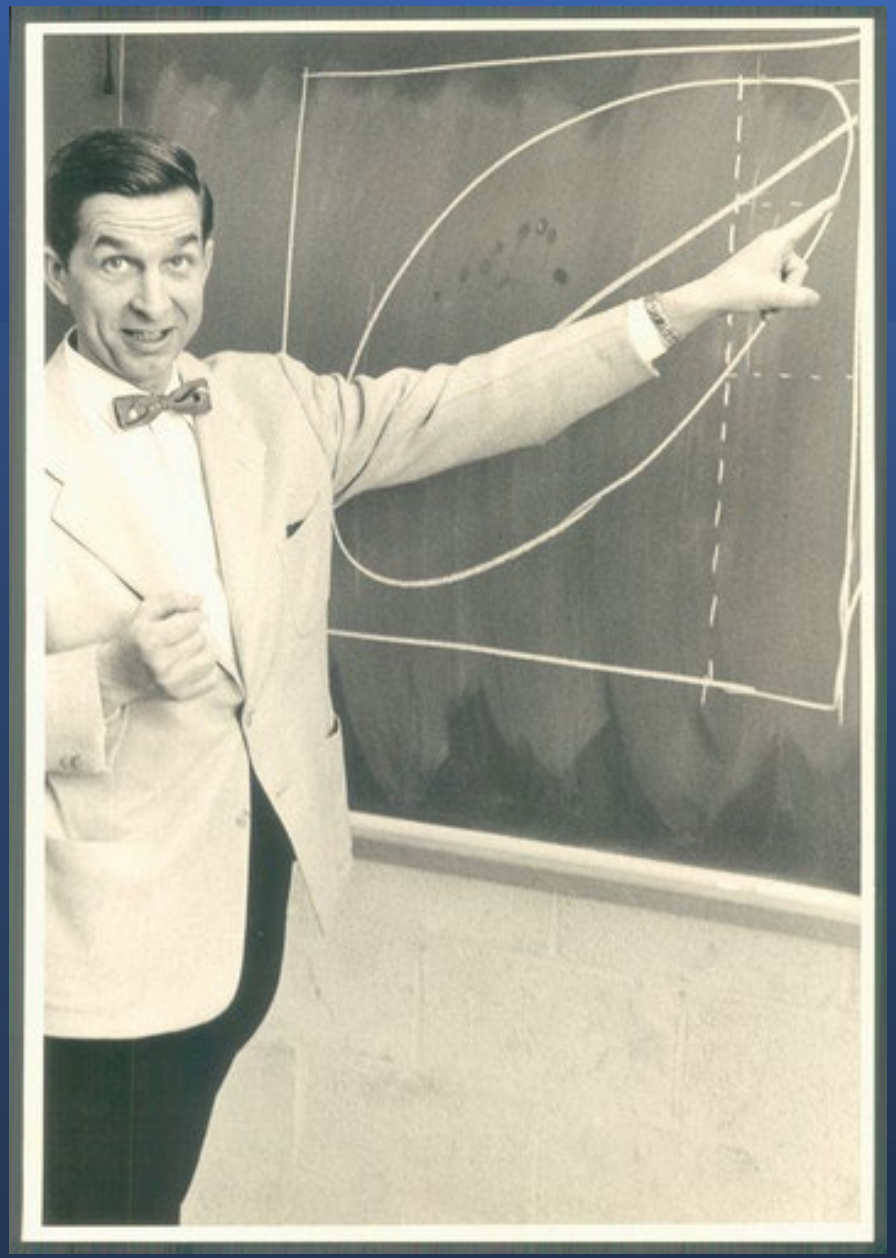
- Old View - systems are inherently safe – humans make mistakes and are unreliable – so when something fails it's the human operator's fault…
  - Medicine holds the provider to infallible standards
  - "Perfect" performance is expected all times

What exactly is HF/E and how does it relate to medicine?

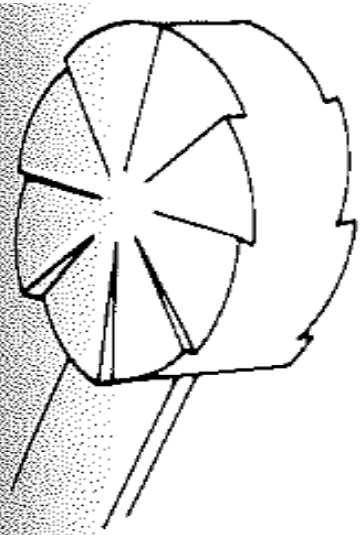
- The scientific discipline concerned with understanding of interactions among humans and other elements of a system.
- The profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.

- **“Healthcare workers who do not understand the basics of human factors are like infection control professionals not knowing about microbiology”**

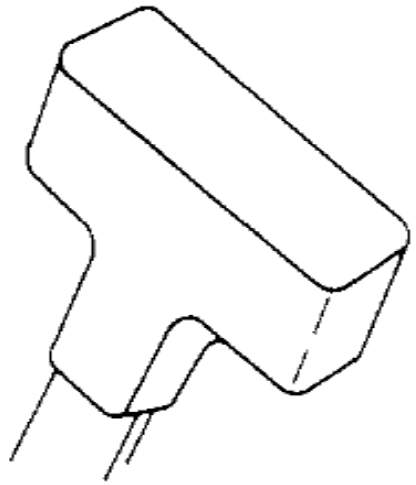
F-BEEA
INSTITUT GEOGRAPHIQUE NATIONAL



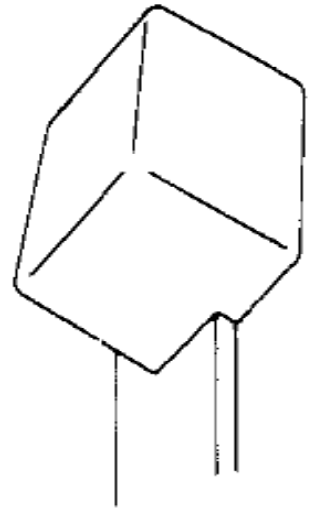
UP
LANDING
GEAR
DOWN
UP
WING
FLAPS
DOWN



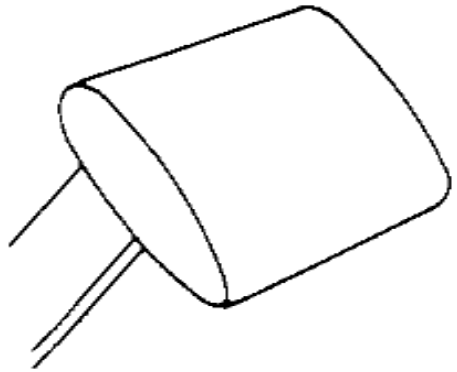
Supercharger



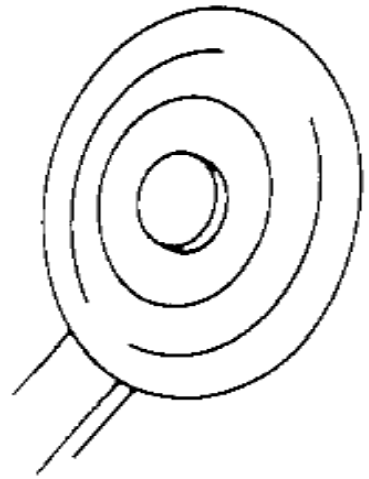
Fire extinguishing



Carburetor air

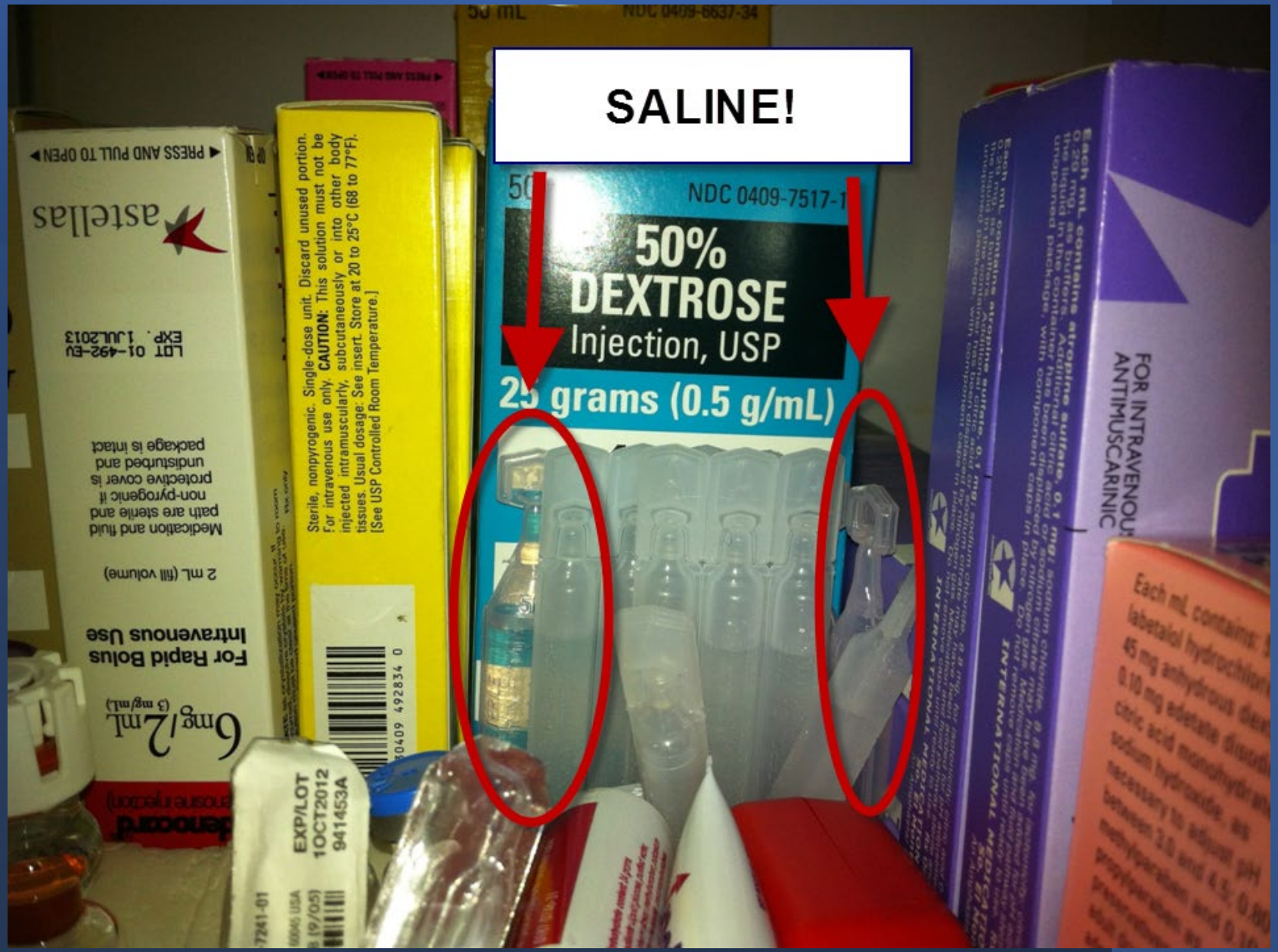


Landing flap

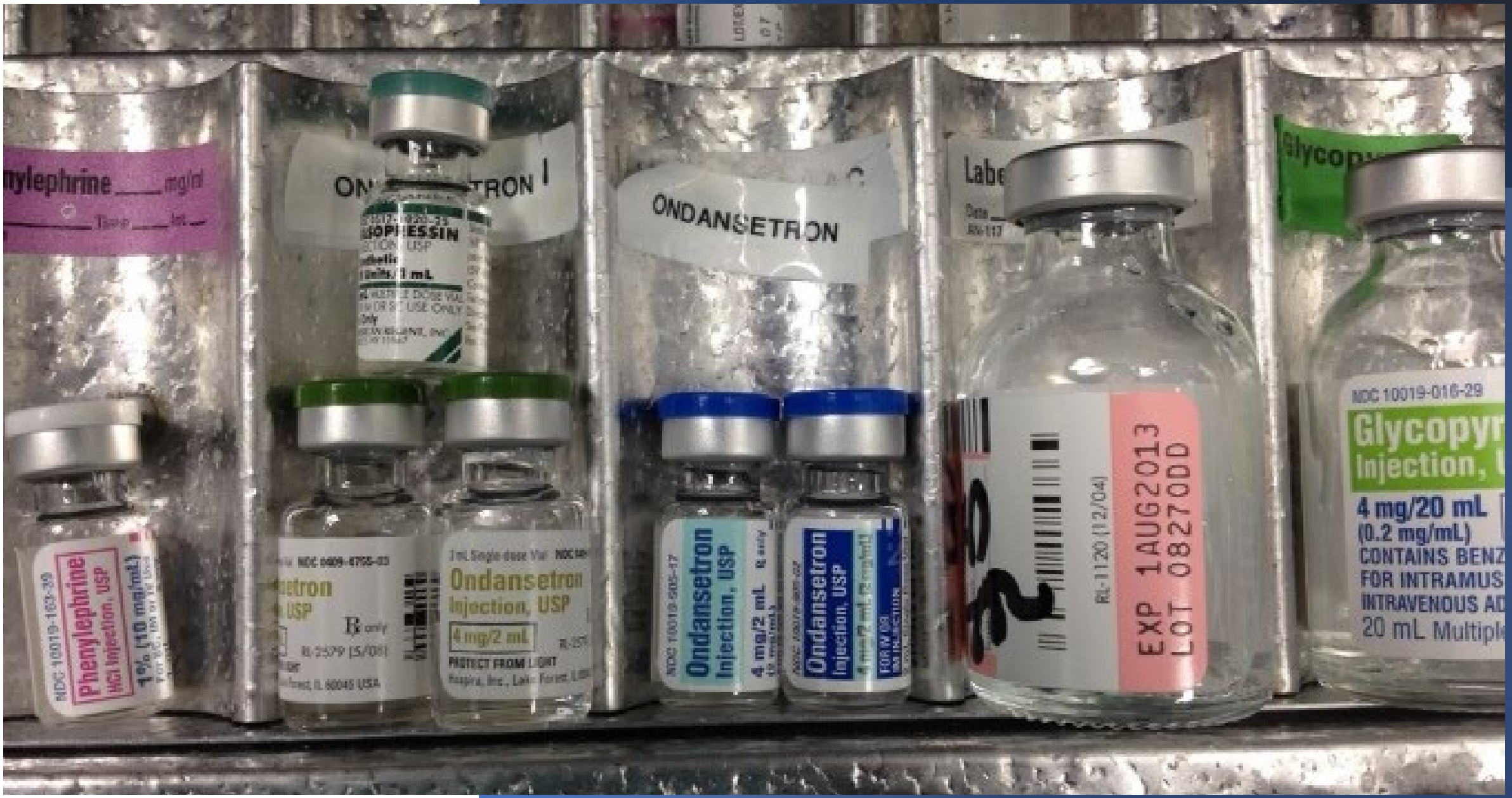


Landing gear

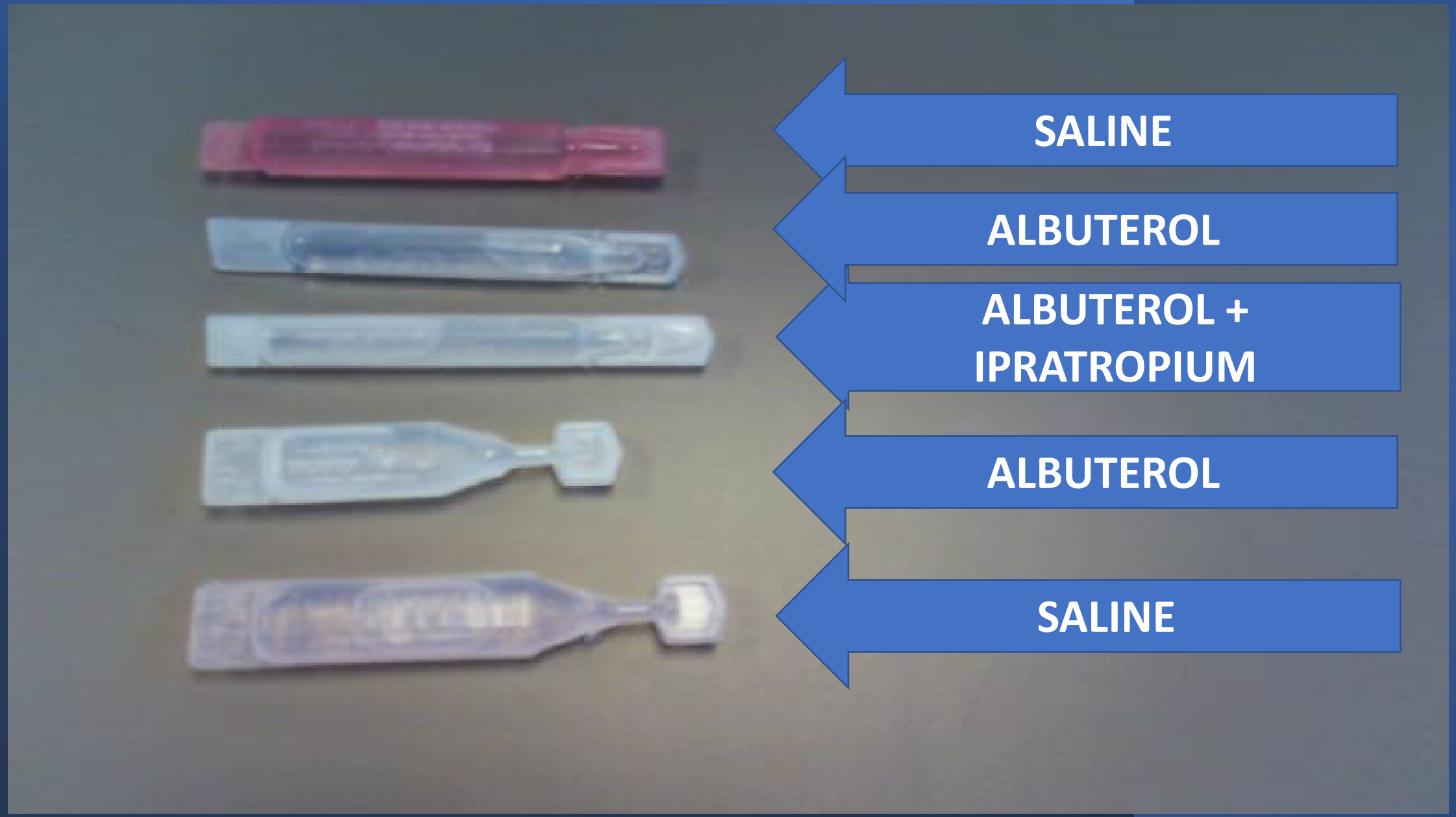
The issues that plagued early aviation…currently plague medicine


SALINE!
NDC 0409-7517-1
50%
DEXTROSE
Injection, USP
25 grams (0.5 g/mL)
astellas
For Rapid Bolus
Intravenous Use
2 mL (fill volume)
Medication and fluid
path are sterile and
non-pyrogenic if
protective cover is
undisturbed and
package is intact
LOT 01-492-EV
EXP. 1JUL2013
PRESS AND PULL TO OPEN
Sterile, nonpyrogenic. Single-dose unit. Discard unused portion.
For intravenous use only. CAUTION: This solution must not be
injected intramuscularly, subcutaneously or into other body
tissues. Usual dosage: See insert. Store at 20 to 25°C (68 to 77°F).
[See USP Controlled Room Temperature.]
EXP/LOT
1OCT2012
941453A
FOR INTRAVENOUS
ANTIMUSCARINIC

SALINE!
NDC 0409-7517-1
50%
DEXTROSE
Injection, USP
25 grams (0.5 g/mL)
MEDICATION


Phenylephrine
HCl Injection, USP
1% (10 mg/mL)
Ondansetron
Injection, USP
4 mg/2 mL
PROTECT FROM LIGHT
ONDANSETRON
Ondansetron
Injection, USP
4 mg/2 mL
Ondansetron
Injection, USP
EXP 1AUG2013
LOT 0827ODD
NDC 10019-016-29
4 mg/20 mL
(0.2 mg/mL)
20 mL Multiple

ONDANSETRON
Ondansetron
Injection, USP
4 mg/2 mL
PROTECT FROM LIGHT
Ondansetron
Injection, USP
4 mg/2 mL
Ondansetron
Injection, USP

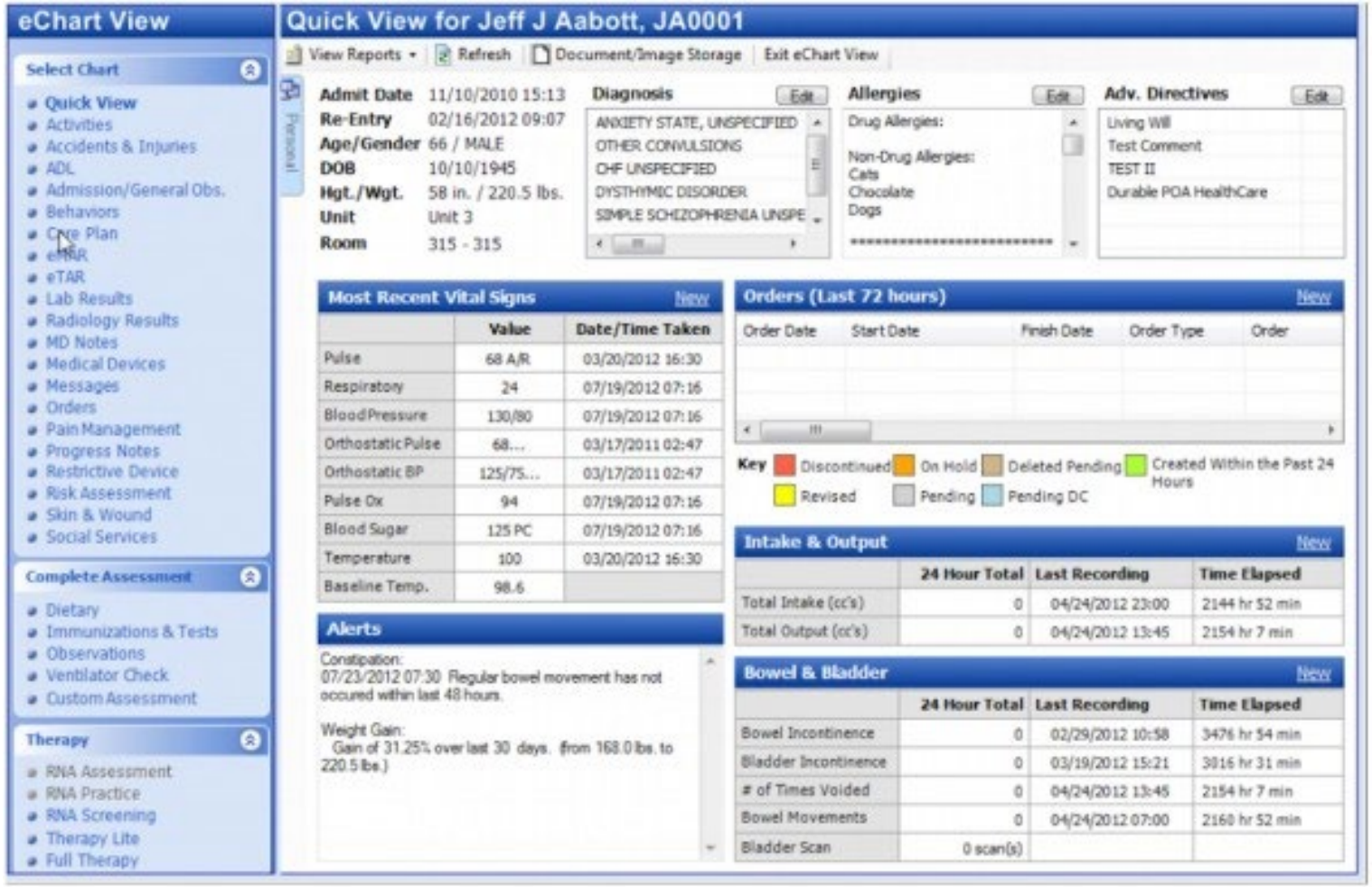

SALINE
ALBUTEROL
ALBUTEROL +
IPRATROPIUM
ALBUTEROL
SALINE

System Power

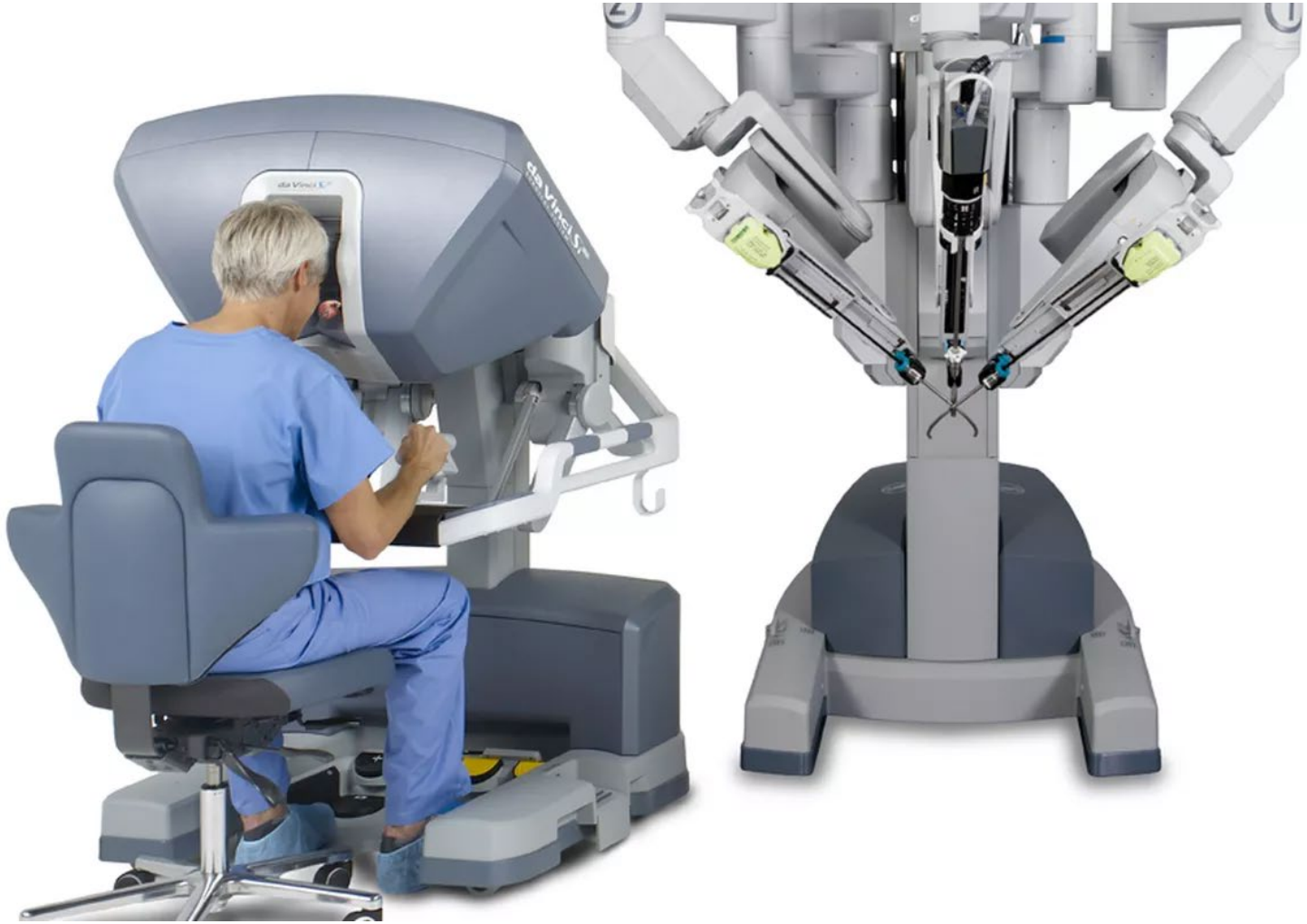
Medicine operates as a complex system

- Complex Patient information
- Complicated Tools
- Heterogeneous Expertise
- Teams and Multi-Team Systems
- Various units/diffuse specialties

Complex Patient Information

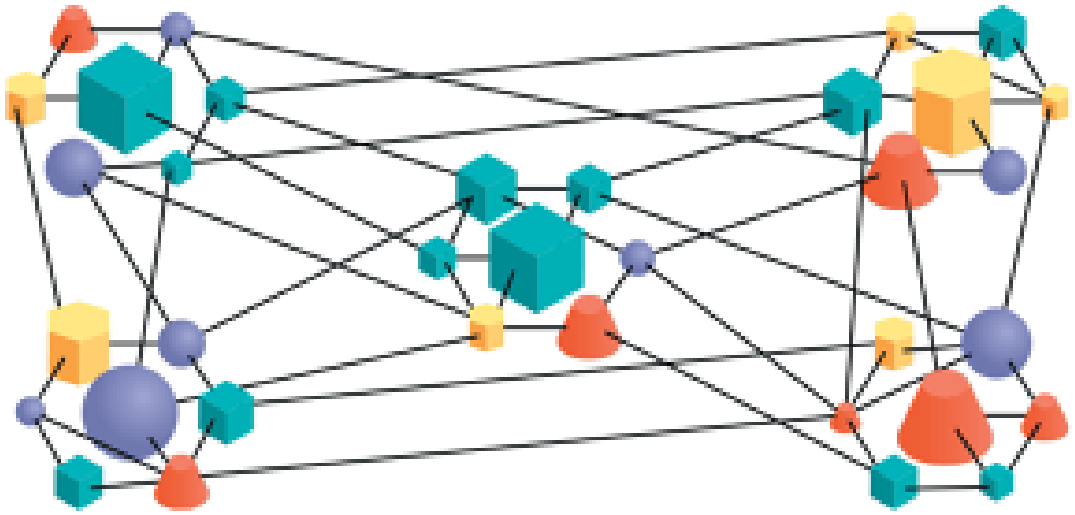


Complicated Tools

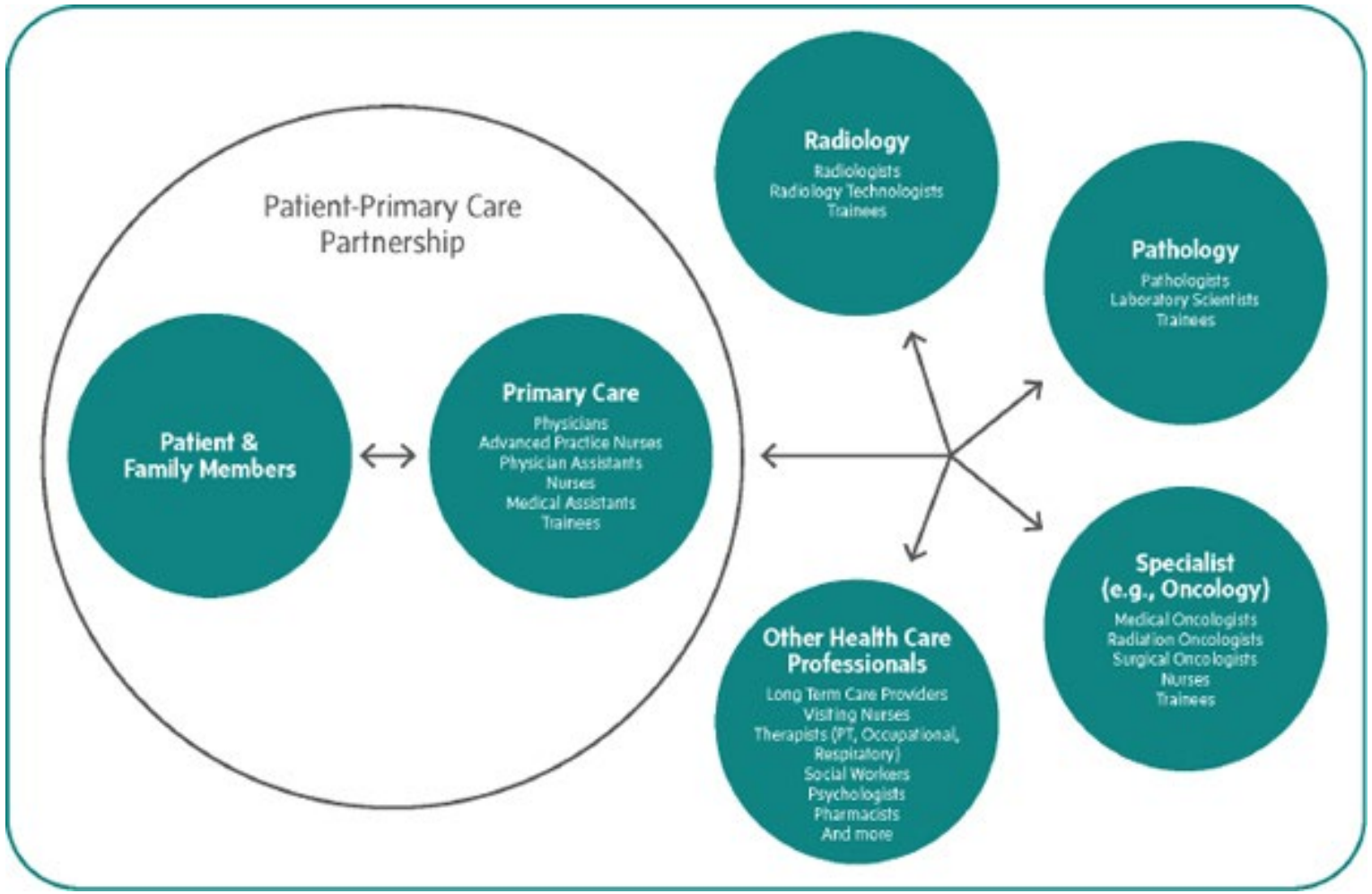


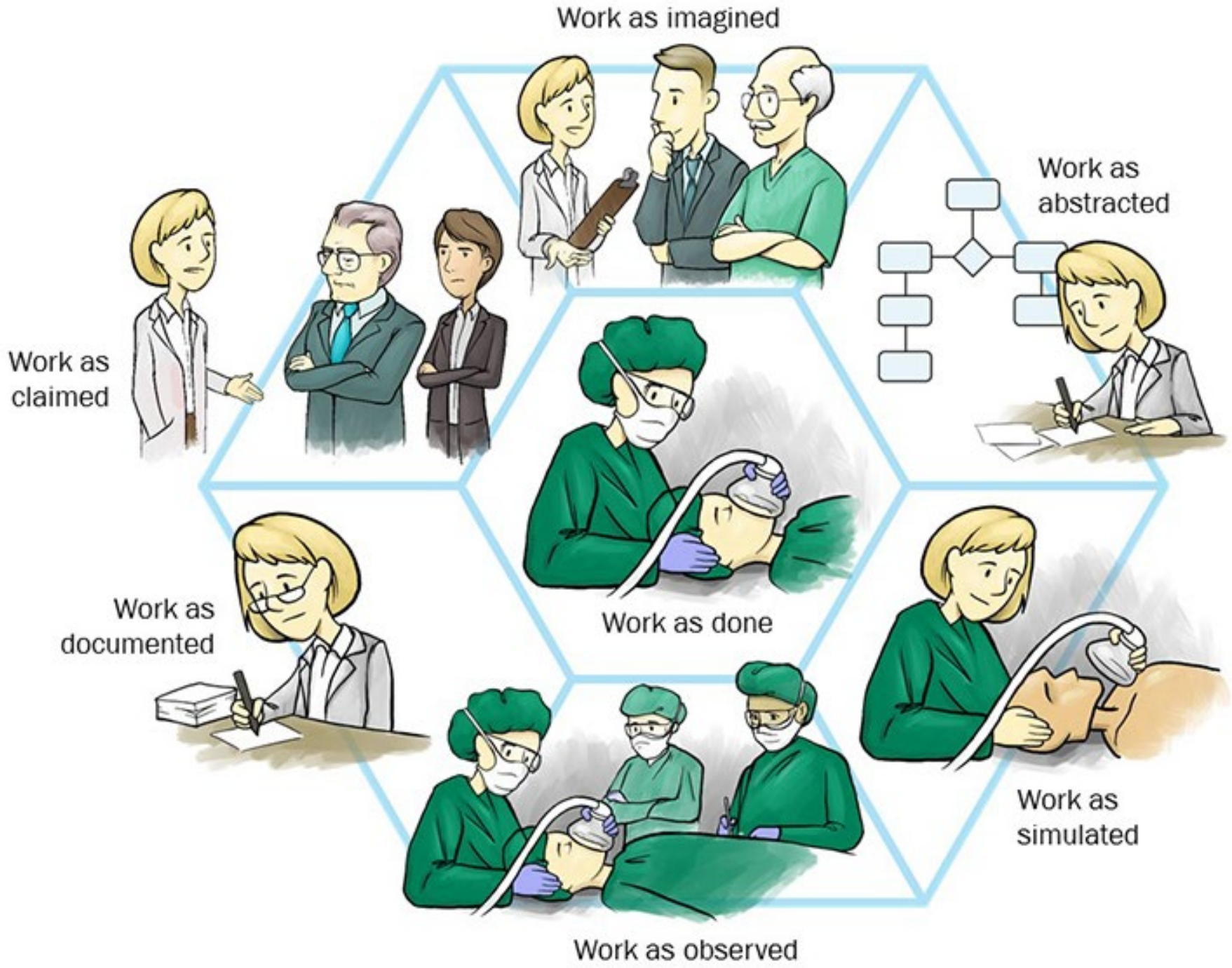
Heterogeneous Expertise

Complex Teams and Multi-Team Systems

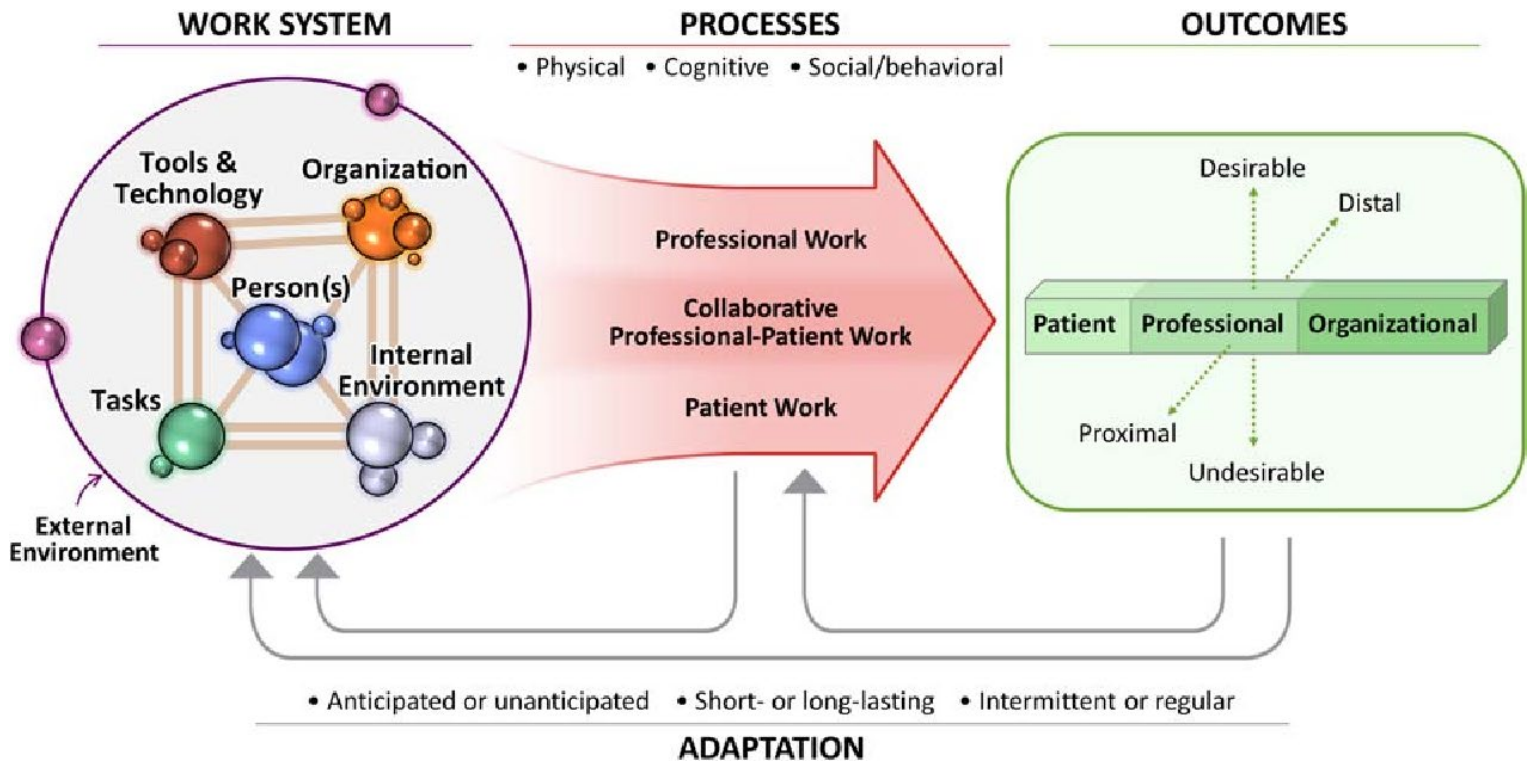


Disparate Specialties

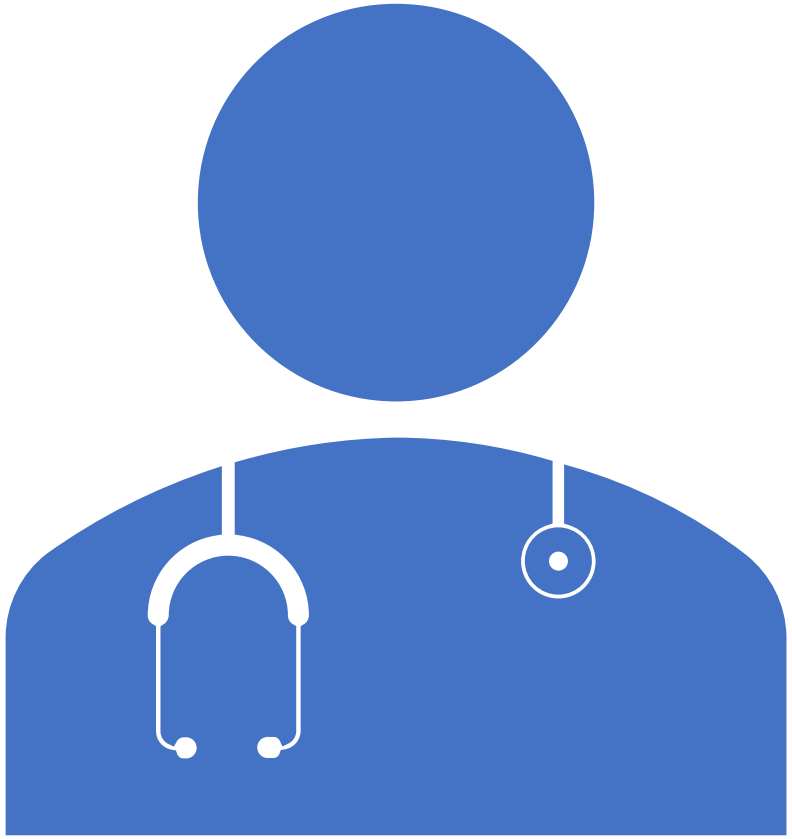



Work as imagined
Work as abstracted
Work as claimed
Work as done
Work as documented
Work as simulated
Work as observed

Sociotechnical Model

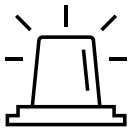


Using Escape Rooms to Improve Medical Teamwork



Escape Rooms

Can escape rooms be used as a practical way to train teamwork in modern healthcare organizations?



Team training is resource intensive – can we train and team build in a fun and engaging way utilizing escape rooms?

Training and preparing teams in today's healthcare organizations is resource intensive

Escape rooms can provide a fun and interactive way to engage teams while also providing team building and training to the medical workforce

Recent Publications:

Cohen, T. N., Griggs, A. C., Kanji, F. F., Cohen, K. A., Lazzara, E. H., Keebler, J. R., & Gewertz, B. L. (2021). Advancing team cohesion: Using an escape room as a novel approach. Journal of Patient Safety and Risk Management, 26(3), 126-134.

Cohen, T. N., Griggs, A. C., Keebler, J. R., Lazzara, E. H., Doherty, S. M., Kanji, F. F., & Gewertz, B. L. (2020). Using escape rooms for conducting team research: understanding development, considerations, and challenges. *Simulation & Gaming*, *51*(4), 443-460.

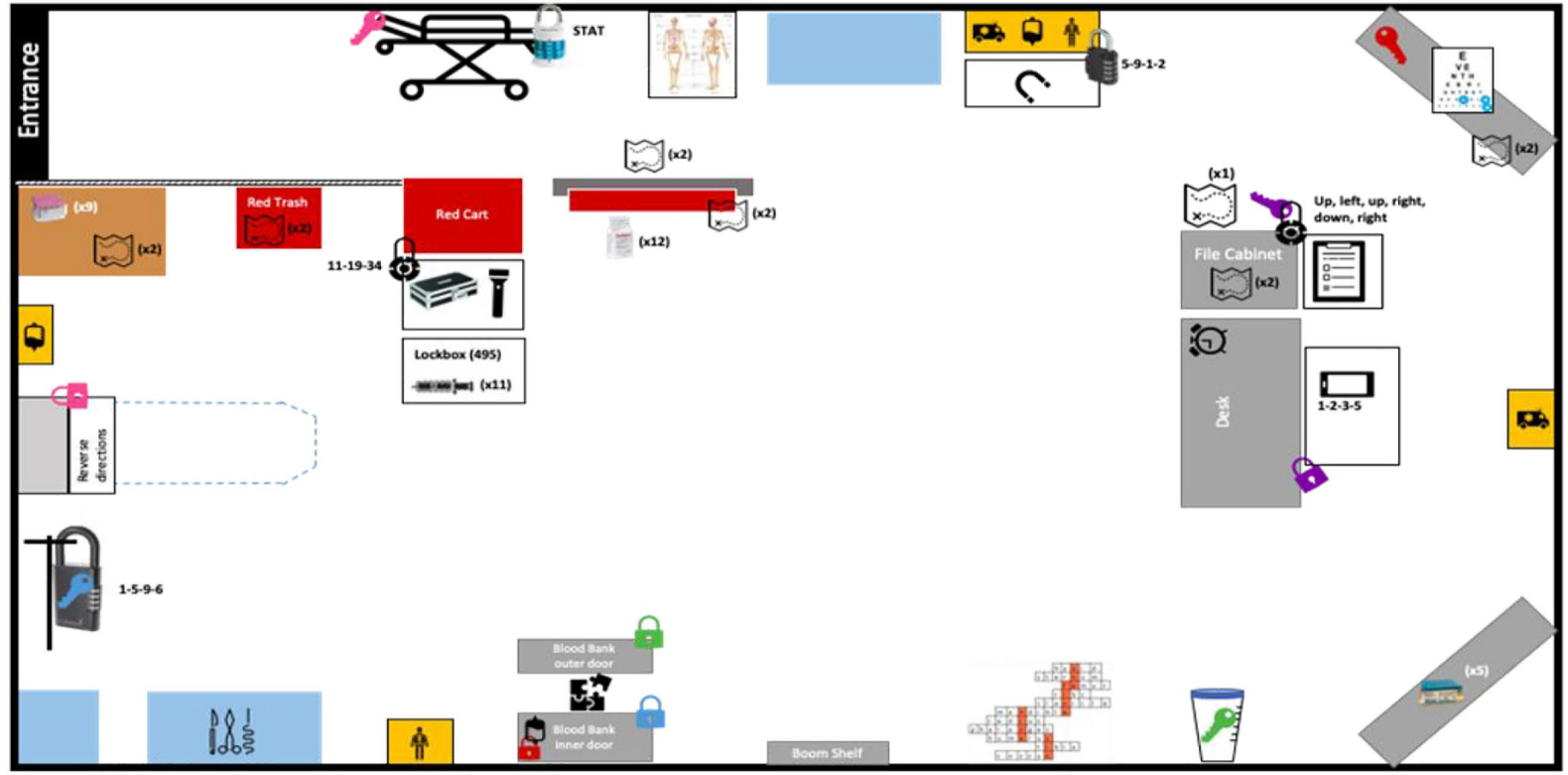
Griggs, A. C., Lazzara, E. H., Doherty, S. M., Keebler, J. R., Gewertz, B. L., & Cohen, T. N. (2022). Unlocking the Methodology of Escape Rooms: Considerations for Conducting Applied Escape Rooms in Research. *Simulation & Gaming*, 10468781221123595.

Creation of an escape room at Cedars Sinai Medical Center

Creating an escape room for healthcare teams

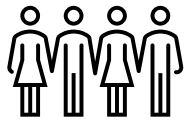
Cedars Sinai

[enObse]



1. Put blood back in inner door of blood bank and lock with laser lock
2. Put remote control for blood bag lock back in the glove container
3. Lock inner door of blood bank and put in the large lock on the iv pole (and lock IV pole lock)
4. Put puzzle pieces back inside the outer door of the blood bank and use yellow tagged key to lock
5. Put key back in the blood canister
6. Put magnet back in the locked yellow bag and lock the bag
7. Make sure remaining yellow bags are locked and colored test tubes are stacked back where they belong
8. Use the key on the gurney to lock the cream-colored lock box that has the directions in it.
9. Move the gurney back to the side of the wall and use the STAT lock to secure it. Scramble the lock
10. Hang the mirror next to the cream lock box
11. Clean off crossword puzzle
12. Put 11 test tubes back into the lockbox in red drawer and lock
13. Put blacklight into red drawer and lock with the chain and purple combo lock
14. Take instruments and put back in their container
15. Take phone and clean off all photos, shut all windows, and close any internet browsers. Make sure it is on the private network and it is locked. Put it back in the drawer FACE DOWN and lock the drawer
16. Put the key from the desk on the directional lock and lock it to the cabinet
17. Put the patient chart in the folder and put in the second drawer of the cabinet
18. Clean off the map pieces and place them in their marked locations around the room

ROLE OF HUMAN FACTORS AND ERGONOMICS

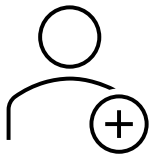


Measurement, experimental design, analysis

The ERAU team worked closely with the Cedars team to conduct this research. This included:

1. Development of the escape room
2. Development and design of the experiment
3. Deciding on which constructs to measure
4. Creating behavioral observation rating forms
5. Coding video footage of escape room participants
6. Coding and analyzing data
7. Submitting research to relevant journal outlets

MEASURING CONTRIBUTIONS AND OUTCOMES



Contributions & Outcomes

1. Improved teamwork, such as perceived group cohesion, across a variety of medical teams

2. Created guidance on how to build an escape room focused on team training and team building

3. Began one of the first programs of research examining escape rooms as team training in an applied healthcare setting with actual healthcare provider teams

Thank you!