Institute *for* Healthcare Improvement

These presenters have nothing to disclose

The Robot Will See You Now

Amelia Brooks
Frank Federico

Institute *for* Healthcare Improvement

World Patient Safety Day

17 September 2019

The Institute for Healthcare Improvement (IHI) is joining the World Health Organization (WHO) and other leading organizations around the world to recognize **World Patient Safety Day,** 17 September 2019.

Declaring patient safety to be a global health priority, WHO will use the day to initiate a campaign of building awareness and commitment to improve the safety of health care worldwide.

For this inaugural year, WHO is urging all stakeholders to "Speak Up for Patient Safety." In the spirit of supporting that goal, IHI is pleased to share the following resources.

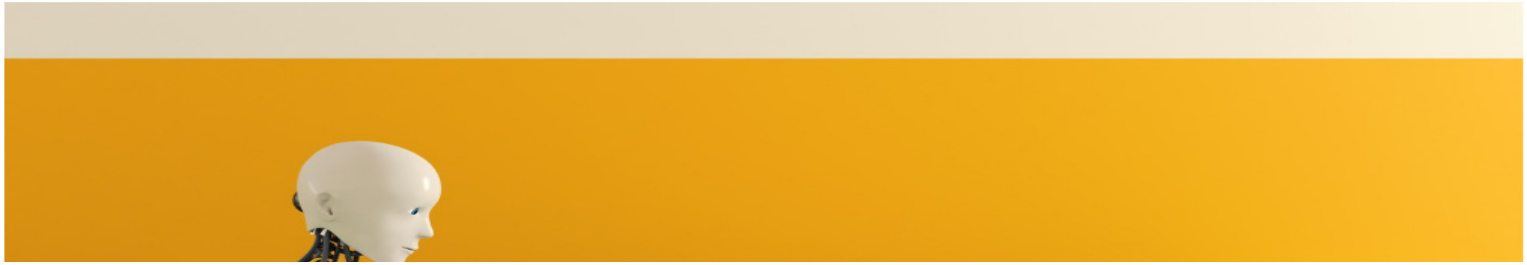
Objectives

- Discuss the role of human factors in the design and use of technology in healthcare.
- Describe the process of testing technology to accommodate the human condition.
- Develop a plan for your organization to improve the safety of technology in use

DAILY SHOUTS

PLEASE CONFIRM YOU ARE NOT A ROBOT

By Mia Mercado August 5, 2017



- Technology is often sought out as a way to reduce errors, improve the diagnostic process and provide ongoing monitoring of our patients in new and innovative ways. However, we have learned that there is danger in magical thinking with the use of technology, “If we only had…. all our problems would be solved.” Often, when we implement new technology, we trade one set of problems for another and fail to identify and mitigate those problems in the design and implementation of a new approach. Technology can offer solutions, but only when designed with the user in mind. In this session, participants will learn how to use a human factors approach to the design and implementation of technology. We’ll share lessons learned with examples from around the world and participants will develop a plan to assess existing and future technology to ensure that it has been designed to support how work is done, and to design interventions to deal with existing poor design

Technology in Healthcare

- Maximize potential benefits
  - Improved communication
  - Improved documentation
  - Provide information to assist in decision making
- Minimize potential errors, existing and new
  - Workarounds
  - Loss of clinical decision making

Reflection

List all of the technology/devices that are in place in your area of work (e.g. Hospital, clinic, office, patient home…)

Typical Technologies Employed

- Computerized prescriber order entry
- Electronic medication administration records
- SMART Pumps
- Robotic dispensing
- Ventilators
- Defibrillators

- Anesthesia machine
- Bar code technology
- Radio Frequency Devices
- Automated dispensing machines
- Diagnostic equipment
- And…..

Global Problems with Technology

- “Magical thinking” – It starts something like this: Let’s have technology do that.
- What does this type of thinking miss?
- Can you think of examples of magical thinking?

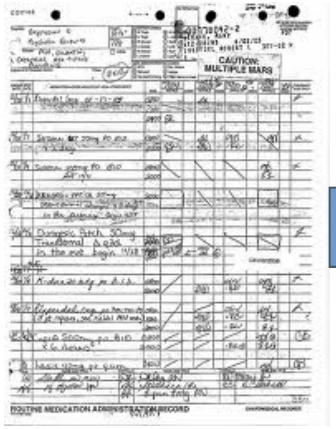
Computers in Everyday Life

Computers in Everyday Life

Ideas from Entertainment

Increasing Use of Technology

Increasing Use of Technology



Increasing Use of Technology

ECRI Top Technology Concerns

- Alarm fatigue
- Exposure Dangers From Radiation Therapy and CT
- Medication Administration Errors When Using Infusion Pumps
- Cross-contamination From Flexible Endoscopes
- Failing to Pay Sufficient Attention to New Device Connectivity
- Feeding Tube Misconnections
- Surgical Fires
- Needlesticks and Other Sharps Injuries
- Anesthesia Dangers From Mistakes in Pre-use Inspection
- Problems With Home Use Medical Devices
- Defibrillator Failure
- Luer (Tubing and Catheter) Misconnections

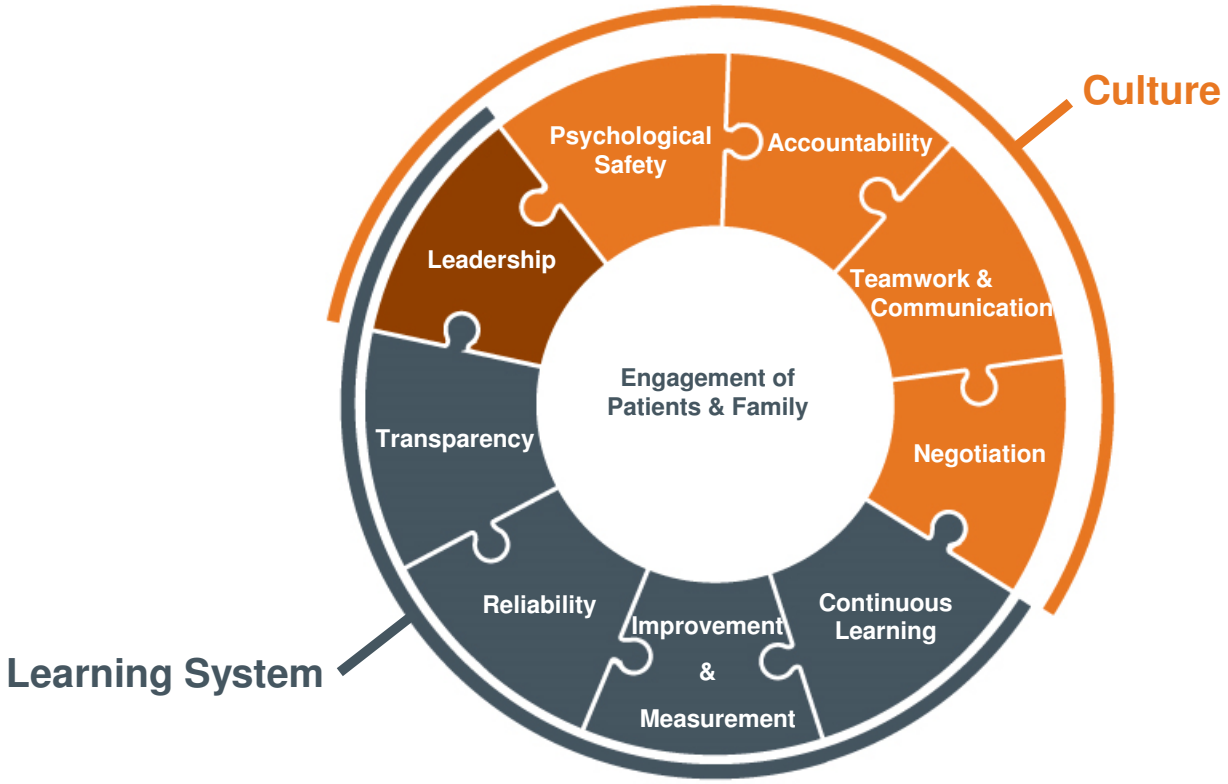
Exercise: In Search of Lost Cord

- Select a facilitator
- Select a scribe
- Read the case
- Discuss what contributed to the event
- Report out: one or two contributing factors

Examples of technology failures

- Errors with electronic health records
  - User errors
    - Wrong patient selection
    - Wrong test/medication selection
    - Ignoring alerts
  - Interface errors
    - Information not shared across systems
    - Information corrupted
  - Care Processes altered
    - Made more complex
  - Over-reliance on clinical decision support

Framework for Safe, Reliable, and Effective Care

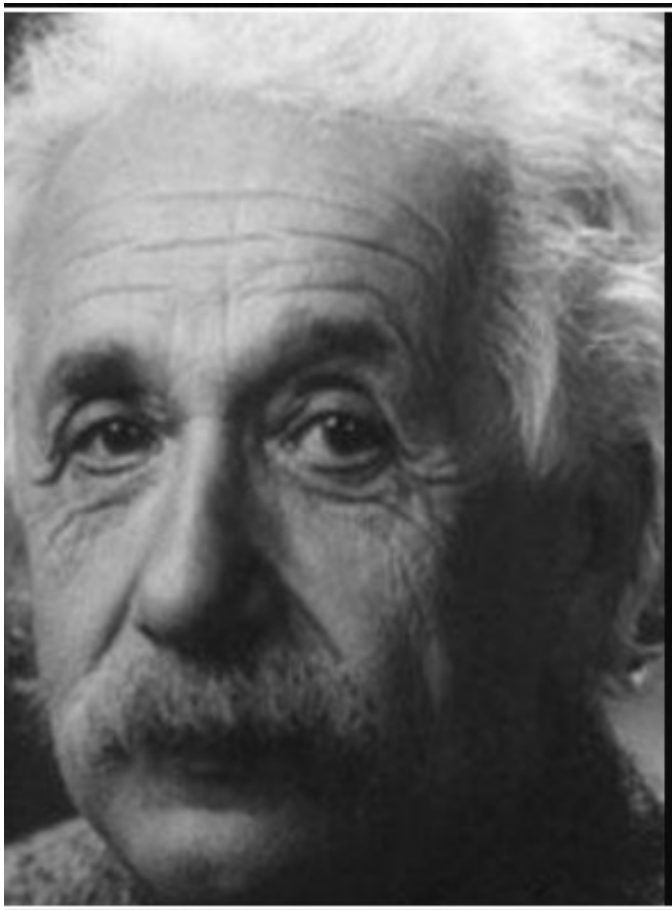


Source: Frankel A, Haraden C, Federico F, Lenoci-Edwards J. A Framework for Safe, Reliable, and Effective Care. White Paper. Cambridge, MA: Institute for Healthcare Improvement and Safe & Reliable Healthcare; 2017. (Available at ihi.org)

Surfacing errors to understand design flaws

- Culture of safety
  - Psychological safety
  - Transparency
  - Fair and just culture

- Learning system
  - Reporting and analysis of defect
  - Learning from other users
  - Designing technology to support the work and not drive the work



If I had an hour to solve a problem I'd spend 55 minutes thinking about the problem and 5 minutes thinking about solutions.

— Albert Einstein —

AZ QUOTES

Human Error

'We can't change the human condition, but we can change the conditions under which humans work'

James Reason

Some common ‘solutions’

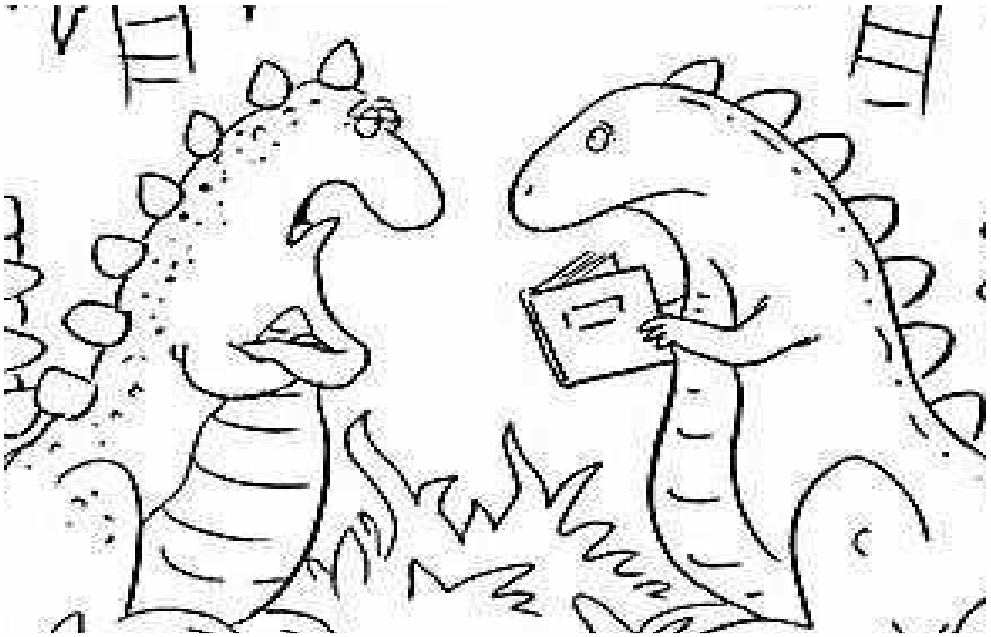
- Update policy/procedure/guideline
  - Email to all
  - Sign to say I’ve read it
  - Promise compliance

Some common ‘solutions’

- Raise awareness
  - Campaigns
  - Posters
  - Newsletters
  - Briefings

Some common ‘solutions’

- Training & Education
- ***Necessary, but not sufficient***



‘Forget it, no matter how hard you study you’ll never become a thesaurus’

Buy more technology

Violation Producing Conditions

- Perceived low likelihood of detection
- Inconvenience
- Misperception or lack of recognition of risk
- Authority / status to violate (self-perceived)
- Copying behavior
- No disapproving authority figure present
- Group pressure

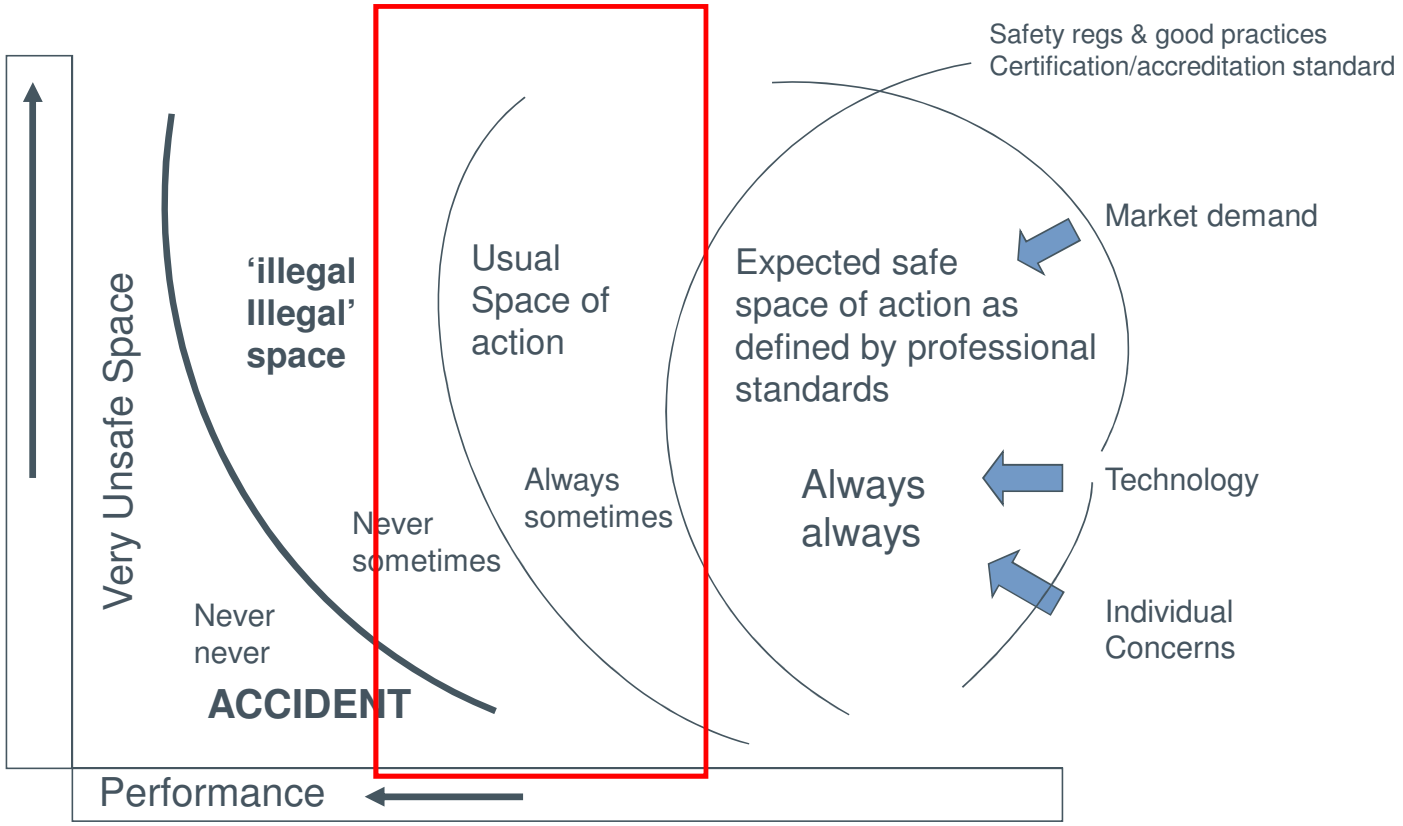
{Primary Source Human Error Assessment & Reduction Technique, Jeremy Williams

Workarounds

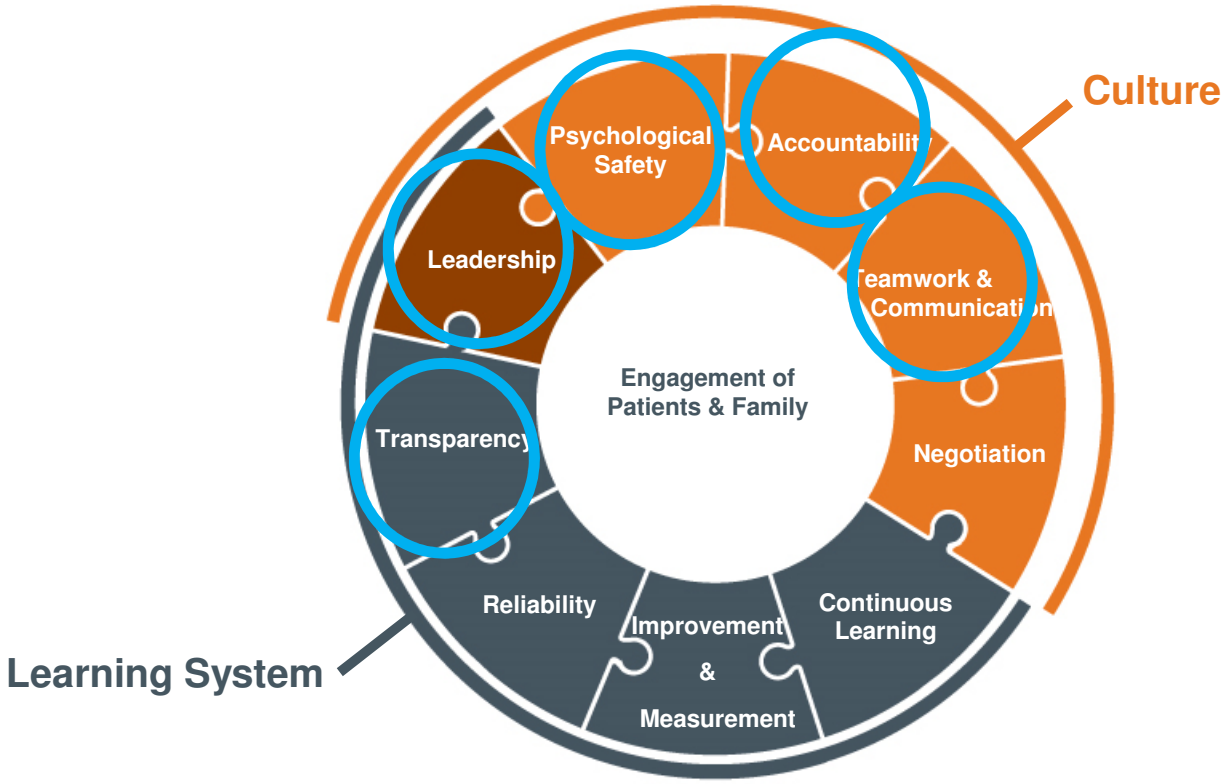
Workarounds enable, yet potentially compromise, the execution of patient care. In some contexts such improvisations may be deemed necessary to the successful implementation of quality care, in others they are counterproductive. Workarounds have individual and cooperative characteristics. Few studies examine nurses' individual and collective conceptualisation and rationalisation of workarounds or measure their impact. The importance of displaying competency (image management), collegiality and organisational and cultural norms play a role in nurses' use of workarounds.

DeBono et al, **Nurses' workarounds in acute healthcare settings: a scoping review. https://bmchealthservres.biomedcentral.com/articles/10.1186/1472-6963-13-175 Accessed August 21, 2019**

Tolerated Violations



What will it take to surface workarounds?

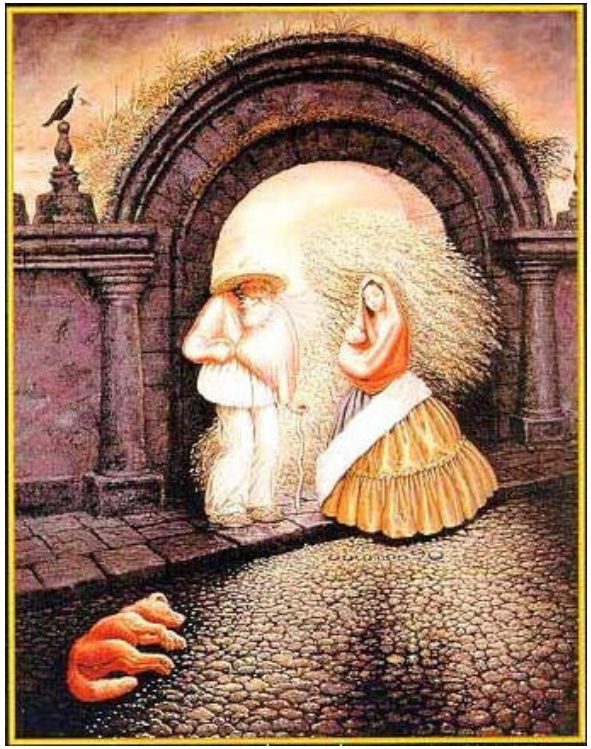


Source: Frankel A, Haraden C, Federico F, Lenoci-Edwards J. A Framework for Safe, Reliable, and Effective Care. White Paper. Cambridge, MA: Institute for Healthcare Improvement and Safe & Reliable Healthcare; 2017. (Available at ihi.org)

Drivers of Human Error

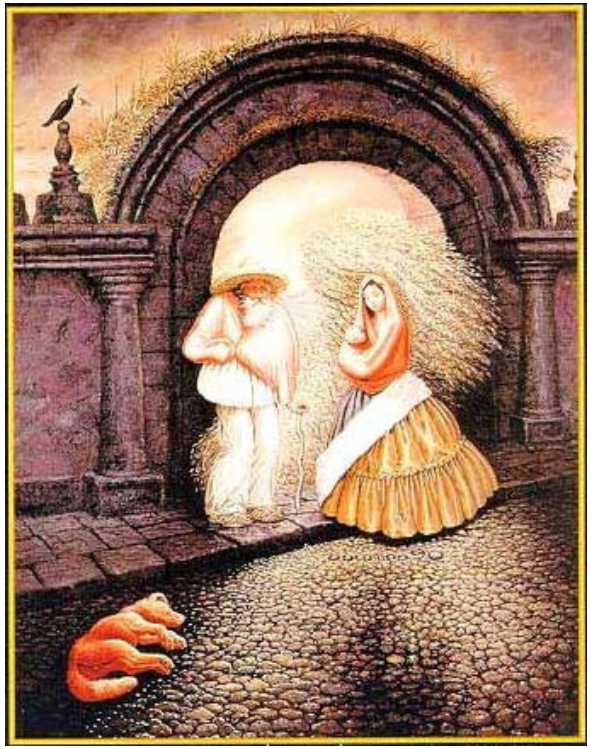
- Fatigue
- Boredom
- Frustration
- Shift work
- Injury or illness
- Fear
- Stress
- Devices designed in an accident prone fashion
- Noise, heat, clutter, lighting
- Unnatural workflow
- Reliance on memory
- Reliance on training
- Reliance on vigilance
- Assuming communication competence
- Assuming teamwork competence
- Interruptions/distractions
- Processes designed in an accident prone fashion (e.g. overly complex, too many steps)

But…We See What We Are Primed to See



What Else Did You See?

- An old man with a hat?
- A lady holding a child?
- A dog in the road?



Attention & Distraction: Priming

Shout out the color you see

ORANGE

ORANGE

BLUE

YELLOW

RED

YELLOW

PURPLE

RED

BLUE

PURPLE

GREEN

GREEN

BLUE

Package similarity between dopram and labetalol vials.

Examples of technology failures

- Errors with electronic health records
  - User errors
    - Wrong patient selection
    - Wrong test/medication selection
    - Ignoring alerts

Alarms on BP's Deepwater Horizon Disabled to "Help Workers Sleep"

Vital warning systems on the Deepwater Horizon oil rig were switched off at the time of the explosion in order to spare workers being woken by false alarms, a federal investigation has heard.

“Hospitals don’t turn up the volume, lower the noise.”

Noise in health care facilities has increased by multiples in past decades, and it has a negative effect on health in several ways, not only through missed alarms.

These include increased stress

and disrupted sleep for patients,

lost privacy, communication errors,

and clinician burn-out.

SoundEar

http://www.boston.com/bostonglobe/editorial_opinion/letters/articles/2010/02/28/hospitals_dont_turn_up_the_volume_lower_the_noise/

CPOE and Warnings

Study indicates most physicians ignore warnings issued by electronic drug-prescribing systems

- Researchers at Dana-Farber Cancer Institute and Beth Israel Deaconess Medical Center found that "out of almost a quarter-million medication safety alerts produced during the study period, the doctors involved accepted only 9.2 percent of the interaction warnings and 23 percent of the allergy warnings. In other words, they ignored more than 90 percent of the drug interaction alerts and more than 75 percent of the allergy alerts.“

Isaac, T et al, Overrides of Medication Alerts in Ambulatory Care
Arch Intern Med. 2009;169(3):305-311

Clinical Decision Support (CDS)

Monitors and alerts clinicians of patient conditions, prescriptions, and treatment to provide evidence based clinical suggestions to health professionals at the point of care.

Potential Benefits

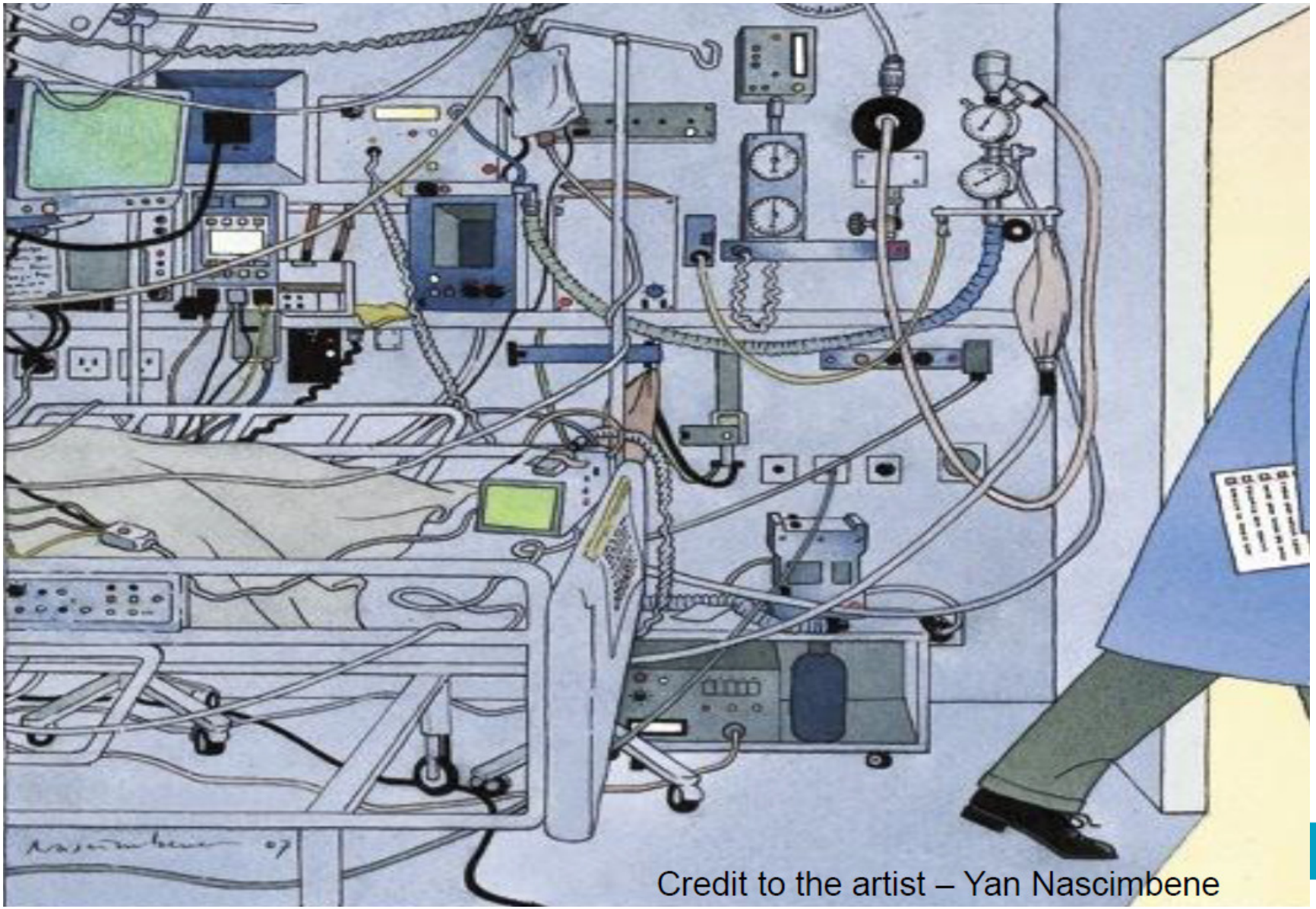
- Reductions in
  - relative risk of medication errors
  - risk of toxic drug levels
  - time to therapeutic stabilization
  - management errors of resuscitating patients in adult trauma centers
  - prescriptions of nonpreferred medications
- Can effectively monitor and alert clinicians of adverse conditions
- Improve long-term treatment and increase the likelihood of achieving treatment goals

Safety Concerns

- Rate of detecting drug–drug interactions varies widely among different vendors
- Increases in mortality rate
- High override rate of computer generated alerts (alert fatigue)

Common Interventions to Decrease Alarm Fatigue

- Select only the most serious alerts needed
- Change parameters on equipment so that it is not as sensitive
- Change the sounds of the alerts
- Decrease number of alerts on order/prescription entry


Credit to the artist – Yan Nascimbene

Tubing Misconnection

- Inadvertent connection of tubing from the medical device for one delivery system to a system that serves a completely different function
  - Formula delivered via IV instead of feeding tube
  - IV fluids connected to breathing circuit
  - Blood pressure tubing connected to IV line
- Also known as
  - Luer misconnections
  - Small bore misconnections
  - Wrong route error

Strategies

- Prevention requires making wrong connections impossible
  - Changing design, shape, or size of the tubing connections
- Recommended solution
  - Creation of incompatible connectors
  - Connectors must be unique to product groups, but compatible across suppliers
- New standards for small bore connectors
- Retain Luer connectors for hypodermic and IV applications
- Develop unique connectors for each clinical delivery system

ISO Tubing Connections

- **ISO 80369-1:2018**
- **Small-bore connectors for liquids and gases in healthcare applications**

https://www.iso.org/standard/64419.html

Discrepancies Between Medication Orders and Infusion Pump Programming

- Pump programming may be the source of the discrepancy and could be related to
  - a lack of recognition of active orders
  - failure to execute programming, and
  - incorrect programming.

Situational Awareness

About how we take in information and make decisions, seeing the whole picture, and not just a part of it

Two Competing Systems of Thought

System 1

- Automatic
- Intuitive
- Involuntary
- Effortless
- Ex. Driving “How did I get here?”
- Less energy

Constant Conflict

System 2

- Deliberating
- Problem solving
- Reasoning
- Concentrating
- Ex. Solving a complex math problem
- More energy

Source: Kahneman, D. (2011). Thinking, fast and slow. New York: Farrar, Straus and Giroux.

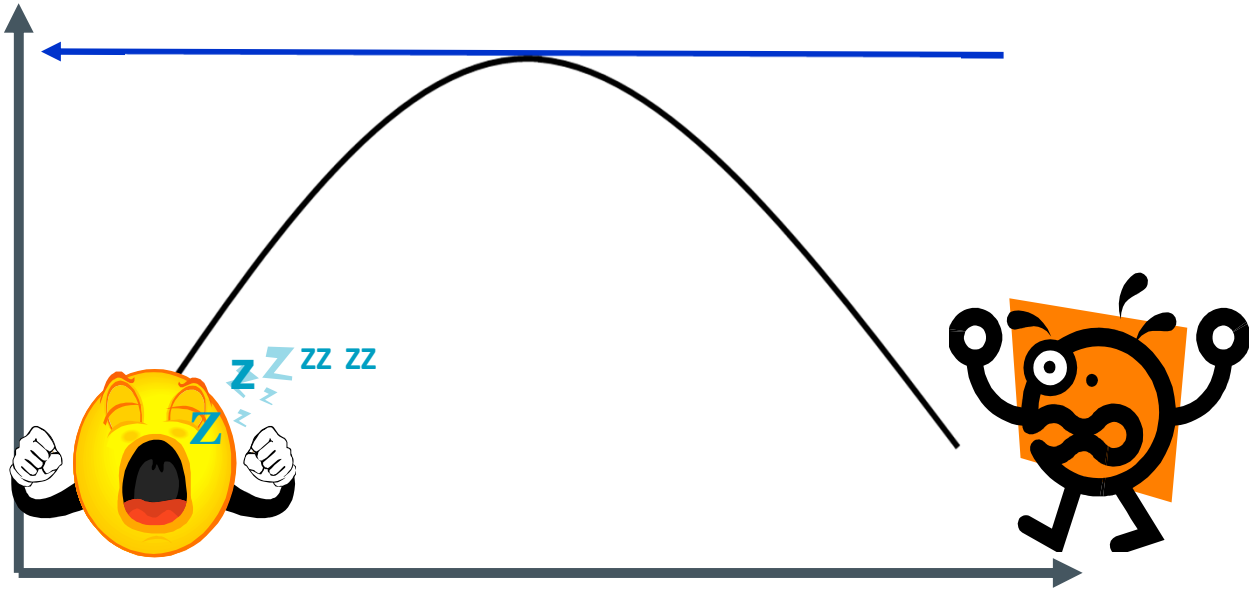
Loss of Situational Awareness

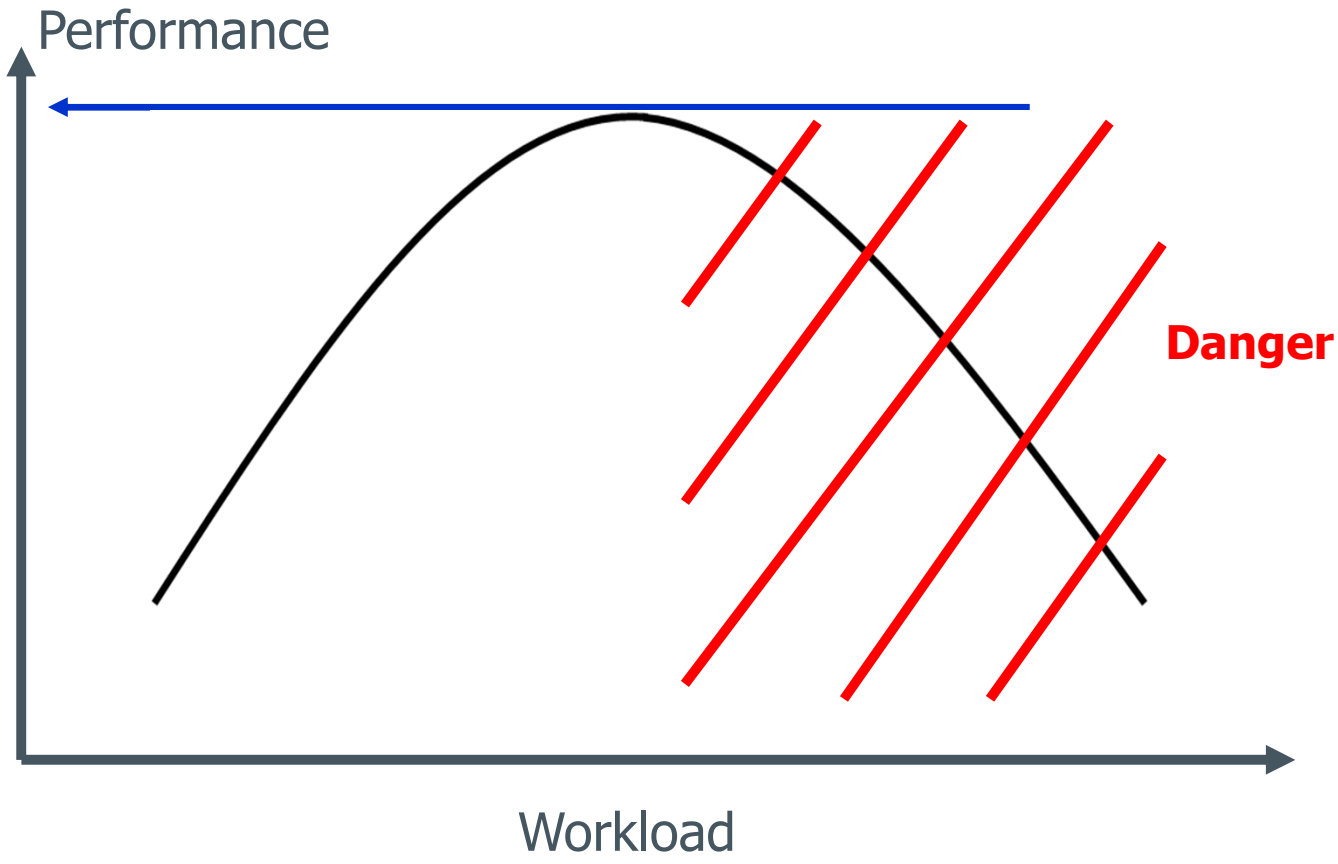
1. Ambiguity
2. Reduced/poor communication
3. Confusion
4. Trying something new under pressure
5. Deviating from established norms
6. Verbal violence
7. Doesn't feel right
8. Fixation / Boredom / Task saturation
9. Being rushed / behind schedule

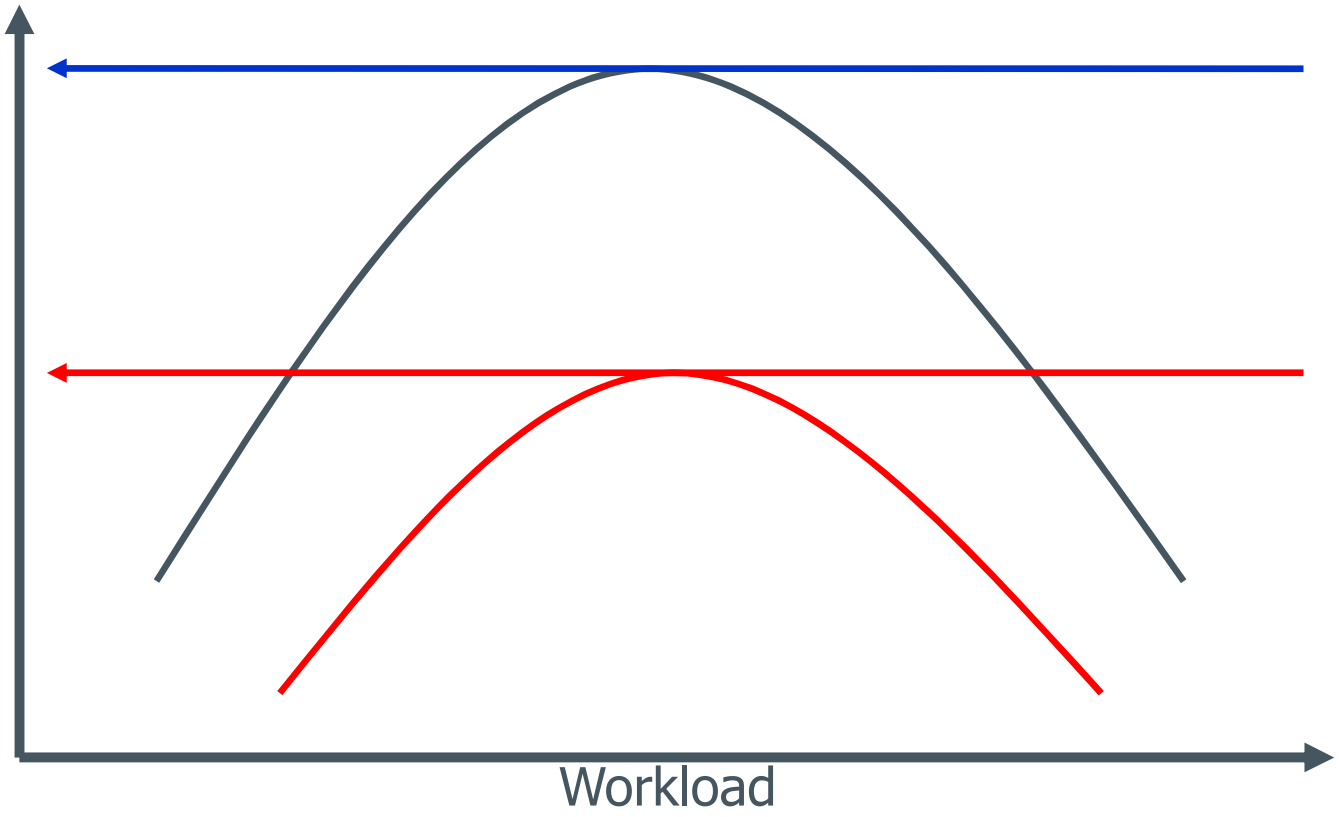
Performance & Overload

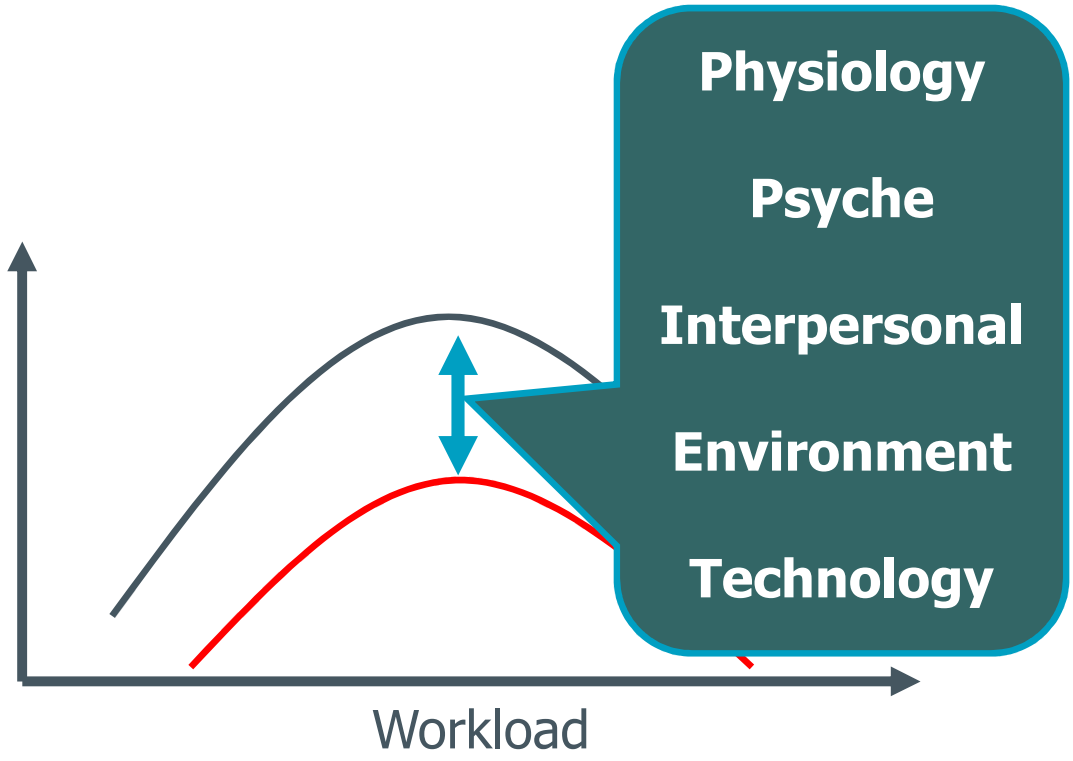
How we judge and understand ability and competence in ourselves and others

- Performance






Workload


Physiology
Psyche
Interpersonal
Environment
Technology
Workload

What Impacts Our Performance?

- Overestimate abilities
- Underestimate limitations
- External stimuli
  - Noise
  - Distractions
  - Environmental conditions
- Internal response to stress
  - Release of stress hormones
  - Anxiety
  - Increased heart rate

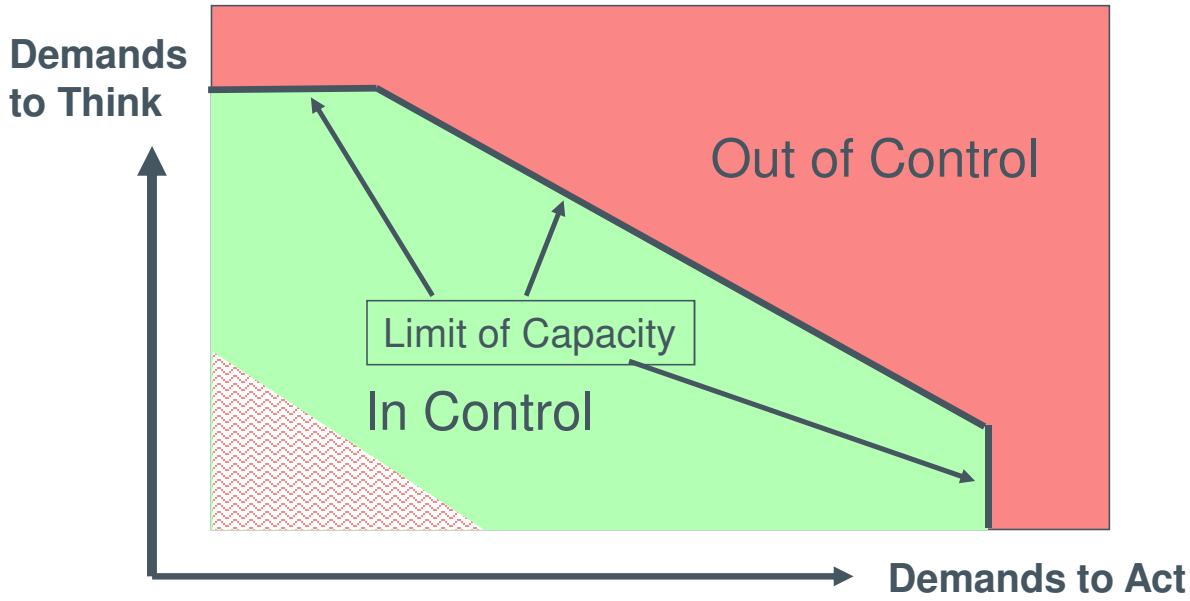
Attention & Distraction: Multitasking

- We're constantly doing more with less
- Results:
  - Task saturation
  - Cognitive overload
  - Burnout
  - Errors
- Are women better at multi-tasking than men?

Capacity or Complexity?

- Human factors engineering research shows that what is important is not the number of tasks but the nature of the tasks being attempted.

One Brain – Stress and Workload



Amalberti

Overload

- When overloaded we **ALL** become incompetent (unforced errors) and our judgement goes (poor decisions)
- When any member of the team is overloaded the performance of **ALL** team members will be affected
- Capacity to think is compromised by demands for activity
- Communication is compromised in high workload situations
- An agreed and well rehearsed vocabulary is critical when the workload is high

Exercise

- Situational Awareness:
  - How could technology improve situational awareness?
  - How could technology decrease situational awareness?
- Performance and Overload:
  - How could technology improve performance and overload?
  - How could technology decrease performance and overload?

Response to Introduction of Technology

Different views:

- Excitement and anticipation of gaining a new skill or as an opportunity to grow.
- Disruption or threat to their practice
- Intrusion into routine of providing patient care

(Bozak, 2003)

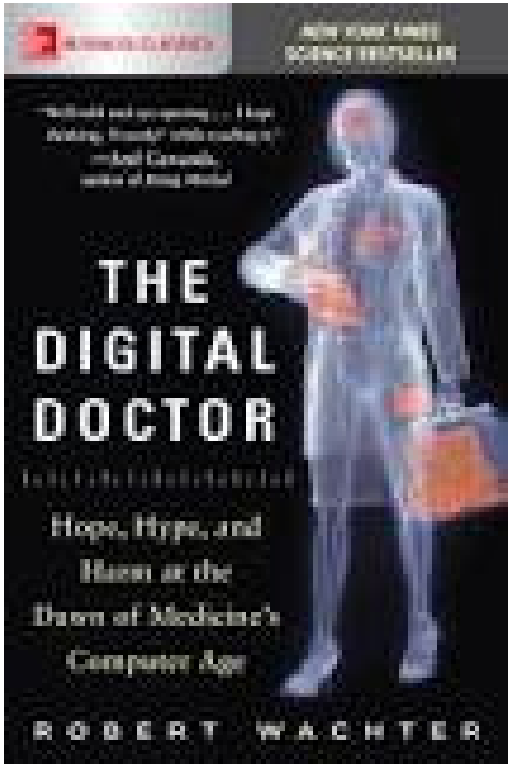
"What do you mean the computer is down and I'll have to communicate the old way? What old way?"

The World Wide Web

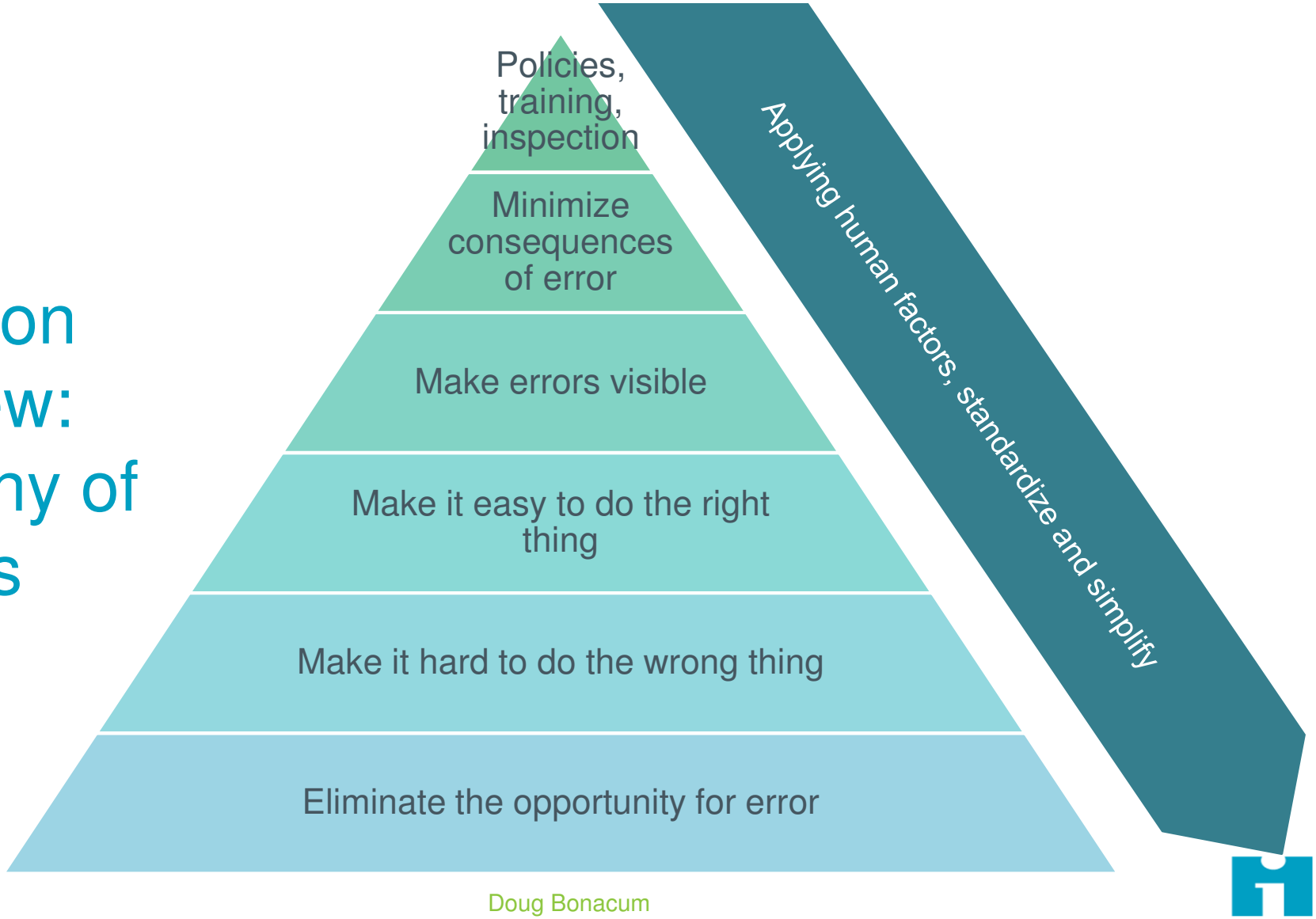
- Patients seek out knowledge
- up to 58% of all Americans use the internet to determine how and when to access other health care resources
- Many websites with dubious information

- "*The trouble with quotes on the Internet is you never know if they are genuine*." - Abraham Lincoln

Smartphone Apps


THE DIGITAL DOCTOR
Hope, Hype, and Harm at the Dawn of Medicine's Computer Age
ROBERT WACHTER

Error Reduction Overview: Hierarchy of Controls



Doug Bonacum

Specific Error Reduction Strategies

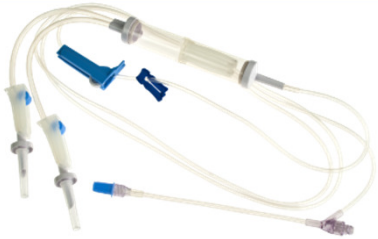
- Use visual controls
- Avoid reliance on memory
- Simplify and Standardize
- Use constraints/forcing functions
- Use protocols and checklists
- Improve access to information
- Reduce handoffs
- Decrease look-alike / sound-alikes
- Automate carefully
- Reduce interruptions and distractions
- Take advantage of habits and patterns
- Promote effective team functioning

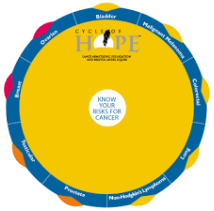
Areas to Consider

1. Cognition and mental workload
2. Distractions
3. The physical environment
4. Physical demands
5. Service/product design
6. Teamwork
7. Process design

Tactics

- Forcing functions
- Constraints
- Habits and patterns
- Visual controls





Tools

NASA Task Load Index

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

Name	Task	Date

Mental Demand — How mentally demanding was the task?

Very Low — Very High

Physical Demand — How physically demanding was the task?

Very Low — Very High

Temporal Demand — How hurried or rushed was the pace of the task?

Very Low — Very High

Performance — How successful were you in accomplishing what you were asked to do?

Perfect — Failure

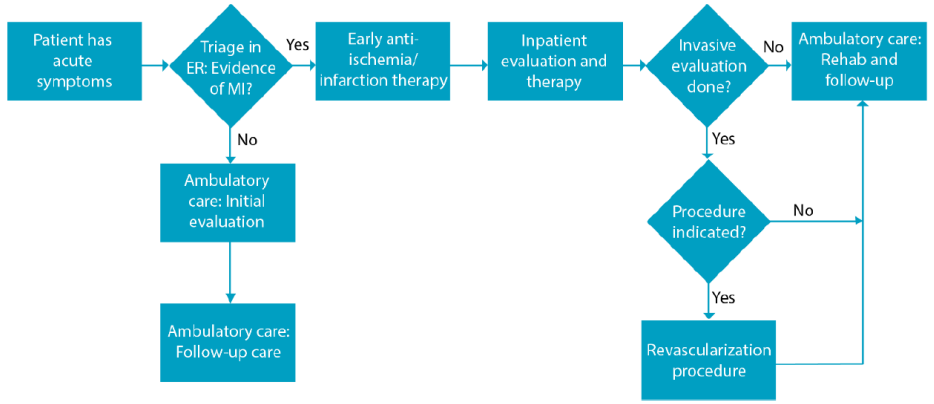
Effort — How hard did you have to work to accomplish your level of performance?

Very Low — Very High

Frustration — How insecure, discouraged, irritated, stressed, and annoyed wereyou?

Very Low — Very High

Example: Flowchart



http://www.ihi.org/resources/Pages/Tools/Flowchart.aspx

Factors That Impact Adoption

- Response time
- Flexibility
- Breakdowns/crashes
- Usability- ease of use
- Usefulness - helps in completing tasks
- Job Factors - impacts how we do our work
- Self-confidence – “I can use technology”

The Lost and Forgotten

- Infrastructure
  - The foundation
- Process Redesign
  - Technology's partner
- Evidenced Based Order Sets (for most if not all common diagnosis)
  - Ease of order entry with supporting best practice documentation

Don’t Forget the Infrastructure

- How is system response time currently?
- What is the frequency of unscheduled downtimes?
- Is the wireless network adequate, stable and responsive?
- Will the number of concurrent users impact performance?
- Is an upgrade needed prior to CPOE?
- Is there adequate and acceptable hardware?
- Is there a tried and true disaster recovery plan?

Designing for Safety

- Would it be easier to design the feature into the system?
- Would it be easier to add safety features as defects are discovered?

Technology in the Home

- in-home monitoring,
- disease management, self-management and
- web-based portals that give patients access to information
- from their provider'smedical record system

Jimison H, Gorman P, Woods S, et al. Barriers and drivers of health information technology use for the elderly, chronically ill, and underserved. Rockville, MD: Agency for Healthcare Research and Quality, 2008. AHRQ Publication No. 09-E004.

Design and Fit

- Lack of fit between clinical health IT systems and
- their users, as well as their users' work environment,
- can create inefficiencies and facilitate error
- risks that could lead to decreased patient safety

Koppel R, Metlay JP, Cohen A, et al. Role of computerized physician order entry systems in facilitating medication errors. JAMA 2005;293:1197e203.
Unertl KM, Weinger MB, Johnson KB. Applying direct observation to model workflow and assess adoption. AMIA Annu Symp Proc 2006:794e8.

Table 2 Recommendations to improve design of consumer health IT and sample relevant human factors methods

Recommendations	Human factors methods
The design process should consider the physical and cognitive needs and abilities of all types of end users (eg, patients, care givers or clinicians)	► Cognitive task analysis ► Function analysis ► Usability evaluations (eg, usability tests; heuristic evaluations; cognitive walkthroughs; think-aloud protocols) ► Visual and hearing impairment simulators
The design process should be user-centred with the goal of understanding the 'health work' of the users and the context in which the work occurs	► Cognitive work analysis ► Task analysis ► Function analysis ► Work system analysis ► Interviews ► Direct observations ► Focus groups ► Analysis of artefacts
The design process should be iterative, and evaluations should be conducted in environments in which the intervention will be used. Subjects involved in testing should represent all possible users.	► Usability evaluations ► Field testing ► Interviews ► Direct observations
Appropriate training and IT support should be available to users	► Usability evaluations ► Field testing and evaluation
Technology, platforms and devices used should consider compatibility and user access (eg, by considering using different platforms or testing using varying internet speeds)	► Pilot tests ► Surveys ► Review of services and infrastructure available in the community

Considerations for the design of safe and effective consumer health IT applications in the home
Qual Saf Health Care 2010;19(Suppl 3):i61ei67. doi:10.1136/qshc.2010.041897

You have been asked to evaluate a new technology.

- Who should be involved in the evaluation?
- What features are must have?
- What features are nice to have?
- What method would you use to test it?
- What would be the ‘deal breaker’?

Safety as a system property

- Safety is a characteristic of a sociotechnical system
- System-level failures occur almost always because of unforeseen combinations of component failures

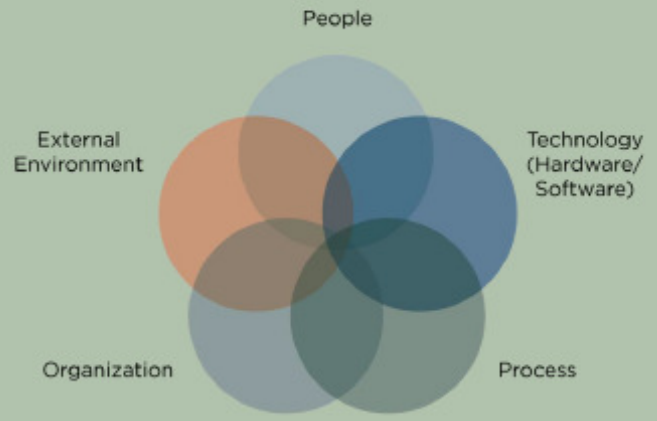


FIGURE 3-1
Sociotechnical system underlying health IT–related adverse events.

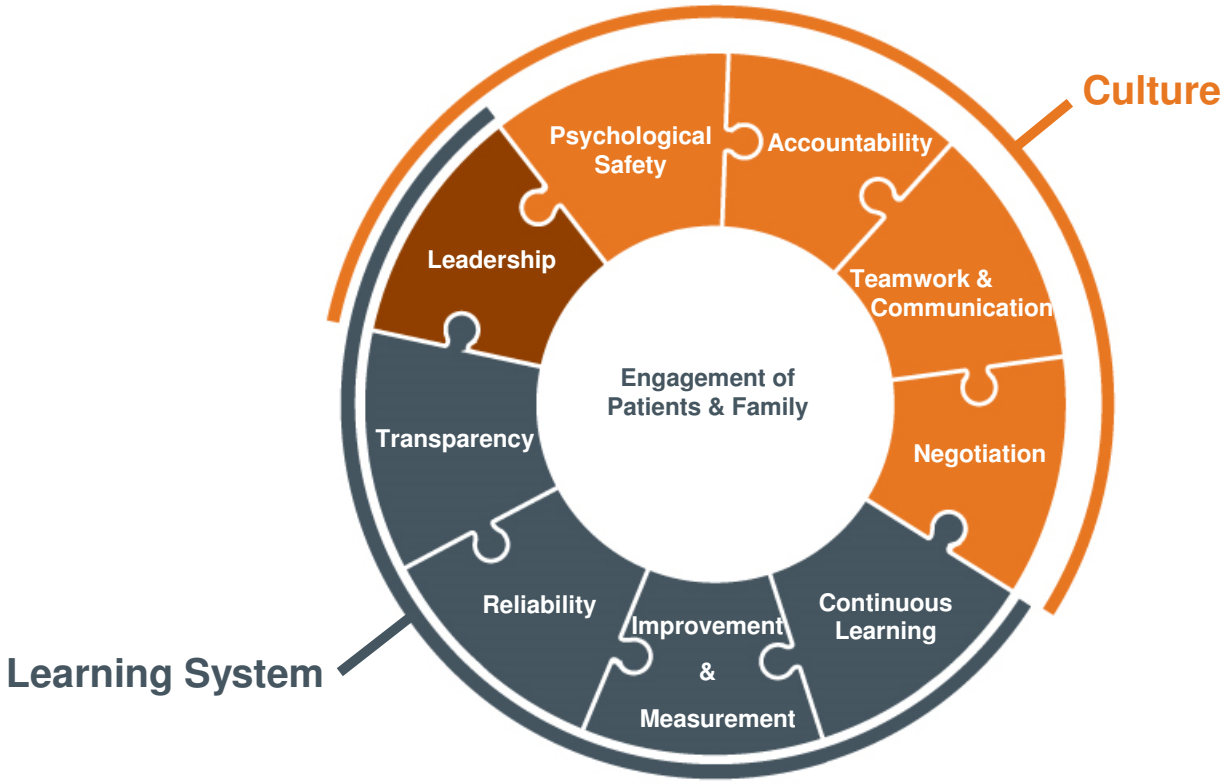
SOURCE: Adapted from Harrington et al. (2010), Sittig and Singh (2010), and Walker et al. (2008).

"New technologies will succeed or fail based on our ability to minimize the incompatibilities between the characteristics of people and the characteristics of the things we create and use."

Steven M. Casey, 1993/1998

"Set Phasers on Stun" and Other True Tales of Design, Technology, and Human Error

Framework for Safe, Reliable, and Effective Care



Source: Frankel A, Haraden C, Federico F, Lenoci-Edwards J. A Framework for Safe, Reliable, and Effective Care. White Paper. Cambridge, MA: Institute for Healthcare Improvement and Safe & Reliable Healthcare; 2017. (Available at ihi.org)

Thank you!

@ameliaIHI
@TheIHI
abrooks@ihi.org
ffederico@ihi.org