Human Factors

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Frank Federico

These presenters have nothing to disclose.

March 4, 2017
Framework for Clinical Excellence

Patient Safety

1. Learning System
2. Engagement of Patients & Family
3. Continuous Learning & Improvement & Measurement
4. Reliability
5. Transparency
6. Psychological Safety
7. Accountability
8. Teamwork & Communication
9. Negotiation
10. Leadership
11. Culture

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Session Objectives

- Describe the principles of human factors and how to apply them in the healthcare setting
- List the human factors violations that contribute to error
- Discuss how human factors principles are applied in other industries
- List the interventions that can be used to minimize errors that are the result of the human factors interface
Why is Understanding Human Factors Important to Your Role?
Human Factors

• Human Factors focuses on human beings and their interaction with each other, products, equipment, procedures, and the environment
• Human Factors leverages what we know about human behavior, abilities, limitations, and other characteristics to ensure safer, more reliable outcomes
• It acknowledges that we can not change the human condition…but we can change the condition under which humans operate
Human Errors are Everywhere

Prosecutors believe human error caused German train crash

Asiana says pilot error partly to blame for San Francisco plane crash

Researchers: Medical errors now third leading cause of death in United States
Error-Producing Conditions

- Unfamiliarity with task x17
- Shortage of time x11
- Poor communication x10
- Information overload x6
- Misperception of risk (drift) x4
- Inadequate procedures / workflow x3

These are compounded by “human factors violations” such as fatigue, stress, work environment (e.g., psychologically unsafe environment), interruptions and distractions, and ambiguity regarding roles and responsibilities.
The “Onion” Model

Human Factors Violations: Drivers of Human Error

- Fatigue
- Lack of sleep
- Shift work
- Boredom, frustration
- Fear
- Stress
- Reliance on memory
- Reliance on vigilance
- Injury or Illness
- Interruptions & distractions

- Noise
- Heat
- Clutter
- Motion
- Lighting
- Unnatural workflow
- Procedures or devices designed in an accident prone fashion
<table>
<thead>
<tr>
<th>Old View</th>
<th>New View</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Human error is a cause of trouble</td>
<td>• Human error is a symptom of deeper system trouble</td>
</tr>
<tr>
<td>• You need to find people’s mistakes, bad judgments and inaccurate assessments</td>
<td>• Instead, understand how their assessments and actions made sense at the time — context</td>
</tr>
<tr>
<td>• Complex systems are basically safe</td>
<td>• Complex systems are basically unsafe</td>
</tr>
<tr>
<td>• Unreliable, erratic humans undermine system safety</td>
<td>• Complex systems are tradeoffs between competing goals — safety v. efficiency</td>
</tr>
<tr>
<td>• Make systems safer by restricting the human contribution</td>
<td>• People must create safety through practice at all levels</td>
</tr>
</tbody>
</table>
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)
Exercise

- Discuss the violations producing conditions that exist in your organization/work area.
- Why do they exist?
We See What We Are Primed to See
A Tale of Two Elevators

Elevators 1-4

Elevator 5
Attention & Distraction: Priming

Shout out the color you see

ORANGE
BLUE
RED
PURPLE
GREEN
YELLOW
Case #4

Package similarity between dopram and labetalol vials.
Attention & Distraction: Priming

- We tend to experience the expected
- We are set up to fail by the information we are given
- Context matters

Look alike
Sound alike
Human errors waiting to happen
Conscious Mind: Attention & Distraction

Can a burnt out lightbulb cause a plane to crash?
The Case of Nifedipine Gel
Two Competing Systems of Thought

System 1
- Automatic
- Intuitive
- Involuntary
- Effortless
- Ex. Driving “How did I get here?”
- Less energy

System 2
- Deliberating
- Problem solving
- Reasoning
- Concentrating
- Ex. Solving a complex math problem
- More energy

Constant Conflict

Conscious Mind: Attention & Distraction

- What’s the diagnosis?
Red Flags – 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
Attention & Distraction: Multitasking

- We’re constantly doing more with less
- Results:
  - Task saturation
  - Cognitive overload
  - Burnout
  - Errors
Tennis Ball Exercise
What can you do to help maintain situational awareness?
Things You Can Do

- Huddles
- Briefings
- Debriefings
- Team communication
- Monitor the Baseline
- Fight Normalcy Bias
- Avoid using the obvious focus locks in transition areas
Stress

- Did added stress affect your performance?
- Stress makes seemingly simple tasks not so simple
- Have you experienced stress at work lately?
Stress: Yerkes–Dodson Law

- Stress can be helpful, but only up to a point
- Extreme boredom can be just as dangerous
Fatigue

- Prolonged work has been shown to produce the same deterioration in performance as a person with a blood alcohol level of 0.05 mmol/l, which would make it illegal to drive a car in many countries

- Consider Colgan Air 3407
  - 2009 - Buffalo, NY
  - Late evening flight (tired crew)
  - Poor judgment at a critical moment
  - 50 lives lost

- Could this happen in a healthcare setting?
Shift Work

- Work hour restrictions placed on many professionals
  - Truck drivers
  - Airline pilots & air traffic controllers
  - Medical residents (more recently)

- Problems associated with shift work
  - Sleep deprivation
  - Disturbances of circadian rhythm
  - Decreased alertness
  - Poor performance on standardized testing

Good idea?
What Can You Do To Help Your Staff?
Reliance on Memory

- Working memory is limited, and when attention is drawn elsewhere, it can be especially vulnerable
- Short-term memory
  - Miller - “The magic number 7 (+/- 2)”
- Long-term memory
  - Huge capacity – only small portion is consciously available
  - Mind not always actively accessing risk information while busy with a task
  - Risk knowledge may not be activated unless there is some external cue to activate it (i.e. memory aids)
Hierarchy

- Steep power gradient
- Top down
- Little questioning of authority
- Standard in the cockpit until mid-1980s
- Where does this type of environment exist in healthcare?
Hierarchy – Risks

- Decreased sense of value among team members
- Decreased job satisfaction
- Reluctance to speak up with safety concerns
- Errors allowed to reach the patient

Source: AHRQ Safety Program for Ambulatory Surgery 2015
Culture of patient safety survey results
Hierarchy – Harmful Results

- Aviation
  - PanAm/KLM
  - Tenerife, Canary Islands 1977

- Healthcare
  - Wrong digit surgery
  - Orthopedic ASC 2015
Communication & Teamwork

- Most team errors are communication related
- Multiple languages and meanings
- Selective listening – hearing what we expect/want
Listening Exercise
What can we do to address human factors violations?
On the Hunt for Violations

- Understand your processes
- View your processes through a human factors lens
- Choose the right strategy
- Proactively address human factors violations
Human Factors Task Analysis

- **Proactive**
  - Are processes standardized?
  - Is there ready access to information?
  - Are redundancies and reminders in place?
  - How many interruptions are there during the work shift?
  - How complex are the tasks or instructions?

- **Reactive**
  - Include human factors analysis in incident investigations
  - Educate staff and remedy the situation
Error Reduction Overview:
Hierarchy of Controls

Mitigate
Policies, Training, Inspection
Minimize consequences of errors
Make errors visible
Facilitate
Make it easy to do the right thing
Eliminate the opportunity for error
Eliminate
Standardization & Simplification

Doug Bonacum, MBA, CSP
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
Use Visual Controls

Which dial turns on the burner?

Stove A

Stove B
Forcing Functions

- *Forcing functions*—An aspect of a design that prevents an unintended or undesirable action from being performed or allows its performance only if another specific action is performed first.

- Forcing functions can be used in device and process design.

  - Automobiles are now designed so that the driver cannot shift into reverse without first putting his or her foot on the brake pedal.
Constraints

- Limitation or restriction to completing an action
- Makes it more difficult to complete a task or make a mistake

Example: prompt asking “Are you sure?”
Take Advantage of Habits and Patterns

- Identifying high risk patients in the office setting
  - Engage patients while waiting
- Hand hygiene
  - Must become part of behaviors
  - Habit
Human Factors Self Assessment

- **I’** – illness
- **M** – medication
- **S** – stress
- **A** – alcohol
- **F** – fatigue
- **E** – eating & elimination
Attention & Distraction

The Sterile Cockpit

Patient Safety
IME OUT
Every Patient. Every Time.
Attention & Distraction

READY TO COLLABORATE
Let’s Work Together to Improve System Resilience

BUSY
Available if Necessary

PLEASE DO NOT DISTURB!
Critical Task in Progress Requiring No Interruptions
# Look Alike Drug Names

## Tall Man Lettering

### Table 1. FDA-Approved List of Generic Drug Names with Tall Man Lettering

<table>
<thead>
<tr>
<th>Drug Name with Tall Man Letters</th>
<th>Confused with</th>
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<tbody>
<tr>
<td>acetzOLAMIDE</td>
<td>acetOLAMIDE</td>
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<td>acetOLAMIDE</td>
<td>acetzOLAMIDE</td>
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<td>bupROPam</td>
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**FDA and ISMP 2014**
Teamwork Training

- Crew Resource Management (CRM)
  - Teamwork and Leadership Training
  - Standardized Communication Tools
  - Conflict Resolution
  - Situational Awareness Training
  - Decision Making Skills
  - Briefing and Debriefing Techniques
- Team Training
Communication

• Briefing/Debriefing
• SBAR
  • Situation
  • Background
  • Assessment
  • Recommendation
• Closed loop
• Readbacks
• Speaking up
Speaking Up Using Structured Language

I am CONCERNED!
I am UNCOMFORTABLE!
This is a SAFETY ISSUE!

“Stop the Line”

TeamSTEPPS®
Cognitive Aids

- SOPs
- Protocols
- Memory aids
- Reference guides
- Checklists
WHO Surgical Safety Checklist

SURGICAL SAFETY CHECKLIST (FIRST EDITION)

Before induction of anaesthesia

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 (child/eg 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

Before skin incision

Before patient leaves operating room

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

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged.
Evolution of the Checklist

Safe Surgery Checklist template

**Before Induction of Anesthesia**
- Nurse and Anesthesia Professional verify:
  - Patient identification (name and DOB)
  - Surgical site
  - Surgical procedure to be performed matches the consent
- Site marked
- Known allergies
- Patient positioning
- Essential imaging available
  - Risk of hypothermia (if operation >1 hour)
    - Warmer in place
  - Risk of venous thromboembolism
  - Boots in place and/or anticoagulants
- Anesthesia safety check completed

**Before Skin Incision**
- **TIME OUT**
  - Circulating Nurse asks: *"Is everyone ready to perform the time out? Please state your name and role."*
  - Entire Surgical Team confirms:
    - Patient name
    - Surgical procedure to be performed
    - Surgical site
    - Essential imaging available
    - Antibiotic prophylaxis given within the last 60 minutes
    - Antibiotic redosing plan discussed

**ANESTHESIA BRIEFING**
- Anesthesia Professional verifies:
  - Anticipated airway or aspiration risk
  - Risk of significant blood loss
    - Two IVs/central access and fluids planned
    - Type and crossmatch/scree
    - Blood availability

**TEAM BRIEFING**
- Anesthesia Professional shares:
  - Anesthetic plan
  - Airway concerns
  - Other concerns
- Circulating Nurse and Scrub Tech share:
  - Sterility, including indicator results
  - Equipment issues
  - Other concerns
- Surgeon asks:
  - "Does anybody have any concerns? If you see something that concerns you during this case, please speak up."

**Before Patient Leaves Room**
- Nurse reviews with team:
  - Instrument, sponge, and needle counts
  - Name of the procedure performed
- Nurse reads aloud to team:
  - Specimen labeling, including patient’s name
- **TEAM DEBRIEFING**
  - Before Surgical Team discusses:
    - Key concerns for patient recovery and management
    - Equipment problems that need to be addressed
    - Other opportunities for improvement

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged. Based on the WHO Surgical Safety Checklist (http://www.who.int/patientsafety/checklist) © 2009 World Health Organization. All rights reserved. SOSC Master template revised: 7 August 2015
Take a Moment and List All of the Technology That Is Available in your Area of Responsibility for Patient Care.
Magical Thinking

Ever been in a situation where you say “If only we had... all our problems would be solved”

- What was the situation?
- What was the problem?
- What did you expect technology to do to solve the problem?
- What did you learn?
“The problem with making the transition from the paper world to the electronic world is that in the paper world a lot of things happen by convention & understanding…implementing the electronic tools to make that happen is a bigger deal than I think anybody expects.”

Chair, Medical Informatics Committee
Evanston Northwestern Healthcare
So what are the issues we need to consider?

- User/machine interface
- Reliability of equipment
- Backup systems when technology fails
- Workarounds because equipment is complex
- Over-reliance on technology
- Loss of critical thinking
- Poor documentation
Some News Is Good

Electronic health record adoption and rates of in-hospital adverse events. After controlling for patient and hospital characteristics, patients exposed to a fully electronic EHR had 17% to 30% lower odds of having an adverse event.

What is your role in ensuring safety in the use of technology?
Recommendations

- Include medical device users and biomedical engineers in purchasing decisions.
- Develop a reporting system for staff that enables them to include details about devices in use during an adverse event or a near miss, along with good narrative descriptions of the event.
- Initiate quality improvement efforts focused on medical device safety for key devices (e.g., defibrillator, MRI, clinical alarm, infusion pump).
- Ensure problem devices are routinely taken out of service when they are implicated (even tentatively) in adverse events, near misses or situations demonstrating potential patient harm (e.g., during preparation for a procedure or device testing).
- Establish a process for reporting important safety information to device manufacturers and the FDA that could improve product safety for patients.
What to do?

- **Usability testing**— Test new systems and equipment under real-world conditions as much as possible, in order to identify unintended consequences of new technology.
  - Example of the clinical applicability of usability testing involves electronic medical records and computerized provider order entry (CPOE).
  - A seminal study found increased mortality in a pediatric intensive care unit after implementation of a commercial CPOE system, attributable in part to an unnecessarily cumbersome order entry process that reduced clinicians' availability at the bedside.
Key Takeaways

- Human factors principles can be applied in the healthcare setting to reduce errors
- The key is to constantly looking for and address human factors violations
- We can learn from the success experienced in other industries
- Several proven interventions can be used to minimize errors that are the result of the human factors interface
“We can’t change the human condition, but we can change the conditions under which humans work.”

James Reason
Take a moment to reflect on your own work. What will you incorporate from this session into your plans?
Framework for Clinical Excellence

Patient Safety

- Engagement of Patients & Family
- Culture
- Leadershi P
- Psychological Safety
- Accountability
- Teamwork & Communication
- Negotiation
- Learning System
- Transparency
- Reliability
- Improvement & Measurement
- Continuous Learning

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