Human Factors

Frank Federico, RPh

This presenter has nothing to disclose.

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Session Objectives

- List three factors that degrade human performance
- Describe three error reduction strategies that take into consideration human factors principles
- Explain how to assess the work environment for human factors violations
Human Error

1. Errors are common
2. The causes of errors are known
3. Many errors are caused by activities that rely on weak aspects of cognition
4. Systems failures are the “root causes” of most errors

Lucian Leape, “Error in Medicine” *JAMA*, 1994
Human Factors

Human Factors Engineering: Examines a particular activity in terms of its component tasks and then considers each task in terms of:

- physical demands,
- skill demands,
- mental workload, and
- other such factors

- adequate lighting,
- limited noise, or other distractions
- device design, and
- team dynamics
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.
Our Focus

- Understanding the ‘violations’ of human factors principles that set us up for errors
- Determining what to do to address these violations (building a better bus!)
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
### Error-Producing Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfamiliarity with task</td>
<td>x17</td>
</tr>
<tr>
<td>Shortage of time</td>
<td>x11</td>
</tr>
<tr>
<td>Poor communication</td>
<td>x10</td>
</tr>
<tr>
<td>Information overload</td>
<td>x6</td>
</tr>
<tr>
<td>Misperception of risk (drift)</td>
<td>x4</td>
</tr>
<tr>
<td>Inadequate procedures / workflow</td>
<td>x3</td>
</tr>
</tbody>
</table>

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.
Case #4

Package similarity between dopram and labetalol vials.
## Human Factors Violations: Drivers of Human Error

- Fatigue
- Lack of sleep
- Illness
- Drugs or alcohol
- Boredom, frustration
- Cognitive shortcuts
- Fear
- Stress
- Shift work
- Reliance on memory
- Reliance on vigilance

- Interruptions & distractions
- Noise
- Heat
- Clutter
- Motion
- Lighting
- Too many handoffs
- Unnatural workflow
- Procedures or devices designed in an accident prone fashion
Error Reduction Overview: Hierarchy of Controls

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

By 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
Strategy: Use Visual Controls

Which dial turns on the burner?

Stove A

Stove B
Visual Control for Safety

5S Anesthesia “Shadow Board” - Before
Visual Control for Safety

5S Anesthesia Shadow Board - After
Strategy: Avoid Reliance on Memory

- Computerized drug-drug interaction checking
  - Drug information databases
  - Customized drug rules
- Preprinted orders
  - Chemotherapy order form
  - Pain management order forms
Strategy: Simplify

- Formulary restrictions
  - Remove items
  - Eliminate therapeutic duplications
  - Limit availability

- Heparin weight based protocol
  - Simplifies ordering process
  - Provides comprehensive orders
Why Simplify Workflow?

First step = 90%

Process reliability = 90% * 90% * 90% * 90% = 66%
Strategy: Standardize

- Who, what, with what, when, where, how
  - Example from Reliability Session
  - “Win / Win” - Less work, better care

- Standard solutions
  - Ease of ordering
  - Ease of preparation
  - Ease of administration
Tubing Connections

Figure 1. Tube delivering oxygen fell off nebulizer

Figure 2. The oxygen tubing was connected to a Baxter Clearlink needleless port.
Strategy:
Use Constraints/Forcing Functions

- Concentrated KCl vials
  - Remove KCl from all inpatient units
- Connectors that prevent IV administration of eternal products
- Epidural vs. IV vs. Intrathecal connectors
- Computer prompt: “Proceed Y or No?”
Strategy: Use Protocols and Checklists

Checklists
- Reminders of every step in the process
- NOT rigid molds for non-thinking behavior
- Pilot checklists: includes method to designate where stopped if interrupted
- Anesthesia Machine Checklist
Strategy:
Improve Access to Information

- Include “Indication” with orders
- Drug information sources
  - Determine ease of use
- Location of medication list/problem list
Strategy: Reduce Handoffs

- Pharmacists on rounds
  - MD and Pharmacist interact directly
  - Increases likelihood of the correct order
  - Reduces delays caused by problematic orders

- Communicating critical test results
  - Communicate directly with ordering provider
Strategy: Avoid Look-alike/Sound-alike Drug Names

- Display lists of easily confused drug names
  How effective?
- Strongly encourage
  - Writing prescriptions more clearly
  - Printing in block letters rather than writing in cursive
  - Avoiding the use of abbreviations
  - Indicating the reason for the drug
Strategy: Automate Carefully

- Errors multiply if input is incorrect
- Automated dispensing machines
- Computerized physician order entry
It’s a jumble out there

With all those signs, you might miss the speed camera

Bewildering: A learner approaches the line of signs in South-West London, which are enough to confuse and distract the most experienced driver.
Reduce Interruptions and Distractions

- What are critical alarms?
- Are personal phones best way to help nurses?
- How many alerts pop-up in a computer system during order entry?
- Have you thought about patient comfort?
- Is there a ‘quiet zone’ for medication administration? (e.g. Green Vest at KP)
Strategy:
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
Habits and Patterns (Continued)

- Patient medication list
  - Sleeve to hold insurance card and medication list
Strategy: Promote Effective Team Functioning
Listening Exercise
Please decide if the following statements are true, false or ? (unable to determine with the information given)

<table>
<thead>
<tr>
<th>Statement</th>
<th>True /False</th>
</tr>
</thead>
<tbody>
<tr>
<td>A man appeared after the owner had turned off his store lights</td>
<td>True</td>
</tr>
<tr>
<td>The robber was a man.</td>
<td>True</td>
</tr>
<tr>
<td>The man did not demand money.</td>
<td>True</td>
</tr>
<tr>
<td>The owner opened the cash register.</td>
<td>True</td>
</tr>
<tr>
<td>After the man who demanded the money scooped up the contents of the cash register, he ran away.</td>
<td>True</td>
</tr>
</tbody>
</table>
What are the technologies employed at your hospital?

- 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?
“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
“What do you mean the computer is down and I’ll have to communicate the old way? What old way?”
200 mL
MCS 100 mL
40 mg/mL
800 mL
4000 mL
20 mL/hr

(1000 mL/hr)

Ceporosan: 1000 mL/hr
Alarm-related Deaths

According to The Joint Commission, there were 80 alarm-related deaths in the U.S. between January 2009 and June 2012.
DEATHS BY DEVICE • 2002-2004
Term “Alarm” in Product Problem description

Figure 1. Impact of Clinical Alarms on Patient Safety

http://psqh.com/alarm-fatigue-hazards-the-sirens-are-calling
MGH Death Spurs Review of Patient Monitors

“A Massachusetts General Hospital patient died last month after the alarm on a heart monitor was inadvertently left off, delaying the response of nurses and doctors to the patient’s medical crisis.”
“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.

http://www.boston.com/bostonglobe/editorial_opinion/letters/articles/2010/02/28/hospitals_dont_turn_up_the_volume_lower_the_noise/
National Patient Safety Goal on Alarm Management

Applicable to Hospitals and Critical Access Hospitals

Effective January 1, 2014

National Patient Safety Goal (NPSG)

NPSG.06.01.01
Improve the safety of clinical alarm systems.

Rationale for NPSG.06.01.01
Clinical alarm systems are intended to alert caregivers of potential patient problems, but if they are not properly managed, they can compromise patient safety. This is a multifaceted problem. In some situations, individual alarm signals are difficult to detect. At the same time, many patient care areas have numerous alarm signals and the resulting noise and displayed information tends to desensitize staff and cause them to miss or ignore alarm signals or even disable them. Other issues associated with effective clinical alarm system management include too many devices with alarms, default settings that are not at an actionable level, and alarm limits that are too narrow. These issues vary greatly among hospitals and even within different units in a single hospital.

There is general agreement that this is an important safety issue. Universal solutions have yet to be identified, but it is

Elements of Performance for NPSG.06.01.01


A 2. During 2014, identify the most important alarm signals to manage based on the following:

- Input from the medical staff and clinical departments
- Risk to patients if the alarm signal is not attended to or if it malfunctions
- Whether specific alarm signals are needed or unnecessarily contribute to alarm noise and alarm fatigue
- Potential for patient harm based on internal incident history
- Published best practices and guidelines

(For more information on managing medical equipment risks, refer to Standard EC.02.04.01.)

A 3. As of January 1, 2016, establish policies and procedures for managing the alarms identified in EP 2 above that, at a minimum, address the following:

- Clinically appropriate settings for alarm signals
- When alarm signals can be disabled
- When alarm parameters can be changed
- Who in the organization has the authority to set...
In order to achieve effective alarm management

- Must deal with culture
- Must use a multidisciplinary approach
- Develop appropriate processes
- One size does not fit all
What Can You Do?

- Include human factors analysis in incident investigations
- Conduct human factors review of organization
  - Are processes standardized?
  - Is there ready access to information?
  - Are redundancies and reminders in place?
- Conduct a human factors task analysis
  - How many interruptions are there during the work shift?
  - How complex are the tasks or instructions?
What Can You Do?

- Conduct human factors audits
  - Noise levels; distractions; design of workspace; label format; work hours review; shift reviews
- Train staff: Self-awareness of human factors issues
  - Staff in position to monitor ongoing situations
  - Information overload
  - Back to back shifts or only short breaks between shifts
Purpose of Alarm Management

- Alarms should direct the clinicians’ attention towards conditions requiring timely assessment or action;
- Alarms should alert, inform and guide required clinician action;
- Every alarm should be useful and relevant to the clinician, and have a defined response;
- Alarm levels should be set such that the clinicians have sufficient time to carry out their defined response before the plant condition escalates;
- The alarm system should be designed to accommodate human capabilities and limitations.

http://www.hse.gov.uk/humanfactors/topics/alarm-management.htm
Recommendation

- The patient safety executive can play an integral role in ensuring that the organization has a plan to evaluate where to dedicate resources
  - Done by including technology as part of strategy
  - Important because technology is part of structure
  - Technology can introduce a whole new set of problems
VA National Patient Safety Center

“We can’t change the human condition, but we can change the conditions under which humans work.”

James Reason
Accountability & Teamwork & Communication
Leadership & Psychological Safety
Continuous Learning & Improvement and Measurement
Transparency & Reliable Process
Culture Learning System
Take a moment to reflect on your own work. What will you incorporate from this session into your plans?
Objectives

- To provide you with the opportunity to identify human factors violations and suggest strategies to address those violations.
Exercise

- We ask you to review one of three cases
- Each table will be given one case
- Read the case and as a team identify the human factors violations
- Are there underlying conditions that may have contributed to the events?
- What can you test to address the human factors violations you identified?
## Human Factors Violations

- Fatigue
- Lack of sleep
- Illness
- Drugs or alcohol
- Boredom
- Frustration
- Fear
- Stress
- Shift work
- Reliance on memory
- Reliance on vigilance
- Distractions
- Noise
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- Too many handoffs
- Unnatural workflow
- Procedures or devices designed in an accident prone fashion
Error Reduction Strategies

- Redundancy
- Forcing function
- Standard process checklist
- Decision aids and reminders
- Standardization
- Visual and Auditory Cues
Exercise – 12:35 to 14:00

- Describe the event and the human factors violation
- Identify one example of at least one error reduction
- Report out from 13:30 to 14:00 PM
Take a moment to reflect on the action plans you are creating.

What will you incorporate from this session into your action plan?