The Human Factor: Applying Safety Science in Health Care

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www.MedicalHumanFactors.net
Normal Accident
Cause of the Accident

• Human error- Sarah forgetting keys.
  – Designated key area
  – Label on door
  – Pin keys to PJs
  – Put extra key on Opie’s collar

• Will any of these things prevent this error from happening again?
Objectives

- Think about (accidents, errors, mishaps, mistakes, slips, lapses, violations, hazards) in a different way
- Define human factors
- Discuss a systems approach
- Discuss real healthcare examples
Human Error in Health Care

It would take less than two years to fill Arlington National Cemetery with the victims of medical harm.

3rd leading cause of death in the United States (U.S.), behind heart disease and cancer. (John, 2013)

About half of adverse events were judged preventable with ordinary standards of care. (Vincent, Neale, Woloshynowycz, 2001)

$17.1 Billion annual cost (Van Den Bos, et al. 2011)
The Problem

• IOM Report in 2000:

• Government mandate: 50% less error in 5 years

• 13 Years later....

210,000

Leape LL, Berwick DM. Five years after To Err Is Human: what have we learned? JAMA. May 18 2005;293(19)

Wachter RM. The end of the beginning: Patient Safety Five Years After 'To Err Is Human'. Health Aff. 2004(11)

The same thing keeps happening over and over...

- 10-fold overdose
- Retained foreign object
- Patient “lost to follow up”
- Poor communication and teamwork

---WHY??---
Systems Approach

Is the goal: “Eliminate Human Error?”

⇒ NO

• Human Error cannot be eliminated
  – Futile goal; misdirects resources/focus
  – Causes culture of blame and secrecy
    • “name, blame, shame, and train” mentality

• It is about reducing HARM
TO EXIT
PRESS HERE

TO EXIT
PRESS HERE

PRESS TO OPERATE DOOR

PRESS TO OPERATE DOOR
What is Human Factors?

...discovers and applies information about human behavior, abilities, limitations, and other characteristics to the design of tools, machines, systems, jobs, and environments for productive, safe, comfortable, and effective human use.
Background - Human Factors
Human Capabilities and Limitations

• Information Processing
• Memory
• Attention
Numbers
Remember these letters...

A T L C B S U A E V C R F B I
Try this...

ATL CBS UAE VCR FBI
It’s easy as 1, 2, ...uh....

1. Set up Meter
2. Check the system
3. Check your blood

Simple, right?
Considering the User

- **Who uses it?**
  - Older people, usually alone, sometimes with help

- **How do they use it?**
  - They pick it up, insert testing tabs (could be upside down or right side up), prick themselves (could miss or could need to do a new location - what is rotation and mobility ability of user population), pull out tab (is it difficult or easy to get out), and test (are the results visible enough - can the user population easily see them?)

- **How long is it used?**
  - Very quickly

- **What does it do?**
  - Displays (digitally or analog?) blood glucose level from a drop of blood (is there a certain amount that must be on the strip?)

- **When will it be used?**
  - 2 times/day: morning and evening
<table>
<thead>
<tr>
<th>TASK</th>
<th>ACTION</th>
<th>SUCCESS CRITERIA</th>
<th>FEEDBACK</th>
<th>POTENTIAL PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Open the drawer</td>
<td>Use the correct tool</td>
<td>NONE</td>
<td>Tool not found</td>
</tr>
<tr>
<td>1.2</td>
<td>Insert the needle</td>
<td>Insert the correct needle</td>
<td>NONE</td>
<td>Needle not inserted</td>
</tr>
<tr>
<td>1.3</td>
<td>Connect the pump</td>
<td>Pump connected correctly</td>
<td>NONE</td>
<td>Pump not connected</td>
</tr>
<tr>
<td>1.4</td>
<td>Adjust the flow rate</td>
<td>Flow rate within acceptable range</td>
<td>NONE</td>
<td>Flow rate outside range</td>
</tr>
<tr>
<td>1.5</td>
<td>Review the medical record</td>
<td>Records match patient information</td>
<td>NONE</td>
<td>Records do not match patient</td>
</tr>
<tr>
<td>1.6</td>
<td>Complete the form</td>
<td>Form filled out accurately</td>
<td>NONE</td>
<td>Form not filled out accurately</td>
</tr>
<tr>
<td>1.7</td>
<td>Communicate with the patient</td>
<td>Patient understands treatment plan</td>
<td>NONE</td>
<td>Patient not able to understand</td>
</tr>
<tr>
<td>1.8</td>
<td>Monitor the patient</td>
<td>Vital signs within normal range</td>
<td>NONE</td>
<td>Vital signs outside normal range</td>
</tr>
<tr>
<td>1.9</td>
<td>Document the results</td>
<td>Results recorded accurately</td>
<td>NONE</td>
<td>Results not recorded accurately</td>
</tr>
<tr>
<td>1.10</td>
<td>Follow-up</td>
<td>Follow-up scheduled</td>
<td>NONE</td>
<td>Follow-up not scheduled</td>
</tr>
</tbody>
</table>

61 steps?!
Have you ever missed the gorilla?

- Humans have limitations
  - Cognitive
    - Multiple modalities
    - Confirm expectations
    - History
    - Cognitive misers
  - Within a system
Where do errors come from?

- Fallibility is part of the human condition
- Adverse events are the product of latent pathogens in a system
- ‘Sharp-enders’ are more likely to be inheritors rather than instigators
Mitigating Human Error

• If error is inevitable... How to improve safety?
  – **Reduce** the occurrence of human error
    • With better design
    • NOT training and policy
  – **Mitigate** the effects of inevitable error
    • With better design
      – Better feedback
      – Forcing functions
Every system is designed to achieve exactly the results it gets.

- Don Berwick, former IHI president, former director of CMS
Traditional (Person-Centered) Perspective

Risk Factors + Technical Skills = Outcome

Slide courtesy of Doug Wiegmann
Systems Perspective: The “Operational Profile”

**Risk Factors**

- Equipment Design
- Extraneous distractions

**Team Factors**

- Teamwork
- Communication
- Leadership

**Supervisory Factors**

- Training
- Staffing

**Cognitive Factors**

- Decision making
- Stress
- Perception

**Team’s Technical Skills**

**Systems Issues**

**Outcome**

\[ \text{Risk Factors} + \text{Team’s Technical Skills} = \text{System's Issues} \]
“I could have told you this was going to happen.”
Accident Causation Pyramid
“Tip of the iceberg”

- 1 serious or major injury
- 10 minor injuries
- 30 property damage injuries
- 600 incidents with no visible damage or injury

1,753,498 accidents from 297 companies, 21 different industries

Slide acknowledgment: Robert Panzer, MD
Time From Arrest to Defibrillation

![Graph showing the chance of survival from sudden cardiac arrest decreases by 7-10% each minute after arrest.](image)
Defibrillator Case

• Trend found in EMS Reporting system
• Simulation study (Denmark)
  - 72 physicians
  - 5 of 192 defib attempts – Turned it off
    ▪ Measurable delay in shock
  - Device turned off even if charged and ready

Medical Professionals: Just don’t make errors
Translation: Preoperative Briefings
Translation: Preoperative Briefing

Phase 1
Gather data to design a preop briefing protocol specifically for cardiac surgery

Phase 2
Implement and Validate preop briefing

Phase 1

Combined Questionnaire and Semi-structured Focus Groups

Methodology

• Attitudes about Briefings
• Logistics (timing/duration/location)
• Content of Briefings
• Participation (who involved?)
• Potential Barriers

Target Groups (n = 55):

• Circulating Nurse
• Surgical Technicians
• Surgical Assistants
• Perfusionists
• Nurse Anesthetists
## 1. RESIDENT (Surgeon)

- History:
  - Diagnosis
  - Planned Procedure
  - Significant past history
    - Low EF
      - CABG
    - Valve
      - Previous vein stripping
  - Allergies

## 2. SURGEON (Resident)

- Cannulation
  - Arterial Cannula
    - Placement
      - Arch
      - Aneurysm
    - Axillary
    - Femoral
  - Venous Cannula
    - Placement
    - Type
      - Bi-caval
      - Two stage

## 3. SURGICAL ASSISTANT

- Length of Vein
- Positioning (IF Atypical)
- Prep (IF Atypical)

## 4. PERFUSIONIST

- Perfusion Pressure
- Perfusion Temperature
- Cannula Size
- Circulatory Arrest
  - Cool down temperature

## 5. SURGICAL TECH

- Suture
- Instrumentation

## 6. RN

- Valve type
- Graft
- Patch
- Special Precautions
- Concerns

## 7. ANESTHESIA/CRNA

- Line Placement
  - Arterial Line
    - Right
    - Left
    - Femoral
    - Radial
- Antifibrinolytics
  - Aprotinin
  - Tranexamic Acid
- OR list management plan for the day

## 8. OTHER CONCERNS- UNIQUE TO THIS CASE

### Clear common purpose

### Clear roles and responsibilities

### Anticipation
Results- It actually changes things...

<table>
<thead>
<tr>
<th>Outcome Measures</th>
<th>% change in outcome measure after briefing was implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN trips to core</td>
<td>40% Decrease</td>
</tr>
<tr>
<td>Procedural Knowledge Issues</td>
<td>34% Decrease</td>
</tr>
<tr>
<td>Equipment Preparation Issues</td>
<td>25% Decrease</td>
</tr>
<tr>
<td>Miscommunication Events</td>
<td>51% Decrease</td>
</tr>
<tr>
<td>Waste</td>
<td>100% Decrease</td>
</tr>
</tbody>
</table>

Barriers - Logistics, conducting the briefing at a time convenient for all staff.
What is the problem?

"Is vent on or off?"

I thought the vent should be off.

You shouldn't have done that because LV clamp was off.

Next time tell me what you're doing"

Vent is on 500

I turn it on after cardioplegia

Sorry about that.

- Interaction in 603
Why is this a problem

• Many different disciplines interacting
  – Each discipline has a different background, different experience, different priorities, different mental model, different expectations of how to get things done.

• Goal: Better communication
  – Avoid missing steps
  – Avoid miscommunication
  – Avoid difficult interactions
Getting the sides together
Draft Protocol

• All critical stage exchanges, closed loop communication, context specific command structure
  – ACT adequate
  – Arterial Line check
  – Circuit check
  – On bypass
  – Cross-clamp on
  – Cardioplegia updates
  – Vent updates
  – Cross-clamp off
  – Off bypass

Results - decrease in miscommunication!

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-implementation group</th>
<th>Post-implementation group</th>
<th>Decrease, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total communication breakdowns per case</td>
<td>11.5</td>
<td>7.3</td>
<td>37</td>
</tr>
<tr>
<td>Non-verbalized critical Actions per case</td>
<td>1.6</td>
<td>0.4</td>
<td>75</td>
</tr>
<tr>
<td>Repeated Commands per case</td>
<td>1.4</td>
<td>0.3</td>
<td>79</td>
</tr>
<tr>
<td>No call back per case</td>
<td>3.9</td>
<td>2.9</td>
<td>26</td>
</tr>
<tr>
<td>Ambiguous or Unstructured commands per case</td>
<td>3.4</td>
<td>2.3</td>
<td>32</td>
</tr>
</tbody>
</table>
Where do medical students get their information on patient safety?

**Social Sources**
- Resident taught
- Experience of a friend
- Nurse taught
- Attending taught

**Non-Social Sources**
- Own experience
- Technical Simulation training
- Recall coursework
- Reading current literature
- Online course
- Lecture at conference
SCENARIO 1:
You are observing your fifth laparoscopic surgery. This is the first surgery you’ve seen with a DaVinci robot. The surgeon doing the case is highly experienced and well respected attending at your institution,...

The operation goes according to plan. At the end of the operation, when the surgeon is depressurizing the belly, the nurse anesthetist tells him that she has no return on the CO2, indicating no pressure in the IVC. The surgeon tells you to call a code for cardiopulmonary arrest.

After a few minutes of assessing the situation, the source of the blood is found, the IVC was split in half by the first trochar insertion.

What would you do?
(FREE TEXT)

How would you know to do that?
(CHECK BOX, CAN CHECK MORE THAN 1)
- Recall class coursework
- Your own experience
- Reading current literature
- Taking online courses
- Experience of a friend or colleague
- Recall a lecture you heard at a conference
- Resident taught you
- Attending taught you
- Nurse taught you
- Technical training on a simulator
Results

- Social, 40%
- NonSocial, 25%
- Own Experience, 31%
- Social and Non, 4%
What does this tell us?

• Medical students obtain more information on patient safety principles from **Social Sources** than **NonSocial Sources**

• Students follow the leaders
• Leaders view themselves as technical experts, not leading on safety

• Think about patient safety education in a new way
  – Where are patient safety principles TAUGHT?
    • Online modules, coursework
    • Clinical experience?
  – Where are patient safety principles LEARNED?
    • Clinical experience
    • Social interactions
Putting it to work

- Report before something happens
- “I could have told you that was going to happen...”
- Open lines of communication
- Employ system safety analysis techniques
- Understand the impact of the system on how we view safety
Power of the Systems Perspective

– Human functions within a system
– Leverage is in modifying the system
– You have power over the system

We cannot change the human condition, but we can change the conditions in which the human works...
Thanks!

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