Reducing Human Error in Healthcare: Getting Doctors to Swallow the Blue Pill

Paul O’Connor

High Reliability Organisations

- Organisations whose performance may be catastrophically impacted by failures can be defined as high risk industries.
- Those organisations that succeed in avoiding catastrophes in high risk environments are known as High Reliability Organisations (HROs; Roberts & Rousseau, 1989).
- Examples of HROs include nuclear power generation, civil aviation, nuclear submarines, and aircraft carriers.
- These industries do not have a perfect safety record (e.g. Deepwater Horizon, Air France Flight 447).
- However, they have far fewer mishaps that would be expected given the type of operations they carry out.
Reducing Mishap Rates in HROs

- The large hardware issues have generally been addressed in HROs (e.g. wings tend not to fall off aircraft).
- There is a recognition by HROs of the need to address human fallibility and designed systems to minimise the impact of human error through a robust safety culture.

Medical Error Figures

- Institute of Medicine (2000): between 44,000 to 98,000 deaths per year attributed to medical error.
- Extrapolate to Ireland: between 632 to 1,409 deaths

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road accidents (2011)</td>
<td>186</td>
</tr>
<tr>
<td>Homicide (2010)</td>
<td>89</td>
</tr>
<tr>
<td>Diabetes mellitus (2006)</td>
<td>539</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>687</td>
</tr>
<tr>
<td>Pneumonia (2006)</td>
<td>1,974</td>
</tr>
</tbody>
</table>
Example: U.S. Naval Aviation Mishaps

![Graph showing the decrease in Class A, B, & C Mishaps/100,000 Flight Hours from 1977 to 1991. The graph shows a decrease in both Human and Mechanical mishaps.]

Shappell & Wiegmann (1996)

Components of Safety Culture (Reason, 1997)

**Informed culture**
Understand the human, technical, organisational and environmental factors that determine system safety.

**Reporting culture**
People are prepared to report their errors and near-misses.

**SAFETY CULTURE**

**Flexible culture**
The organisation is able to reconfigure in the face of op-tempo shifts or certain other kinds of dangers.

**Just culture**
Atmosphere of trust in which people are encouraged to provide safety-related information, but there is a clear distinction between acceptable and unacceptable behaviour.

**Learning culture**
Willingness of the organisation to draw the right conclusions from safety information and implement major reforms.
Military Thinking

**Red Threat**
The enemy
e.g. enemy fire, improvised explosive devices (IEDs)

**Blue Threat**
The threat posed to friendly military forces from friendly fire or mishaps.

Military examples of blue/red threat statistics

- In 2006, U.S. Naval aviation had 25 major mishaps, with the loss of 21 aircrew, and 17 aircraft, at a cost of almost $508 million.
- Contrast this to direct-enemy action over the same period in which one helicopter was destroyed, with the loss of both aircrew (U.S. Navy Safety Centre, 2006).
- In 2008, 20 U.S. Marines killed in action in Iraq, and 25 were killed riding motorbikes.

*The majority of these mishaps can be attributed to human error*
What is Human Error?

- “An inappropriate or undesirable human decision or behaviour that has the potential to reduce effectiveness, safety, or system performance.” (Sanders & McCormick, 1993).
- The study of human error in the workplace falls within the domain of human factors.

What is Human Factors?

- “Human factors is primarily concerned with the performance of one or more persons in a task-oriented environment interacting with equipment, people, or both” (U.S. National Academy of Sciences, 1992).
- It is a multi-disciplinary field.
- The goals of human factors are to:
  - Enhance performance
  - Increase safety
  - Increase user satisfaction
SHEL Model of Human Factors (Edwards, 1972)

- **Software**
  - Procedures
  - Policies
  - Rules

- **Liveware (people)**
  - Physical
  - Knowledge
  - Attitudes
  - Cultures
  - Stress

- **Environment**
  - Physical
  - Organisational
  - Political
  - Economic

- **Liveware (teams)**
  - Team work
  - Communication
  - Leadership
  - Norms

- **Hardware**
  - Equipment
  - Technology

Healthcare

**Red threat**
The disease, injury, or condition

**Blue threat**
The threat posed to patients from errors made by healthcare professionals.
Example: Turning Off a Ventilator

- **Software**
  - Lack of clear procedures

- **Liveware (people)**
  - Lack of knowledge in use of the ambu bag.
  - Lack of knowledge in how to use ventilator
  - Failure to perform effectively under stress

- **Environment**
  - Failed to enforce standards
  - Failed to ensure personnel were trained

- **Liveware (teams)**
  - Failure to address the patient’s concerns

- **Hardware**
  - Error provoking interface design

Turned Off a Ventilator
Health Care Blue Threat Statistics

- Medical error affects approximately 10% of hospitalized patients.
- Within an Irish context, that equates to approximately 160,000 patients injured every year.
- Approximately 80% of adverse events in health care are due to human error.
- One in 300 chance of a patient being harmed during health care.
- One in a million chance of a traveller being harmed while in an aircraft.
- Clear need for human factors research within the Irish healthcare system.

NUIG Human Factors in Healthcare Research

**Software**
- Surgical checklist
- Orthopedic surgery procedures

**Liveware (people)**
- Human factors training for interns
- Assessment of levels of stress in interns
- Teamwork attitudes and knowledge of surgeons

**Hardware**
- Robotic surgery

**Liveware (teams)**
- Brachiotherapy
- Teamwork attitudes and knowledge of surgeons
Software: Projects in Infancy

- Classifying risk of error at each step in an orthopaedic surgical procedure.
- An assessment of attitudes to the WHO surgical checklist.

Reduced complications by 36%, and deaths by 40% (Haynes et al., 2008).

However, there is no standardisation across Ireland with each hospital making changes (e.g. adding/deleting steps, signatures).
**Hardware**: Laparoscopic vs Robotic Surgical Performance (Hartmann, O’Connor, Bouchier-Hayes, & Allazam)

- Comparison of novices performing basic surgical skills laparoscopically versus robotically.
- Data collected, but not yet analysed.

**Liveware (people)**: Human Factors for Interns (O’Connor, Byrne, & Kerin)

- Designed a short human factors training course for interns based on an aviation model.
- It was identified that training was required in the following non-technical skills:
  - Situation Awareness
  - Decision Making
  - Team Working
  - Leadership
  - Communication
  - Managing Stress
  - Coping with Fatigue
  - Empathy
- Filmed UCHG consultants and a patient representative describing a challenging situation resulting in 11 scenarios.
Findings

- 8 training courses run to date, 51 interns trained.
- The initial reactions were positive.
- Half of the respondents wanted more films to be used in the training, and a quarter wanted more discussion of nontechnical skills.
- Further data collection beyond reactions is on-going.
- Recognised that one 90 minute training course will have limited impact.

Liveware (people): Stress in Interns
O’Connor, Byrne, Lydon, Kerin

- A particularly stressful part of training to be a doctor is the intern year. High levels of stress have been shown to negatively impact patient safety and quality of care.
- A questionnaire was used to assess self-reported levels of stress in interns
- Responses were obtained from 56 inexperienced interns and 34 experienced interns.
## Findings and Conclusions

<table>
<thead>
<tr>
<th>% Pathological</th>
<th>Men</th>
<th>Women</th>
<th>Row total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inexperienced</td>
<td>39.1</td>
<td>36.3</td>
<td>37.5</td>
</tr>
<tr>
<td>Experienced</td>
<td>50.0</td>
<td>5.6</td>
<td>26.5</td>
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<tr>
<td>Column total</td>
<td>43.6</td>
<td>25.4</td>
<td>33.3</td>
</tr>
</tbody>
</table>

- Levels of stress reported by the inexperienced interns and experienced male interns were typical of that of other studies examining stress in interns.
- There is a need for a multi-centre prospective study of levels of stress in Irish interns and screening to identify stressors which may impact ability to deliver optimal patient care.

## Future Intern Stress Research

### Ongoing
- Within subjects assessment design study of levels of stress reported by NUIG Interns at three time points in the intern year.
- A multi-centre study of self-reported stress by interns across Ireland and New Zealand.

### Future
- In the future we would like to screen for ‘at-risk’ medical students.
- Collect physiological measures of stress.
- Examine the effectiveness of intervention strategies.
Liveware (people): Virtual reality training
O’Connor, Byrne, & Kerin

- There is going to be an enormous increase in the numbers of medical students over the next five years.
- However, there is still the need to provide scenario-based training so that they have the clinical and nontechnical skills required to be an effective doctor.
- We have applied for a small amount of NUIG funding to develop a ‘proof of concept’ virtual reality to train basic clinical and non-technical skills.

Liveware (people and team): Teamwork Attitudes and Knowledge of Surgeons
(O’Connor, Ryan, & Keogh, in press)

- A questionnaire was used to assess the attitudes towards, and knowledge of the human factors that contribute to mishaps and poor teamwork.
- Irish surgeons ($n=72$); U.S. Naval aviators ($n=552$ for the attitude questions, and $n=172$ for the knowledge test).
- U.S. Naval aviators have significantly more positive attitudes, and are significantly more knowledgeable about the human factors that contribute to poor performance than Irish surgeons.
Responses to items addressing speaking up and pre- and post-operative briefing.

<table>
<thead>
<tr>
<th>Item</th>
<th>Group</th>
<th>% Frequently/ Very frequently</th>
</tr>
</thead>
<tbody>
<tr>
<td>How frequently are junior personnel afraid to express disagreement with more senior personnel?</td>
<td>SHO</td>
<td>81.5</td>
</tr>
<tr>
<td></td>
<td>Registrar</td>
<td>76.7</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>31.3</td>
</tr>
<tr>
<td></td>
<td>Naval aviator</td>
<td>15.8</td>
</tr>
<tr>
<td>How frequently are adequate pre-operative team briefs conducted?</td>
<td>SHO</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Registrar</td>
<td>23.3</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>18.8</td>
</tr>
<tr>
<td>How frequently are adequate post-operative team briefs conducted?</td>
<td>SHO</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>Registrar</td>
<td>16.7</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>31.3</td>
</tr>
</tbody>
</table>

Implications

- There is a need to stress the importance of assertiveness in juniors, listening in seniors, and more reinforcement, and training in good team working behaviours in the operating theatre.
- Team training given to U.S. theatre teams (similar to that provided to NUIG interns) was found to lead to a decline in surgical mortality of 18% where the training was implemented, compared with a 7% mortality reduction in the control hospitals (Neily et al., 2010).
**Liveware (team):** Oncology Error Analysis (Fallon & van der Putten)

- ROSSA (Radiation Oncology Safety Systems Analysis) project funded by HRB (with Prof Sullivan)
- A systematic approach to safety and risk in radiation oncology
- To look at a retrospective study of incidents and how they can be used to examine the potential of future incidents.
- To allow users to analyse risks and hazards in a systematic way by using the actual patient and data flow
  - Impact of automation on staff roles during brachytherapy treatment by examining human: machine interaction issues.
- The development of a taxonomy to identify areas of risk and error in healthcare.
- Comparison of the risks associated with paper versus electronic patient records.

**Conclusion**

- Many doctors and other health care professionals have ‘swallowed the blue pill.’
- There is a need to put more effort in measures focusing on the blue threat to patients and to improving the safety culture in healthcare within Ireland.
- There is no academic centre for patient safety research and education in Ireland.
- Research is being carried out in this area at NUI Galway.
- With even a little effort and support, NUI Galway has the potential to rapidly become the national leader, and begin to build an international reputation in this area.
Thanks

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“The day you were born was a medical error!”