An Introduction to Quality Improvement & Human Factors – Design for Use by Humans

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Overview and Summary

• Introduction to quality improvement
• Introduction to human factors and safety management
The Linkage of Knowledge Required for Continual Improvement

Professional Knowledge
- Subject
- Discipline
- Values

Improvement Knowledge
- System
- Variation
- Psychology
- Theory of knowledge

Traditional Improvement of Health Care

Continual Improvement of Health Care

(illustration adapted from Paul B. Batalden, MD and Patricia K. Stoltz, PA-C)
Six Areas of Fundamental Knowledge

- System
- Variation
- Psychology
- Theory of Knowledge
- Cause & Effect
- Customer Knowledge
The Nolan Model

Aim

What are we trying to accomplish?

(adapted from Thomas W. Nolan)
The Nolan Model

Aim

What are we trying to accomplish?

Current Knowledge

How will we know that a change is an improvement?

(adapted from Thomas W. Nolan)
The Nolan Model

Aim

What are we trying to accomplish?

Current Knowledge

How will we know that a change is an improvement?

Cycle for Learning & Improvement

What changes can we make that will result in improvement?

(adapted from Thomas W. Nolan)
Elements of the PDSA Cycle

Plan
- State objective of the cycle
- Make predictions
- Develop plan to carry out cycle...

Act
- What changes are to be made?
- What will be the next cycle?

Do
- Carry out the test
- Document problems and unexpected observations
- Begin data analysis

Study
- Complete the data analysis
- Compare data to predictions
- Summarize what was learned
Action Periods

Rapid Change

- Small-scale tests
- Simple measurements
Small cycles soon rather than large ones after a long time
Repeated Use of the Cycle

Hunches
Theories
Ideas

Data

Changes That Result in Improvement

(illustration adapted from Gerald J. Langley, Kevin M. Nolan, and Thomas W. Nolan)
Repeated Use of the Cycle

Changes That Result in Improvement

A P S D

Hunches Theories Ideas

(illustration adapted from Gerald J. Langley, Kevin M. Nolan, and Thomas W. Nolan)
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Changes That Result in Improvement

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How Soon?

Year ➔ Month ➔ Week ➔ Day ➔ Hour
Uses of Data

- Describe
- Learn
Simple Measurements

- Seek usefulness, not perfection
- Don’t wait for the information system
- Use sampling
- Use qualitative and quantitative data
Change Concepts

- All changes don’t lead to improvement, but all improvements require change.
- Change concepts are general notions that can be used to come up with specific ideas for change.
Nolan and company have developed a list of 70 change concepts in 9 categories.
Human factors is:

The science of designing tools, tasks, information, and work systems to be compatible with the abilities of human users; this includes both physical and cognitive abilities.

(This discussion considers also risk perception and behavioral propensities.)
Error (from Reason, 1990):

Error ... those occasions in which a planned sequence of mental or physical activities fails to achieve its intended outcome and the failure can’t be attributed to the intervention of some chance agency.

Errors can be further divided into errors of execution (slips, lapses) and errors of planning (mistakes).
Human Factors and the Nolan Model for Improvement

What are we trying to accomplish?

How do we know that a change is an improvement?

What changes can we make that result in an improvement?

Human factors can help answer this question!
A Design Example: Structural Steel

- Bending
- Crushing
- Deflection
- Thermal Effects
Information Processing and Response

- Perception
- Decision and Response Selection
- Working Memory
- Long-Term Memory
- Response Execution
- Attention Resources
- Stimuli
- Feedback
Error and Cognitive Performance

- Perception
- Decision and Response Selection
- Memory
- Long-Term Memory
- Working Memory
- Response Execution
- Response
- Feedback

Stimuli

Attention Resources
# Cognition & Performance

<table>
<thead>
<tr>
<th>Performance Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skill-based</td>
<td>Virtually or actually automatic (non-conscious) response to familiar situations</td>
</tr>
<tr>
<td>Rules-based</td>
<td>Almost effortless, practiced or expert, if-then/else,</td>
</tr>
<tr>
<td>Knowledge-based</td>
<td>Problem solving in novel situations; powerful but slow, effortful, serial, difficult</td>
</tr>
</tbody>
</table>
## Error Types

<table>
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<tr>
<th>Performance Level</th>
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</thead>
<tbody>
<tr>
<td>Skill-based</td>
<td>Slips, lapses, omissions following interruptions, interference, …</td>
</tr>
<tr>
<td>Rules-based</td>
<td>Exceptions/first exceptions, rule strength, missed countersigns, …</td>
</tr>
<tr>
<td>Knowledge-based</td>
<td>Confirmation bias, selectivity, limited workspace, illusory correlation, overconfidence, …</td>
</tr>
</tbody>
</table>
Performance Levels and Exposure

- Skill-based
- Rules-based
- Knowledge-based

exposure

performance level
Performance Levels and Likelihood of Error

- Skill-based
- Rule-based
- Knowledge-based

exposure

likelihood of error

performance level
## Generic Tasks and Error Probabilities

<table>
<thead>
<tr>
<th>Generic task</th>
<th>Error probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totally unfamiliar, performed at speed with no idea of likely consequences</td>
<td>0.55</td>
</tr>
<tr>
<td>Complex task requiring high level of comprehension and skill</td>
<td>0.16</td>
</tr>
<tr>
<td>Routine, highly practiced, rapid task involving relatively low level of skill</td>
<td>0.02</td>
</tr>
<tr>
<td>Completely familiar, well designed, highly practiced routine task, oft repeated, performed by well motivated, highly trained individual</td>
<td>0.0004</td>
</tr>
</tbody>
</table>
Behavioral Psychology and Safety Management

Violations – intentional deviations from safe operating procedures, standards, or rules.
## Violation Producing Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Likelihood multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived low likelihood of detection</td>
<td>× 10</td>
</tr>
<tr>
<td>Inconvenience</td>
<td>× 7</td>
</tr>
<tr>
<td>Apparent authority or status to violate, disregard or override advice, requests, procedures or instructions</td>
<td>× 3</td>
</tr>
<tr>
<td>No disapproving authority figure present</td>
<td>× 2</td>
</tr>
<tr>
<td>Gender (for males)</td>
<td>× 1.4</td>
</tr>
</tbody>
</table>
Human Factors as a Design Discipline

Performance is a product of design – error is a consequence

- Change stimuli/task information characteristics
  - Team work
  - Reminders/prompts
- Impact attention (carefully)
- Change contents of long-term memory
- Redistribute tasks
- Provide feedback/make the state of the system visible
- Reduce reliance on short-term memory and vigilance
- Manage performance-shaping factors
- Engineer limiting (or forcing) functions
Human Factors as a Diagnosis Tool

Improving a work system starts with diagnosis – why isn’t it working?

• Task analysis: Information characteristics, Complexity, Time constraints
• Context
• Operator: Goals, Mindset, Information available
• Team functioning
• .... 
What causes conditions that promote errors and violations?

- Information Management
- Unfamiliar Task
- Poor Task Design
- Goal Conflicts
- Perceived Authority to Violate Rule

Gap

Errors

Violations

Measure

?
Safety Culture & Organizational Factors

Error/violation promoting conditions

Information Management
Unfamiliar Task
Poor Task Design
Goal Conflicts
Perceived Authority to Violate Rule

Organizational Factors/Safety Culture
- Leadership orientation and effectiveness
- Assumptions about human performance capacity
- Operational models of error causation
- Safety/performance information systems
- Assumptions about the roles of organizations, professionals, regulation, and accreditation
- Promotion of effective team development and functioning
- Organizational values
- Tolerance of deviation or rule violations

Examples of potentially important organizational dimensions (not a comprehensive list).
What’s the alternative?

Health care quality improvement without human factors

• Resistance to change?
• Do reminders work?
• Will time-series analysis help our customers achieve their aims?
• Is education an effective system change?
• Does academic detailing work?
• Are incentives effective?
• Are “systems changes” effective?

We have to do better than observe that there is no magic bullet. Human factors makes the performance of the system more comprehensible and helps us ask better questions.
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“Human error in medicine, and the adverse events that may follow, are problems of psychology and engineering, not of medicine.”

J.W. Senders


