Mistake-Proofing: Changing Designs to Reduce Error

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Disclosures

Nothing to disclose
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• This continuing nursing education activity was approved by the Virginia Nurses Association, an accredited approver by the American Nurses Credentialing Center’s Commission on Accreditation.

• Criteria for successful completion includes attendance at the entire event and submission of a completed evaluation form.

• No individual in a position to control content for this activity has any relevant financial relationships to declare.
Disclosures

• This activity is being jointly provided by Inova Fair Oaks Hospital and Virginia Hospitals and Healthcare Association.

• The contact hours are provided on behalf of Inova.
Agenda/objectives

• Define concept of mistake-proofing
• Identify physical design changes as a key feature of mistake-proofing
• Discuss the limitations of improving mental processes and how knowledge in the world can help
• Discuss FMEA and Fault tree analysis and how certain failure modes can be used as part of an effective vocabulary of prevention strategies
• Discuss evidence necessary to change processes.
• Design thinking
• Call to action
Get the Book as free PDF

- Google: mistake proofing AHRQ Grout
- You should find this entry...

Mistake-Proofing the Design of Health Care Processes | AHRQ Archive
It contains over 150 examples of mistake-proofing that can be applied in health care—and in many cases ... By John Grout, Ph.D., Berry College, Rome, GA ...
Lean anyone?

Is your hospital utilizing lean or six sigma?

ポカヨケ

Poka-Yoke
Generic Improvement

• Adverse event/performance gap occurs
• In-depth understanding of what happened
  – Just Culture (David Marx coming up next)
  – Root Cause analysis
• Fix it.
• Make sure it’s fixed
• Make sure it stays fixed
Generic Improvement

• Fix it.
  – Step 1: Fix
  – Step 2: It
  – Step 3: Fix it
  – Step 4: repeat steps 1-3 until it's fixed

• Make sure it’s fixed

• Make sure it stays fixed

The assumption is that if you understand what happened, you know how to fix it
Knowledge in the World vs. Head

Head:
- Alter SOPs
- Retrain
- Re-certify skills
- Manage & enhance attentiveness

World:
- Provide clues about what to do
- Change process design: embed the details in the process
- Frees mind to consider the “big picture”
- Facilitates “knowledge work”

The Human Factor:
We need additional vocabulary for responding to human error.
Place keeping

Dosage Directions: Take 2 tablets before breakfast, 1 tablet after lunch and supper, and 2 tablets at bedtime.

2nd day: Take 1 tablet before breakfast, 1 tablet after lunch and after supper, and 2 tablets at bedtime.

3rd day: Take 1 tablet before breakfast and 1 tablet after lunch, after supper, and at bedtime.

4th day: Take 1 tablet before breakfast, after lunch, and at bedtime.

5th day: Take 1 tablet before breakfast and at bedtime.

6th day: Take 1 tablet before breakfast.

Unless otherwise directed by your physician, all six (6) tablets in the row labeled 1st day should be taken the day you receive your prescription, even though you may not receive it until late in the day. All six (6) tablets may be taken immediately as a single dose, or may be divided into two or three doses and taken at intervals between the time you receive the medicine and your regular bedtime.
Get a new toothbrush

Use a metric wrench

Your syrup is hot

Take the elevator to X-ray
MRI is this way

Alcatraz kitchen: The convicts are armed
Preventing a different type of fall
Leave me alone while I get these meds

Beware the magnet

Wear your scrubs
A Vocabulary of Responses

- Mistake prevention in the work environment
- Mistake detection
- Mistake prevention
- Minimizing the influence of mistake
Mistake prevention in the work environment
Mistake prevention in the work environment

Before

After

Special thanks to Parson, Hicks & Heller; Wellstar Paulding County Hospital
Pick-to-light bin carousel
Mistake prevention in the work environment
Mistake detection
Mistake prevention
Minimizing the influence of mistakes
Not invented here

See the difference?
Guaranteed to break
Failure Mode  
Effect Analysis (FMEA)

Three 1 to 10 scales: sev * occ * det = risk priority number (RPN)
Fault Tree

\[ P(\text{top event}) = P(F_1F_2) + P(F_3) + P(F_4) = 0.11 \]

\[ P(F_1F_2) = P(F_1) \times P(F_2) = 0.01 \]

Basic Failure #1
\[ P(F_1) = 0.1 \]

Basic Failure #2
\[ P(F_2) = 0.1 \]

Basic Failure #3
\[ P(F_3) = 0.05 \]

Basic Failure #4
\[ P(F_4) = 0.05 \]
Multiple fault trees: Designing Processes to Fail?

“We rely on failure of all kinds being designed into many of the products we use every day, and we have come to depend upon things failing at the right time to protect our health and safety...”

“We often thus encourage one mode of failure to obviate a less desirable mode.”

(Petroski H. Designed to fail. American Scientist 1997; 85:412-46.)
Design in Benign Failures.

"Failure is a relative concept, and we encounter it daily in more frequent and broad-ranging ways than is generally realized. And that is a good thing, for certain types of desirable failures, those designed to happen, are ones that engineers want to succeed at effecting."
Designing Benign Failures

“...a process that is designed to detect failure and to interrupt the process flow is preferable to a process that continues on in spite of the failure...We should favor a process that can, by design, respond automatically to a failure by reverting to a predetermined (usually safe) default mode.

Note that interruptions are process failures

Money Well Spent...

...Creating a Failure

- Audi 5000
- Jeep Grand Cherokee
Using fault trees to design benign failures

Use these methods for TWO purposes:

1. Traditional use: Determine what can happen
   • Carefully define the current situation,
   • Determine causes of undesirable failure, and
   • identify the “resources” required to generate that undesirable failure

2. New use: Determine ways of creating benign failures, and use them AS the preventive measures
   • provide insights into desired failures
   • Identify the “resources” required to generate them.
Using multiple fault trees to design benign failures

Creating benign failures means moving causes from tree #1 to tree #2

Converting Undesired Failures to Benign Failures (before)

1. Pick any failure that is more benign than the one that currently occurs. (The more benign the better.)
2. Somehow change the logic of the trees so the cause of the harmful event causes the benign failure instead.

You have taken a failure and turned it into an “inventive problem”
Converting Undesired Failures to Benign Failures (before)

Undesired failure (operator injury)
- table saw turned on prematurely
  - anti-kickback blade guard not mounted
  - blade insert not mounted properly
  - wrench left on spindle nut

benign failure (aggravation only)
- Table saw motor will not operate
  - Electricity not reaching motor
    - broken wire in electric cord
      - not plugged in
    - motor unable to turn properly
      - excessive friction
      - inadequate lubrication

install limit switch in insert cavity
tie wrench to electric cord near plug
Converting Undesired Failures to Benign Failures (after)

Undesired failure

- Table saw turned on prematurely
- Anti-kickback blade guard not mounted

Benign failure

- Table saw motor will not operate
  - Electricity not reaching motor
    - Break in electrical connection
    - Not plugged in
      - Excessive friction
      - Inadequate lubrication
    - Operator forgets to plug in
    - Wrench left on spindle nut
  - Motor unable to turn properly
SawStop Table Saw

Search “time warp table saw on www.youtube.com
Design failures changes the problem from “prevention” to “invention”

• Now is the best time ever to invent things
“Design thinking” is trending

Instructables.com and Thingiverse.com are clearinghouses for making things

- 3D printed vein finder
- Body motion sensor

FYI: 3D printers cost $500
Not every good idea is highly technical

- Buzzy for shots
- VibraCool
- Wheels on a suitcase? ...Genius!
- Check out Modobag
MIT-based invention support

Total of five expedition sites across the country

- Maimonides Medical Center of Brooklyn, NY
- Driscoll Children’s Hospital of Corpus Christi, TX
- Bon Secours St. Mary’s Hospital of Richmond, VA
- The University of Texas Medical Branch at Galveston, TX
- South Shore Hospital of South Weymouth, MA

For more information Google: TedMed Anna Young & visit MakerNurse.com
Be prepared for what you’ll find

• Makerspaces are often industrial looking and done on the cheap, and inhabited by geeks.
Nation of Makers
Thank you!