THREE DICE:
THE PATH TO HIGHLY RELIABLE OUTCOMES

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PATIENT SAFETY TRENDS

• Healthcare Systems continue to look for answers to preventable patient harm

• “Highly Reliable Organizations” seems to offer promise – can healthcare look like aviation?

• Hospitals following the “Vision Zero” trend – “no preventable harm by 2020”
DOES HEALTHCARE WANT TO LOOK LIKE AVIATION?

INJURY RATES

Industry Average: 3.2 per 100 full time workers per year

- Financial Portfolio Management: 0.1
- Nuclear Power Generation: 0.3
- Petroleum Refining: 0.7
- Railroads: 2.0
- Commercial Fishing: 2.0
- Coal Mining: 3.8
- Healthcare: 4.5
- Logging: 5.1
- Airlines: 8.2
- Police: 10.6
- Fire: 12.1

2014 BLS
WHAT IS HIGH RELIABILITY?

1 in 10?
1 in 100?
1 in 1000?
1 in 100,000?
1 in a Million?
1 in a Billion?
0?

The “infrequent” occurrence of adverse events?
SWEDEN’S VISION ZERO

Adopted by Sweden in 1997

• Then 541 deaths per year
• Goal of 50% reduction by 2007
• Goal of zero deaths by 2020

In 2007

• 471 fatalities
• 13% actual reduction, compared to 50% goal

Goal amended in 2009

• Total reduction of 50% by 2020
• Zero accidents by 2050
THE PROBLEM WITH ZERO
US – YOU, ME, THAT PERSON SITTING NEXT TO YOU

We are inherently self-serving, occasionally altruistic, happiness-seeking, inescapably fallible, pack animals blessed (or cursed) with free will and a mis-tuned ability to see and avoid hazards in the world around us.
SOME MATH
A SIMPLE SIX-SIDED DIE

The odds of rolling a one?
A SIMPLE SIX-SIDED DIE

The odds of rolling two ones?
A SIMPLE SIX-SIDED DIE

The odds of rolling three ones?
THREE 100-SIDED DIE?

The odds of rolling three ones?
THREE 1000-SIDED DIE?

The odds of rolling three ones?
“THREE DICE” EXPLORED

How many mistakes (or independent events) does it take to back over a child?
THE DESIGN

Three dice – so why do we kill two kids a week?
OUR TYPICAL STRATEGY?

Hey you! We got a new rule: Don't back over a child

Child hit by car

We play with one dice, we hope for perfection, and then we wonder why it didn’t work
DON’T BELIEVE ME?
THE NEW YORK CITY SUBWAY
HEY YOU – DON’T FALL IN THE TRACKS!
HOW ABOUT BETTER SYSTEM DESIGN?
THINKING ABOUT DESIGN

1. Acknowledge that perfection is not possible
2. Set expectations (THREE DICE)
3. Design to reduce to rate of human error
4. Design to tolerate human error
5. Design to avoid common cause failure
6. Design to mitigate harm
7. Design to avoid upstream drift
8. Design to avoid downstream drift
9. Design to avoid self-interested behavior
10. Be proactive
ACKNOWLEDGE THAT PERFECTION IS NOT POSSIBLE

- We build a system comprised of inescapably fallible human beings. As a consequence, perfection itself is not possible. *(there is no such thing as a “never” event)*

- That said, we set an expectation, we design the system, we manage within the system, we continuously audit/assess/learn.

A Risk Profile – for a Single Class of Outcome (e.g., wrong dose of drug)

As Low As Reasonably Practicable (ALARP)
SET AN EXPECTATION

As for me and my house...

We will, where possible, put ourselves three human errors from patient harm
THE BASIC TRAJECTORY

Human Error → Undesired Outcome
DESIGN TO REDUCE THE LIKELIHOOD OF HUMAN ERROR

Play with one dice – just have lots of sides on that one dice
DESIGN TO TOLERATE HUMAN ERROR

- Recovery
- Redundancy

Play with three or more dice, where you can
DESIGN TO AVOID COMMON-CAUSE FAILURE

Huma n Error  Defense  Defense  Defense  Undesired Outcome

Dependency

Make sure the dice are not stuck together
DESIGN TO MITIGATE HARM

Reduce the impact (mitigate harm)
DESIGN TO AVOID UPSTREAM DRIFT

Keep the error rate low – prevent upstream drift
DESIGN TO AVOID DOWNSTREAM DRIFT

Make sure humans do not remove themselves as defenses
DESIGN TO AVOID SELF-INTERESTED BEHAVIOR

Be realistic – we humans will sometimes be particularly self-serving
BE PROACTIVE

• Monitor it all
• But actively manage:
  • System Design
  • Safety Culture

Three Dice

Patient Harmed

Patient Given Wrong Medication

Patient Nearly Given Wrong Medication – only one mistake away

Design of the Medication Delivery System

Behavioral Choices of those within the System
WHERE WE DO WELL - SPONGES

Surgeon leaves sponge in patient → Scrub miscounts → Circulator miscounts → RFID Counting System Fails → RFID wanding fails to detect sponge → Sponge left in patient

Five dice – good design! (actually, overbuilt)
Do laps of nursing station, take your infusion pump with you, but remember, please do not fall

While it does not prevent us from having a goal of zero falls, is it being disingenuous? (Like my goal of being an NFL wide receiver)
BEHAVIORAL CHOICES

Patient Harmed

Patient Given Wrong Medication

Patient Nearly Given Wrong Medication – only one mistake away

Design of the Medication Delivery System

Behavioral Choices of those within the System
HUMAN CHOICE

I know, I know. I can’t reach the top. Hey, do we have a third ladder?

Hurry, Bob, the Giants play the Patriots in 10 minutes.
A SIMPLE MENTAL MODEL

Perception ➞ Interpretation and Decision-Making ➞ Action

Sight
Sound
Smell
Taste
Touch

Pursuit of the Mission

The “Risk Monitor”
(background process, harm focused)
THE LIMITS OF NATURAL CONSEQUENCES

The less likely the undesired outcome, the more distant the undesired outcome, the harder it is to see the link between a risky choice and the undesired outcome it may cause.
HOW WE MAKE CHOICES

• “Life, Liberty, and the Pursuit of Happiness”
• Pursue our individual mission, while trying to respect our shared values
• We are NOT inherently rule followers (we take them under advisement)
• We ARE hazard and threat avoiders
  • Natural and man-made hazards
  • Values-based threats
  • Engineered threats
WE HUMANS PURSUE OUR INDIVIDUAL MISSIONS, WHILE TRYING TO AVOID HAZARDS

Man-Made Hazard

Values-Based Threat

Engineered Threat
AN ORDER OF PREFERENCE?

1. I comply because I see the link between my deviation and the potential harm being managed by the rule.

2. I comply because it’s a cultural expectation (peer condemnation).

3. I comply to avoid organizational sanction.

I comply because it’s the rule
CHOICES = CULTURE

Culture: the degree to which human beings will, through their choices, be protective of a shared value. This often appears as the “extra effort” it takes to act in protection of a value, in the face of a belief that potential harm is uncertain, delayed, or will simply happen to someone else.
THE THREE BEHAVIORS

Human Error - inadvertent action, inadvertently doing other than what should have been done, slip, lapse, mistake.

At-Risk Behavior - behavioral choice that increases risk where risk is not recognized or is mistakenly believed to be justified.

Reckless Behavior - behavioral choice to consciously disregard a substantial and unjustifiable risk.
Human Error – Inadvertent action; inadvertently doing other than what should have been done; slip, lapse, mistake.
At-Risk Behavior – Behavioral choice that increases risk where risk is not recognized or is mistakenly believed to be justified.
Reckless Behavior – Behavioral choice to consciously disregard a substantial and unjustifiable risk.
### JUST CULTURE

<table>
<thead>
<tr>
<th>Human Error</th>
<th>At-Risk Behavior</th>
<th>Reckless Behavior</th>
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</thead>
<tbody>
<tr>
<td>Product of Our Current System Design and Behavioral Choices</td>
<td>A Choice: Risk Believed Insignificant or Justified</td>
<td>Conscious Disregard of Substantial and Unjustifiable Risk</td>
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<tr>
<td>Manage through changes in:</td>
<td>Manage through:</td>
<td>Manage through:</td>
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<tr>
<td>• Choices</td>
<td>• Removing incentives for at-risk behaviors</td>
<td>• Remedial action</td>
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<td>• Processes</td>
<td>• Creating incentives for healthy behaviors</td>
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<td>• Procedures</td>
<td>• Increasing situational awareness</td>
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<td>• Design</td>
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<td>• Environment</td>
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**Console**

**Coach**

**Sanction**
GETTING TO HIGHLY RELIABLE OUTCOMES
UNDERSTAND WHAT WE CAN CONTROL

Systems + Choices = Outcomes

Reliable Systems + Good Choices = Good Outcomes
HIGHLY RELIABLE OUTCOMES

There is no such thing as a “high reliability organization”

There are only organizations who are highly reliable around those outcomes that they value

Highly reliable outcomes require:

• An investment in time to determine an appropriate system design
• An investment in the cost of the system design (the three dice)
• An investment in time to shape the right behavioral choices within the system (keeping the dice in play)
• An investment in time to monitor system performance, adjust system and as needed (knowing what’s happening)
WHAT IS POSSIBLE?

For each class of adverse outcome (e.g., RFO, SSI, wrong dose), you should expect a 50% per year drop, until ALARP
THANK YOU