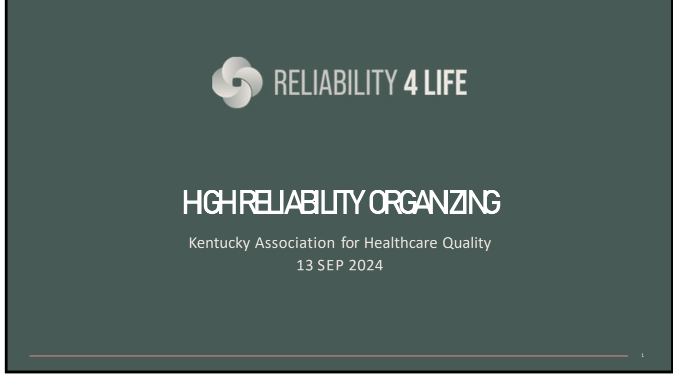


Craig Clapper PE is a systems engineer who specializes in improving human and machine-based systems using evidence-based methods from high reliability organizations.

He is a founder and the chief knowledge officer of Reliability 4 Life (R4L) with 30 years of experience in improving reliability in power, transportation, manufacturing, and healthcare industries. He specializes in failure analysis, event analysis, reliability improvement, and safety culture improvement.

Craig has led safety culture transformation engagements for Duke Energy, the US Department of Energy, ABB Automation Company (formerly ASEA Brown Boveri, a Swedish-Swiss multinational corporation headquartered in Zurich, Switzerland, operating mainly in robotics, power, heavy electrical equipment and automation technology areas), Westinghouse, Framatome ANP (Advanced Nuclear Power), Sentara Healthcare, and Sharp Healthcare. Prior to entering private practice, Craig was the Chief Knowledge Officer of Healthcare Performance Improvement (HPI), the Chief Operating Officer of HPI, the Chief Operating Officer of Performance Improvement International, Vice President of Failure Prevention Inc. (FPI), Systems Engineering Manager for Hope Creek Nuclear Generating Station, and Systems Engineering Manager for Palo Verde Nuclear Generation Station.

Clapper holds a Bachelor of Science degree in Nuclear Engineering from Iowa State University, a Professional Engineer (PE) license in Mechanical Engineering from the State of Arizona, a Certified Reliability Engineer (CRE) certification from the American Society for Quality (ASQ), and a Certified Manager of Quality (CMQ) certification from the American Society for Quality (ASQ).

Publications: Zero Harm: How to Achieve Patient Safety in Healthcare
Chapter 5, Safety Science and HRO, The Healthcare Quality Book 5th Ed
Maximize Patient Safety with Advanced Root Cause Analysis

RELIABILITY 4 LIFE

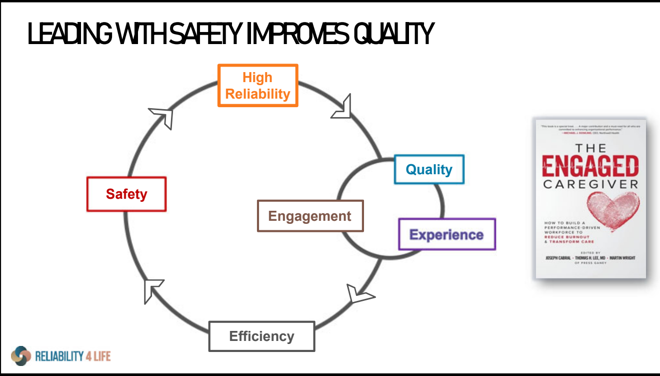
RELIABILITY

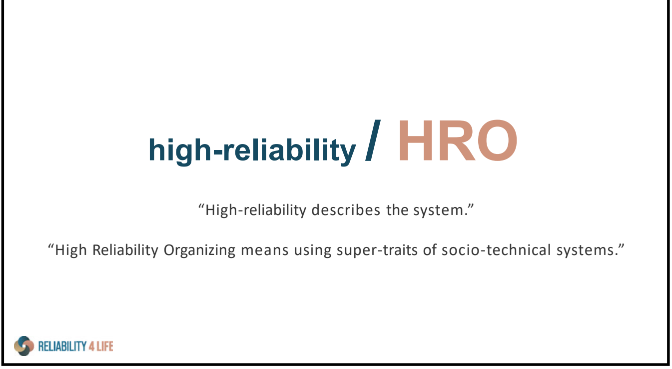
Reliability is the probability that a system will function successfully.
Reliability (R) = total demands – failures (system error)

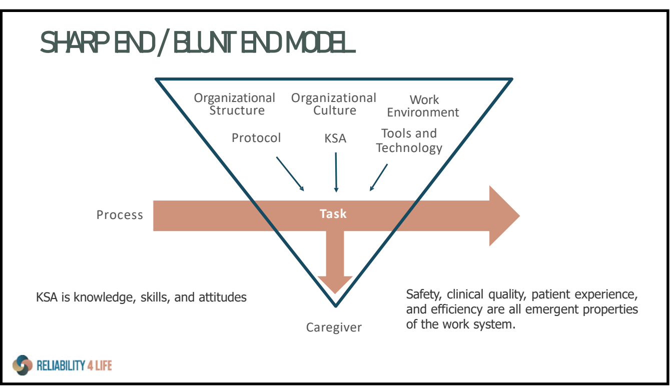
$$R = 1 - \varepsilon$$

RELIABILITY 4 LIFE

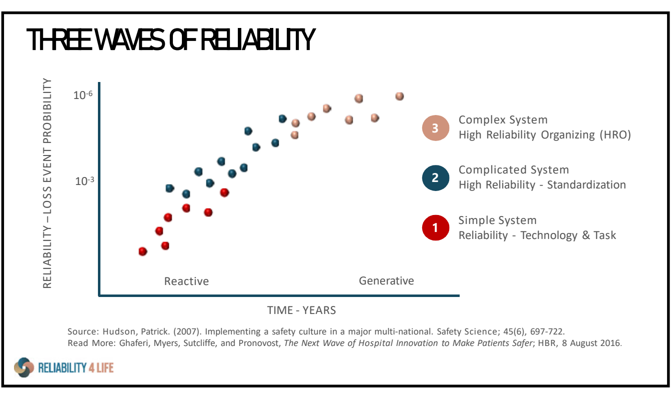
80% reduction
in loss events every macro-improvement cycle
ZERO HARM
Leading with Safety
RELIABILITY 4 LIFE

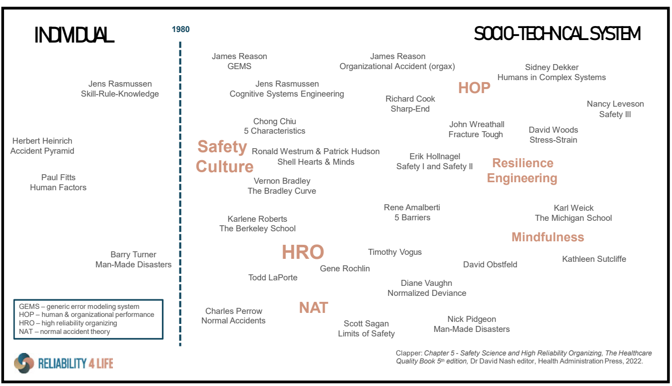

LEADING WITH SAFETY IMPROVES QUALITY
High Reliability
Quality
Experience
Engagement
Safety
Efficiency
THE ENGAGED CAREGIVER
RELIABILITY 4 LIFE

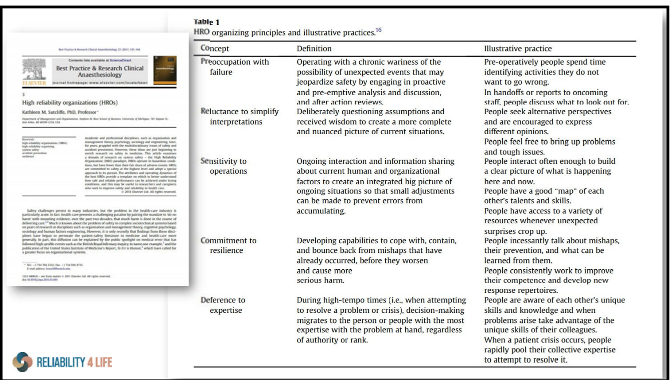

high-reliability / HRO
"High-reliability describes the system."
"High Reliability Organizing means using super-traits of socio-technical systems."
RELIABILITY 4 LIFE


SHARP END / BLUNT END MODEL
Organizational Structure
Organizational Culture
Work Environment
Protocol
KSA
Tools and Technology
Process
Task
KSA is knowledge, skills, and attitudes
Caregiver
Safety, clinical quality, patient experience, and efficiency are all emergent properties of the work system.
RELIABILITY 4 LIFE

Complicated or Complex?


THREE WAVES OF RELIABILITY
RELIABILITY – LOSS EVENT PROBABILITY
10^{-6}
10^{-3}
Reactive
Generative
TIME - YEARS
3 Complex System
High Reliability Organizing (HRO)
2 Complicated System
High Reliability - Standardization
1 Simple System
Reliability - Technology & Task
Source: Hudson, Patrick. (2007). Implementing a safety culture in a major multi-national. Safety Science; 45(6), 697-722.
Read More: Ghaferi, Myers, Sutcliffe, and Pronovost, The Next Wave of Hospital Innovation to Make Patients Safer; HBR, 8 August 2016.
RELIABILITY 4 LIFE



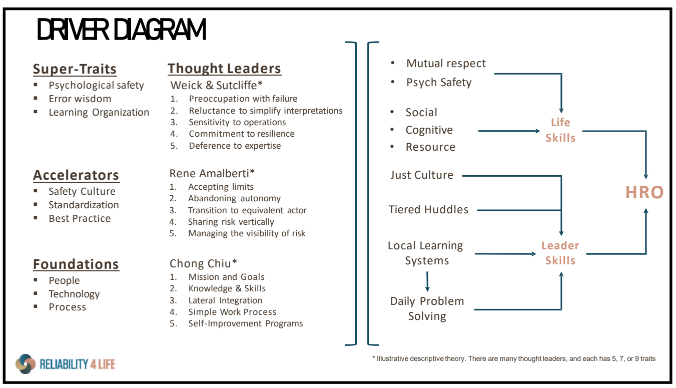


Best Practice & Research Clinical Anaesthesiology

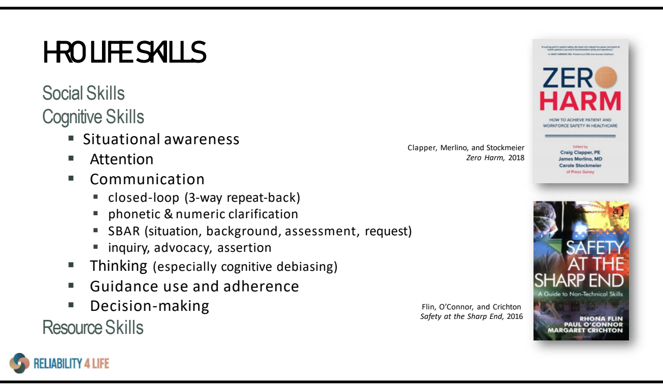
High reliability organizations (HROs)

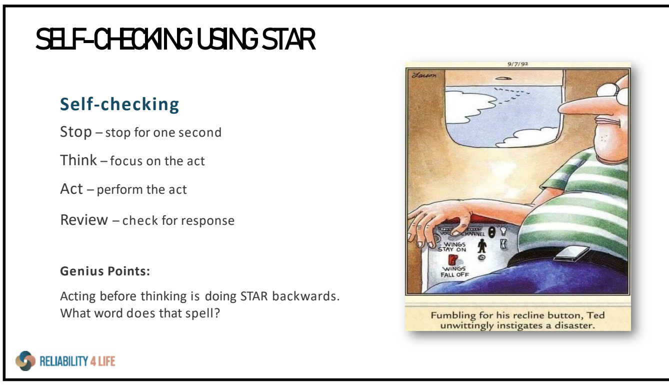
Table 1
HRO organizing principles and illustrative practices.[16]

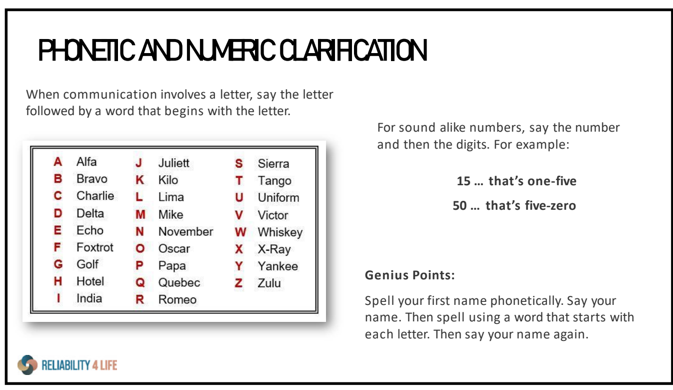
Concept	Definition	Illustrative practice
Preoccupation with failure	Operating with a chronic wariness of the possibility of unexpected events that may jeopardize safety by engaging in proactive and pre-emptive analysis and discussion, and after action reviews.	Pre-operatively people spend time identifying activities they do not want to go wrong. In handoffs or reports to oncoming staff, people discuss what to look out for.
Reluctance to simplify interpretations	Deliberately questioning assumptions and received wisdom to create a more complete and nuanced picture of current situations.	People seek alternative perspectives and are encouraged to express different opinions. People feel free to bring up problems and tough issues.
Sensitivity to operations	Ongoing interaction and information sharing about current human and organizational factors to create an integrated big picture of ongoing situations so that small adjustments can be made to prevent errors from accumulating.	People interact often enough to build a clear picture of what is happening here and now. People have a good "map" of each other's talents and skills. People have access to a variety of resources whenever unexpected surprises crop up.
Commitment to resilience	Developing capabilities to cope with, contain, and bounce back from mishaps that have already occurred, before they worsen and cause more serious harm.	People incessantly talk about mishaps, their prevention, and what can be learned from them. People consistently work to improve their competence and develop new response repertoires.
Deference to expertise	During high-tempo times (i.e., when attempting to resolve a problem or crisis), decision-making migrates to the person or people with the most expertise with the problem at hand, regardless of authority or rank.	People are aware of each other's unique skills and knowledge and when problems arise take advantage of the unique skills of their colleagues. When a patient crisis occurs, people rapidly pool their collective expertise to attempt to resolve it.

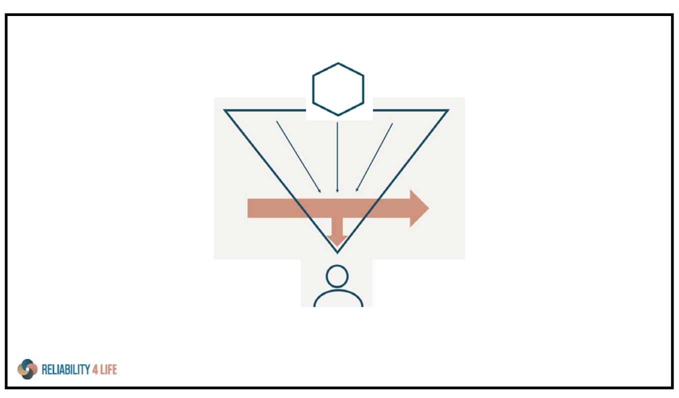


Craig Clapper, CE, CRE
Founder and the Chief Knowledge Officer
Reliability 4 Life (R4L)


HRO LIFE SKILLS
Social Skills
Cognitive Skills
Situational awareness
Attention
Communication
closed-loop (3-way repeat-back)
phonetic & numeric clarification
SBAR (situation, background, assessment, request)
inquiry, advocacy, assertion
Thinking (especially cognitive debiasing)
Guidance use and adherence
Decision-making
Resource Skills
Clapper, Merlino, and Stockmeier
Zero Harm, 2018
ZERO HARM
Flin, O'Connor, and Crichton
Safety at the Sharp End, 2016
SAFETY AT THE SHARP END
RHONA FLIN
PAUL O'CONNOR
MARGARET CRICHTON
RELIABILITY 4 LIFE


SELF-CHECKING USING STAR
Self-checking
Stop – stop for one second
Think – focus on the act
Act – perform the act
Review – check for response
Genius Points:
Acting before thinking is doing STAR backwards.
What word does that spell?
WINGS STAY ON
WINGS FALL OFF
Fumbling for his recline button, Ted unwittingly instigates a disaster.
RELIABILITY 4 LIFE


PHONETIC AND NUMERIC CLARIFICATION
When communication involves a letter, say the letter followed by a word that begins with the letter.
A Alfa
B Bravo
C Charlie
D Delta
E Echo
F Foxtrot
G Golf
H Hotel
I India
J Juliett
K Kilo
L Lima
M Mike
N November
O Oscar
P Papa
Q Quebec
R Romeo
S Sierra
T Tango
U Uniform
V Victor
W Whiskey
X X-Ray
Y Yankee
Z Zulu
For sound alike numbers, say the number and then the digits. For example:
15 … that's one-five
50 … that's five-zero
Genius Points:
Spell your first name phonetically. Say your name. Then spell using a word that starts with each letter. Then say your name again.
RELIABILITY 4 LIFE

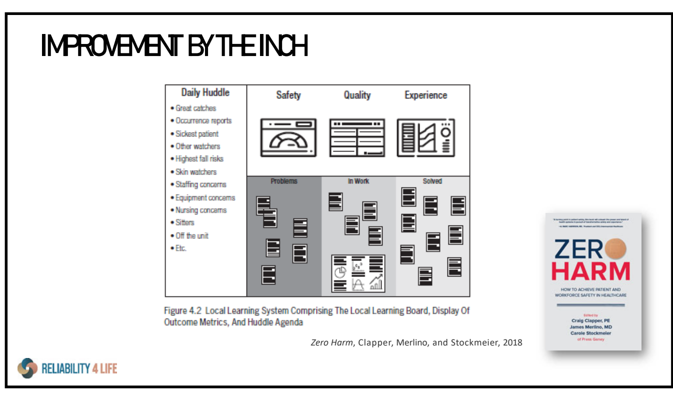


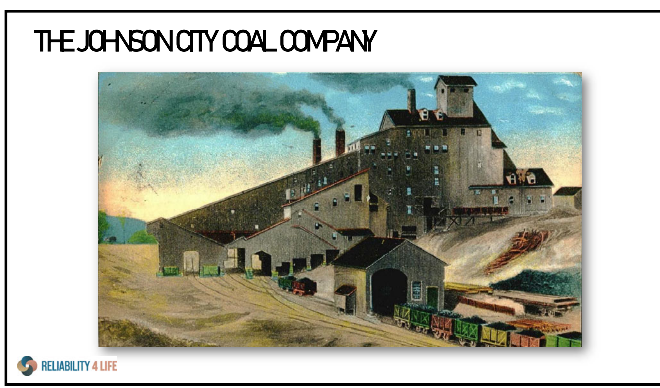
THREE-PART STRUCTURE

Choose a message (or story) that shapes the culture that you want for your patients and people. Plan your message or story. Deliver your safety moment in three parts:

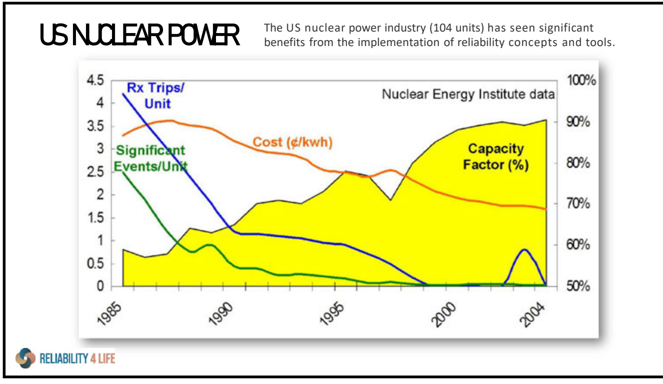
1. Open by introducing your message
2. Relay your message (not read your message) as a simple narrative
3. Finish by revisiting your theme and increase energy for emphasis

RELIABILITY 4 LIFE


IMPROVEMENT BY THE INCH
Daily Huddle
• Great catches
• Occurrence reports
• Sickest patient
• Other watchers
• Highest fall risks
• Skin watchers
• Staffing concerns
• Equipment concerns
• Nursing concerns
• Sitters
• Off the unit
• Etc.
Safety
Quality
Experience
Problems
In Work
Solved
Figure 4.2 Local Learning System Comprising The Local Learning Board, Display Of Outcome Metrics, And Huddle Agenda
Zero Harm, Clapper, Merlino, and Stockmeier, 2018
ZERO HARM
RELIABILITY 4 LIFE


THE JOHNSON CITY COAL COMPANY
RELIABILITY 4 LIFE

RELIABILITY 4 LIFE
APPENDIX



PUBLISHED CASE STUDY

1. **Duke Power** – *Six Tools* approach from 1995-1996 results in fewer events, increased generation, lower production costs (*Power Engineering*, October 2002).
2. **Tennessee Valley Authority (TVA)** – human reliability approach 1997-1998 results in 55% reduction in events and $30 M reduction in cost of poor safety (COPS) (North American Electric Reliability Corporation (NERC)).
3. **Bonfire Collapse Texas A&M University** – organizational and behavior issues contributing to the structure collapse resulting in 12 fatalities and 27 injured (technical report series (USFA-TR-133 / November 1999).
4. **Memorial Health University Health System** – 89% serious harm reduction, Clinical Advisory Board, 2005.
5. **Sentara Healthcare** – 80% serious harm reduction overall (50% harm reduction in 18 months) - AHA Quest for Quality Award 2004, Eisenberg Quality Award 2005.
6. **Advocate HealthCare** - "Can Your Nurses Stop a Surgeon?" *Hospitals & Health Networks*, September 2007.
7. **Spectrum Health Helen DeVos Children's Hospital** – 68% reduction in serious safety events over first two years (Journal of Patient Safety, SEP 2012).
8. **Memorial Hermann Health System** – certified zero awards for harm on units, Eisenberg Quality Award, 2012.

RELIABILITY 4 LIFE

PUBLISHED CASE STUDY

9. **Vidant Health** – 83% serious harm reduction overall, 62% HAI reduction, and 98% optimal care (core measures). TJC Eisenberg Quality Award, 2013.
10. **WellStar Health System** – 90% serious patient harm reduction and 84% worker injury reduction, NPSF Annual Patient Safety Conference, 2014.
11. **Abington Memorial Hospital** – 85% reduction in serious preventable harm. (2013 Delaware Valley Patient Safety & Quality Award winner.)
12. **Owensboro Health** – falls reduced by 75%, HAPU to zero. (April 2013, Healthcare Executive).
13. **Main Line Health System** – five hospital system in Philadelphia area, 88% reduction in serious preventable harm with related 58% reduction in mortality and 28% increase in HCAHPS. (2014 Delaware Valley Patient Safety & Quality Award winner.)
14. **Solutions for Patient Safety** – eight Ohio children's hospitals, 60% reduction in serious preventable harm. National network – 1,897 kids not harmed and $45,061,000 savings.
15. **Community Health Systems (CHS)** – reduces serious preventable harm by 79.9% for legacy hospitals (PG Industry Edge, February 2017).
16. **Novant Health** – reduces serious safety event rate by 86%, from a baseline of 0.86 to 0.12 in 6 years. (*Creating and Maintaining a System-wide Safety Event Classification Team,* HPI – Press Ganey Safety Summit 2017.)

RELIABILITY 4 LIFE

PUBLISHED CASE STUDY

17. **Genesis Health** - achieved zero Serious Safety Events (SSE) in JUN 2017, meaning zero SSE for 12 consecutive months (Journal of Healthcare Risk Management online, 2018).
18. **Primary Children's** – 44.2% reduction in serious preventable harm (Presented by Intermountain Health at the Press Ganey *Pediatrics Summit* in Palm Beach, FL, 27 APR 2018).
19. **Sharp HealthCare** – 64% reduction in serious preventable patient harm and 48% reduction in workforce injury over two years (Zero Harm, NOV 2018).
20. **SCL Health** – 62% reduction in serious preventable patient harm over 3 years and 58% reduction in workforce injury over 3 years (Zero Harm, NOV 2018).
21. **Signature Health** - 80% reduction in serious preventable patient harm and 75% reduction in workforce injury over four years. HCAHPS communication with nurses' domain score improved four percent between 2013 and 2018. Safety Culture assessment scores between 2013 and 2017 improved in 7 of 12 dimensions. 20% improvement in non-punitive response to error, reaching the 85th percentile nationally. 16% improvement in communication openness, putting them at 90th percentile. (Zero Harm, NOV 2018).
22. **Solutions for Patient Safety** – 135 children's hospital members, 11,108 fewer children seriously harmed, and $182,604,000 saved (Solutions for Patient Safety (SPS) 2018 Year in Review).

RELIABILITY 4 LIFE

PUBLISHED CASE STUDY

23. **Inspira Health** - 79% reduction in serious preventable patient harm and a 49% reduction in workforce injury over four years. Safety culture improved 35% and engagement improved 2%. (The Engaged Caregiver, NOV 2019).
24. **Providence St Joseph Health** – "Our results have been striking. Between 2015 and 2018, our rates of infection decreased significantly." (Spreading at Scale, NEJM Catalyst FEB 2020) (Providence had previously shared a 48% reduction in serious preventable patient harm and 5% increase in safety culture survey for first 35 hospitals over first 5 years in Zero Harm, NOV 2018.)

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