

MEDICINE AND SOCIETY

How High Reliability Can Facilitate Clinical, Organizational, and Public Health Responses to Global Ecological Health Risks

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Abstract

High reliability organizations operate in complex, high-hazard domains for extended periods without serious accidents or catastrophic failures. High reliability can be described as a condition of persistent mindfulness within an organization, coupled with a relentless, assiduous prioritization of adverse event prevention. This article describes ethically and clinically relevant features of high reliability that health care organizations can draw on to anticipate, identify, and respond to global ecological health threats.

High Reliability and Global Health

In February 2023, the West African country of Equatorial Guinea declared an outbreak of Marburg virus disease, formerly known as Marburg hemorrhagic fever.¹ There had been at least 9 laboratory-confirmed cases, 7 of which resulted in death during this outbreak, according to the World Health Organization.¹ The pathogen likely spilled over from wild animals to humans. In 1967, the Marburg virus was identified when outbreaks of the disease in Marburg and Frankfurt, Germany, and in Belgrade, Serbia, were traced to African green monkeys imported from Uganda that were being used in laboratories.² Outbreaks of **Marburg virus disease** have typically resulted from prolonged exposure to mines or caves inhabited by *Rousettus* bat colonies.³ As many species of bats are endangered,⁴ disease prevention campaigns to protect people living close to bat-inhabited caves and tourist groups become complex undertakings. While there have been no reported Marburg virus disease diagnoses in the United States, the World Health Organization believes the disease has epidemic potential,² and the Centers for Disease Control and Prevention (CDC) seeks to “increase awareness of the risk of imported cases in the United States.”⁵

These outbreaks of Marburg virus disease underscore that the world’s ecosystems are fragile, delicately balanced, and complex systems, and, as such, rife with potential for collapse and health threats. The consequences of failure within these complex systems could be dire. Moreover, health threats such as viral spillover or spillback can be accelerated by climate change and exacerbated by undesirable socioeconomic conditions,⁶ such as overcrowding. This article argues that health care organizations could benefit greatly from the adoption of systematic methods conducive to high

reliability to effectively respond to global ecological health risks and, to this end, canvasses key principles and practical considerations pertaining to high reliability for health care and public health organizations.

High Reliability Organizations

The construct of *high reliability organization* (HRO) was originally applied to high-hazard industries, such as nuclear power and commercial aviation, to achieve minimal errors. Arguably, these are industries in which even a slight error can have catastrophic consequences.⁷ In 1984, Yale sociologist Charles Perrow published a groundbreaking book, *Normal Accidents: Living with High-Risk Technologies*, which provides a detailed analysis of complex systems from a sociological perspective.⁸ It was the first to propose a framework for characterizing complex technological systems, such as air traffic, marine traffic, chemical plants, dams, and especially nuclear power plants, by inherent risk.⁵ Subsequently, a group of researchers at the University of California, Berkeley (Todd La Porte, Gene Rochlin, and Karlene Roberts) studied *Normal Accidents* and how organizations working with complex and hazardous systems operated error free.⁹ While many of their findings related to structure, they also showed that culture and decision-making processes had the potential to challenge some of Perrow's original tenets, and the results of these studies helped give rise to what is recognized today as the concept of HRO.⁹

Health care organizations comprise complex, sophisticated, high-risk systems and technologies; significant and even potentially catastrophic consequences could ensue should failures occur. For this reason, health care and public health organizations would benefit greatly from the incorporation of HRO principles in their leadership, organizational structure, operations, and systems, as well as in their foundational culture.¹⁰

Basic HRO Principles

Reliability can be defined as the quality of being trustworthy or performing consistently well. To realize this quality, the HRO framework should be underpinned by 3 pillars: (1) leadership commitment, (2) a culture of safety, and (3) process improvement. In their book, *Managing the Unexpected: Resilient Performance in an Age of Uncertainty*, Karl Weick and Kathleen Sutcliffe defined 5 principles of HROs,¹¹ which the Agency for Healthcare Research and Quality later adopted for the health care setting.¹² These principles amplify and build on the 3 fundamental ideas mentioned above and furnish the basic structure of HROs.

Preoccupation with failure (and the anticipation and prevention thereof). Upholding this principle involves assiduously examining processes and conditions to ferret out “what could possibly go wrong” (taking Murphy's Law literally). An example of a familiar method for carefully and systematically reviewing a process and its associated risks to anticipate and **mitigate the occurrence of failure** is failure modes and effects analysis (FMEA)—also called failure modes, effects, and criticality analysis.¹³ Originally developed by the US military in the 1940s, FMEA is a proactive, step-by-step process-analysis tool for identifying all possible failures in a design or process—or “failure modes”—and “effects analysis” refers to study of the consequences of those failures.¹³

Sensitivity to operations, or strong consideration of the purpose, integration, and complexity of relevant systems and processes. One example of the application of this principle is Harvard Business School's study of the 2003 Columbia space shuttle

disaster.¹⁴ This study included a poignant review of the culture of the National Aeronautics and Space Administration's space shuttle program and takeaway lessons, including organizational decision making, understanding how failures can evolve and be prevented, and how to manage crises effectively.¹⁴

Reluctance to simplify. Novelist Jack Kerouac once said, "One day I will find the right words, and they will be simple."¹⁵ With all due respect to Kerouac's commitment to simplicity and other common principles like the "KISS" method (keep it simple, stupid) or Occam's Razor (the law of parsimony), I contend the opposite: a reluctance to simplify means accepting that operations are very complex and anticipating that the risk of failure is inherent in complicated and tightly coupled systems.

Commitment to resilience. Resilience can be defined as the capacity to recover quickly from difficulties. In the context of organizations, resilience—how well and how quickly an organization bounces back, adjusts, and recovers—can be developed by prioritizing contingency planning and training in response to possible, albeit unlikely, system failures or unforeseen difficulties.

Deference to expertise. This principle involves seeking out staff with the most pertinent knowledge and privileging their insights and perspectives over those of staff members with greater seniority or in a higher position in the organization. For example, administrators could ask environmental services or housekeeping staff for ideas about better management of waste streams that could potentially contribute to release of methane and carbon dioxide (CO₂) in landfills.¹⁶

HRO and a Culture of Safety

Layering concepts of patient safety onto a bedrock of high reliability is a natural progression for hospitals, especially since—ironically—hospitals can be quite unsafe.

In 1850, Hungarian physician Ignaz Semmelweis stood behind the lectern at the Vienna Medical Society's lecture hall and bravely presented a lifesaving epiphany that could be summed up in 3 little words: wash your hands!¹⁷ His colleagues and other medical professionals, however, were incredulous, mainly because they refused to accept the idea that they could be responsible for spreading infections.¹⁷ In today's hospitals, according to the CDC, about 1 in 31 patients has at least 1 health care-associated infection on any given day.¹⁸ When patients enter the facility's doors, it demonstrates their trust in the organization's covenant. This promise dates back to the Hippocratic Oath itself.¹⁹

It is imperative that patient safety culture be essentially hardwired and exist at all levels and in all aspects of the organization and that it embody shared values, attitudes, norms, beliefs, practices, policies, and behaviors about safety issues in daily practice.²⁰ Safety culture is what is often referred to as "speak up culture." A recent *LinkedIn* article defines speak up culture as a healthy, supportive environment in which people can **speak up and speak out**, where they can feel emboldened to point out both challenging areas and opportunities for new disruptions and innovations.²¹ In the context of health care organizations, staff at all levels—regardless of seniority or clinical discipline—should feel safe enough and confident enough to raise their hand if something just doesn't feel right: "see something—say something."

Interweaving a culture of safety into the fabric of an organization requires an important, albeit uncomfortable, commitment to depart from the old way of doing things. Defending “how we’ve always done it” allows what author James O’Toole described as the “despotism of custom.”²² If the status quo remains unchecked and unchallenged, mediocrity can engulf an organization like kudzu. Leaders must be true paladins of safety and quality and not merely a group of prefects and school hall monitors.

High Reliability and Climate Change

It appears that man’s neglect and lack of environmental stewardship has helped to elevate Shakespeare from poet to prophet. The earth’s atmosphere is indeed rapidly becoming a “foul and pestilent congregation of vapours.”²³ In 2020, the United States’ first-ever trial in a constitutional climate lawsuit commenced in Helena, Montana. In the case (*Held v Montana*), 16 young plaintiffs, ranging from 2 to 18 years of age when the suit was filed, alleged that Montana state officials violated their constitutional right to a healthy environment by enacting pro-fossil fuel policies.²⁴ On August 14, 2023, a district court judge ruled in the plaintiffs’ favor.²⁵ Needless to say, this ruling makes a powerful statement, analogous to the rock band Twisted Sister’s anthem, “Oh we’re not gonna take it; No, we ain’t gonna take it ... anymore.”²⁶

Climate change is no secret and definitely not a hyperbolic, contrived conspiracy myth: studies show that increased spates of extreme rainfall, flooding, blistering heat waves (paleoclimatologists reported that, by mid-year 2023, the earth had reached its highest average temperatures in recorded history²⁷), and arid drought have occurred over the past 20 years, which are causing or contributing to wildfires, crop failure, global economic challenges, infrastructure damage, and even devastating health crises.²⁸ Recently, professor of geosciences at Pennsylvania State University, Richard Alley, poignantly stated that the current rise in global temperature “is not natural, but caused by us.”²⁸ Scientific data confirm that these weather changes and damaging environmental conditions are attributable to burning petroleum-based fuels and other human activity, including improper management of solid wastes. Landfill gas, a natural byproduct of the decomposition of organic material, comprises mostly methane and CO₂.¹⁶ According to a recent assessment by the Intergovernmental Panel on Climate Change, 1 ton of methane is equivalent to 28 to 36 tons of CO₂ over a 100-year period.²⁹

Applying the principles of HRO as part of an organization’s culture of safety and environmental stewardship can greatly assist in anticipating risks of harm. Examples of HRO in this context include designing and implementing sustainability processes and protocols and environmental management systems (eg, fashioned after ISO 14001, an international standard that provides a framework for an effective environmental management system³⁰) and the use of technologies and procedures—from energy and carbon emissions reduction to **compliant waste management practices**—that are sustainable across the board and that reflect fervent stewardship. In this context, commitment to resiliency starts with proactive steps that can take the form of continuous hazard vulnerability analysis, or risk assessment that begets contingency planning using an “all hazards” approach to anticipate and respond to the potentially devastating extreme weather conditions believed to be attributable to climate change.

HRO and Viral Spillover and Spillback

One of the HRO principles applicable to infection prevention and disease control is preoccupation with failure—specifically, proactive risk management strategies to help

anticipate and to identify potential for and actual spillover events. Clinicians should be vigilant and engage public health officials with urgency whenever they discern prognosticators that suggest that the populations they serve may be at risk of zoonotic infections.

Another HRO principle that can apply to addressing spillover is deference to expertise. For example, organizations should incorporate in their patient safety programs applicable governmental provisions designed to protect against animal-to-human transmission. For example, California's Title 8 §5199.1, "Aerosol Transmissible Diseases—Zoonotic," provides basic requirements for covered employers to establish, implement, and maintain effective procedures for preventing employee exposure to zoonotic aerosol transmissible pathogens.³¹

Another applicable HRO principle is resilience. During periods of uncertainty and crisis, promoting resiliency can take the form of continuous business operations planning and disaster recovery facilitation. Health care organizations have demonstrated and continue to demonstrate remarkable resiliency secondary to the global pandemic. Organizations must be agile and nimble, even as part of routine business strategic and tactical planning.

HRO and Poverty

In addition to a health crisis of historic proportions, the COVID-19 pandemic ushered in a global economic downturn. Primary diseases commonly associated with poverty, such as tuberculosis, malaria, and HIV/AIDS—and comorbid malnutrition—often target the more vulnerable populations in socioeconomically marginalized areas and in developing countries. Poverty is not just income deprivation but optimism deprivation.³² In 2011, the CDC published its first *Health Disparities and Inequalities Report*, which examined health disparities—or differences in health outcomes—associated with groups of people "as defined by social, demographic, environmental, and geographic attributes."³³

HROs' fervent commitment to a culture of safety includes making every effort to seek to understand social determinants of health (SDOH). Standardized, compassionate, and responsible [approaches to addressing SDOH](#) within an organization's or practitioner's control include discounted payment, charity care or other assistance to patients in meeting their financial obligation, and promoting awareness of patients' benefits coverage. Health care organizations can also institute internal policies that commit to supporting free clinics and eleemosynary organizations that provide emergency health care, food, and water.

Performance Measurement and Improvement

So, how does an organization know if high reliability and patient safety principles are truly embedded within its culture and are making a difference? Are things getting better, getting worse, or staying the same? According to Lord Kelvin, "When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind."³⁴

One key strategy for implementing HRO principles is to develop metrics for evaluating data reliability and to use data systems to measure the progress and efficacy of interventions. This strategy can help address needs related to open sharing of data and

other information concerning safe, respectful, and reliable care and continually improving work processes and measuring progress over time.

Conclusion

High reliability is by no means the deus ex machina that will swoop down and vanquish all the world's chaos. But it is a portfolio of viable perspectives, tools, and ideas upon which a culture of safety can be built amidst what the Temptations described as a "ball of confusion" back in 1970.³⁵ And HRO is not some nebulous construct; it describes organizations comprising people who care enough to commit to making the world a better place.

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