

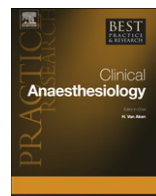


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### High reliability organizations (HROs)

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Academic and professional disciplines, such as organisation and management theory, psychology, sociology and engineering, have, for years, grappled with the multidisciplinary issues of safety and accident prevention. However, these ideas are just beginning to enrich research on safety in medicine. This article examines a domain of research on system safety – the High Reliability Organization (HRO) paradigm. HROs operate in hazardous conditions, but have fewer than their fair share of adverse events. HROs are committed to safety at the highest level and adopt a special approach to its pursuit. The attributes and operating dynamics of the best HROs provide a template on which to better understand how safe and reliable performance can be achieved under trying conditions, and this may be useful to researchers and caregivers who seek to improve safety and reliability in health care.

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Safety challenges persist in many industries, but the problem in the health-care industry is particularly acute. In fact, health-care presents a challenging paradox by pairing the mandate to ‘do no harm’ with mounting evidence, over the past two decades, that much harm is done in the course of delivering care.<sup>1,2</sup> Much is known about the problem of safety in complex sociotechnical systems based on years of research in disciplines such as organisation and management theory, cognitive psychology, sociology and human factors engineering. However, it is only recently that findings from these disciplines have begun to permeate the patient-safety literature in medicine and health-care more generally. In part, this diffusion can be explained by the public spotlight on medical error that has followed high-profile events such as the British Royal Infirmary inquiry, to name one example,<sup>3</sup> and the publication of the United States Institute of Medicine’s Report, *To Err is Human*,<sup>2</sup> which have called for a greater focus on organisational systems.

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This article provides a particular overview on system safety by examining concepts from the growing literature on high reliability organizations (HROs). In so doing, we strengthen the bridge between medicine and contemporary research on system safety and accident causation and prevention. In addition, by offering a systemic lens to view the underpinnings of safety in complex systems and suggesting that the success of individuals and teams of health-care providers in providing safe care can be amplified (or lessened) by organisations and institutions in which caregivers are embedded, we move beyond medicine's prevailing focus on individual's excellence and achievement as the sole means to ensuring safe and reliable care. We introduce the high-reliability paradigm, explain its underpinnings and how it is relevant to anaesthesia, discuss the two basic models for achieving reliable performance and examine HRO attributes and organising processes that contribute to reliable performance in dynamic contexts. The article concludes with a summary of key points and some ideas for practice and future research.

### The high reliability paradigm

The 'high reliability organization' paradigm was developed by a group of researchers at the University of California, Berkeley,<sup>4–6</sup> to capture observed commonalities of operations among aircraft carriers, air traffic control (and, more generally, commercial aviation) and nuclear power. These three settings constitute the default reference when describing the processes found in the most effective HROs. Although they may seem diverse, these organisations have a number of similarities. First, they operate in unforgiving social and political environments. Second, their technologies are risky and present potential for error. Third, the scale of possible consequences from errors or mistakes precludes learning through experimentation. Finally, to avoid failures, these organisations use complex processes to manage complex technologies.<sup>7,8</sup>

HRO theory is one of at least two streams of work that has addressed system safety and organising with regard to high-hazard work and technologies.<sup>9</sup> Normal Accident Theory (NAT), the other major stream, is based on sociologist Charles Perrow's<sup>10</sup> attempt to translate his understanding of the disaster at the Three Mile Island nuclear facility into a more general formulation. At the Three Mile Island, the technology was tightly coupled due to time-dependent processes, invariant sequences and limited slack. The events that spread through this technology were invisible concatenations that were impossible to anticipate and cascaded in an interactively complex manner.<sup>10</sup> Perrow hypothesised that, regardless of the effectiveness of management and operations, accidents in systems that are characterised by tight coupling and interactive complexity will be 'normal' or 'inevitable' as they, often, cannot be foreseen or prevented. This pessimistic view, described by some theorists as unashamedly technologically deterministic,<sup>11</sup> contrasts with the more optimistic view of HRO proponents who argued that high-risk, high-hazard organisations can function safely, despite the hazards of complex systems.<sup>4–6,12</sup> In spite of their differences, the NAT and HRO theory share a focus on the social and organisational underpinnings of system safety and accident causation/prevention.<sup>9</sup> They pay little or no attention to the technical and engineering aspects, which, some have argued, is problematic.<sup>13</sup>

Defining HROs and the concept of high reliability more generally has presented some challenges. Roberts<sup>5</sup> initially proposed that HROs are a subset of hazardous organisations that have enjoyed a record of high safety over long periods of time. Specifically, she argued that: "One can identify this subset by answering the question, 'how many times could this organisation have failed resulting in catastrophic consequences that it did not?' If the answer is on the order of tens of thousands of times, the organisation is 'high reliability'".<sup>5</sup> Nevertheless, a focus on absolute error rates is misplaced, in part, because it can apply to any organisation.<sup>14</sup> HRO researchers, themselves, have acknowledged that not only was the choice of terminology necessary but also it was unfortunate. It was necessary because there was a need to distinguish these effective high-risk, high-hazard organisations from more ordinary organisations that, up to that point, typically, had been studied by organisation scholars.<sup>14</sup> At the same time, it was an unfortunate choice<sup>14</sup> for at least two reasons.

First, it was an unfortunate choice because it is a static descriptor for a fundamentally dynamic set of properties, activities and responses. HROs demand perfection but they know they cannot attain it: they are constantly seeking to improve reliability and intervening, both to prevent errors and failures as well as to cope and recover quickly should errors become manifest. As Schulman<sup>15</sup> notes, safety is an

illusory concept: there are no safe organisations because past performance cannot determine the future safety of any organisation. Thus, it is more appropriate to think of HROs as reliability-seeking rather than reliability-achieving entities.<sup>14</sup> This vital point is often overlooked, in particular, in health care as administrators, caregivers and researchers search for a single silver bullet that will ensure safer and more reliable care. From the perspective of performance as a continuing process or set of activities, it is both more useful and accurate to think about high reliability as a dynamic process of organising rather than one of being an HRO. Pursuing and achieving reliability is a continuous, ongoing accomplishment.

A second reason why the choice of the term ‘high reliability organisation’ is problematic is that the label HRO implies that the evaluation of high reliability is based on “some absolute, and static, standard of performance rather than on a relative evaluation....”<sup>14</sup> Reliability-seeking organisations are not distinguished by their absolute errors or accident rate, but rather by their “effective management of innately risky technologies through organisational control of both hazard and probability.”<sup>14</sup> Consequently, the phrase high reliability, more generally, has come to mean that high -risk and high effectiveness can coexist, that some organisations must perform well under very trying conditions and that it takes intensive effort to do so.<sup>9</sup> In health care, high reliability has come to be used as a proxy for safety, although reliability and safety are not truly equivalent.<sup>1,16–18</sup>

### **The relevance of HROs to anaesthesia**

The HRO paradigm provides insight into adaptive organisational forms for complex environments. In fact, it is surprising how well the qualities of well-functioning HROs (e.g., carriers) can be generalised and applied to medical care, and, in particular, to anaesthesia. The Institute of Medicine<sup>2</sup> identified the close parallels between health-care systems and the systems that contribute to effectiveness in carriers:

People are quick to point out that health care is very different from a manufacturing process, mostly because of the huge variability in patients and circumstances, the need to adapt processes quickly, the rapidly changing knowledge base, and the importance of highly trained professionals who must use expert judgement in dynamic settings. Though not a biological system, the performance of crews and flight personnel on aircraft carriers provides an example that has features that are closer to those in health-care environments than manufacturing...[P]eace-time flight operations on aircraft carriers [are] an example of organizational performance requiring nearly continuous operational reliability despite complex patterns of interrelated activities among many people. These activities cannot be fully mapped out beforehand because of changes in weather (e.g., wind direction and strength), sea conditions, time of day and visibility, returning aircraft arrivals, and so forth. Yet, surprisingly generally mapped out sequences can be carried out with very high reliability in novel situations using improvisation and adaptation and personnel who are highly trained but not highly educated...As in health care, it is not possible in such dynamic settings to anticipate and write a rule for every circumstance. Once-rigid orders that prescribed how to perform each operation have been replaced by more flexible, less hierarchical methods. For example, although the captain’s commands usually take precedence, junior officers can, and do, change these priorities when they believe that following an order will risk the crew’s safety. Such an example demonstrates that even in technologically sophisticated, hazardous, and unpredictable environments it is possible to foster real-time problem solving and to institute safety systems that incorporate a knowledge of human factors, (pp. 160–161).

From a theoretical standpoint, therefore, anaesthesia shares many characteristics in common with the aircraft-carrier flight-deck setting. Anaesthesia and aircraft-carrier decks are settings where there is high interdependence of various aspects of the organisational system and where the organisational environment is continuously changing, resulting in unexpected high-variety disturbances. In anaesthesia, highly reliable performance is necessary, work is non-routine and there is a high level of interactive complexity. By interactive complexity, we refer to a system property of high-risk organisations where interactions between various processes can have hidden, unanticipated or unintended consequences.<sup>10</sup> Small problems that, initially, do not seem consequential can quickly become large problems.

## Competing approaches to achieving reliability

Research shows that HROs pursue two competing approaches to achieve reliable performance<sup>15</sup>: the prevention (anticipation) approach and the resilience (containment) approach. We consider each of the two approaches in the following paragraphs.

### *Prevention*

Prevention or anticipation requires that organisational members try to anticipate and identify the events and occurrences that must not happen, identify all possible causal precursor events or conditions that may lead to them and then create a set of procedures for avoiding them.<sup>15,19,20</sup> From this perspective, reliability depends on a lack of unwanted variance in performance, and is thought to be achieved through the development of highly standardised operating procedures and routines.<sup>9</sup>

Studies show how HROs are obsessed with detailed operating procedures, contingency plans, rules, protocols and guidelines as well as using the tools of science and technology to better control the behaviour of organisational members to avoid errors and mistakes.<sup>21</sup> For example, at one point in time, the Diablo Canyon nuclear power plant had 4303 separate, multistep, written procedures – each one revised up to 27 times – that were designed to anticipate and avoid problems with maintenance, operations, protection and analysis.<sup>22</sup> This commitment to anticipation and prevention removes uncertainty, reduces the amount of information that people have to process – which decreases the chances of memory lapses, judgement errors or other biases that can contribute to crucial failures – provides a pretext for learning, protects individuals against blame, discourages private informal modifications that are not widely disseminated and provides a focus for any changes and updates in procedures. Recent research in the medical domain highlighting the importance and value of protocols, clinical practice guidelines and checklists are examples of the prevention/anticipation approach.<sup>23</sup> Nevertheless, research also shows that adherence to rules and procedures alone will not prevent incidents. There are limits to the logic of prevention.<sup>9,15,19,21</sup> which assumes that consistent error-free outcomes will be produced in the future if people repeat patterns of activity that have worked in the past.

One limitation is that unvarying procedures cannot handle what they do not anticipate. In other words, you cannot write procedures to anticipate all the situations and conditions that shape people's work.<sup>21</sup> Moreover, even if procedures could be written for every situation, there are costs of added complexity that come with too many rules.<sup>24</sup> This complexity increases the likelihood that people will lose flexibility in the face of extensive rules and procedures. Thus, although compliance with detailed operating procedures is critical to achieving reliability in many instances, partly because it creates operating discipline, blind adherence can sometimes reduce the ability to adapt or to react swiftly to surprises.<sup>25,26</sup> The idea that standard operating procedures and invariant routines are the only means by which reliable outcomes occur conflates variation and stability and makes it more difficult to understand the mechanism of reliable performance under trying conditions.<sup>9</sup> Reliability is far broader; it requires resilience as well as prevention.

### *Resilience*

HROs are unique in that they understand that reliability is not the outcome of organisational invariance, but rather, results from a continuous management of fluctuations<sup>9,15</sup> in job performance and human interactions. To be able to become alert and aware of these inevitable fluctuations, to cope with, circumscribe or contain untoward events, such as mistakes or errors, 'as they occur' and before their effects escalate and ramify, HROs also build capabilities for resilience.<sup>9,19,27,28</sup> The essence of resilience is the intrinsic ability of an organisation (team, unit, system, etc.) to maintain or regain a dynamically stable state, which allows it to continue operations in the presence of a continuous stress and/or after a major mishap.<sup>27,28</sup> Resilience involves three abilities: (1) the ability to absorb strain and preserve functioning in spite of the presence of adversity (e.g., rapid change, ineffective leadership, performance and production pressures, increasing demands from stakeholders); (2) an ability to recover or bounce back from untoward events – as the team, unit, system becomes better able to absorb a surprise and stretch rather than collapse; and (3) an ability to learn and grow from previous episodes

of resilient action.<sup>29</sup> HROs develop capabilities to detect, contain and bounce back from inevitable errors that are part of an indeterminate world. The hallmark of an HRO is not that it is error-free but that errors do not disable it.

HROs are unique in their abilities both to prevent and to manage mishaps before they can spread throughout the system, thus, causing widespread damage or failure. These abilities are generally traced to dynamic organising principles.<sup>9</sup> That is, HROs purportedly have mechanisms for monitoring and reporting small signals that the system may be breaking down. Furthermore, they have the flexibility and the capabilities to respond in real time, reorganising resources and actions to maintain functioning in spite of peripheral failures.<sup>29</sup> In contrast to the NAT, which suggests that the best approach to improving system reliability and safety is to change the system itself – to reduce its complexity or tight coupling, the HRO theory suggests that reliability and safety are achieved through human processes and relationships. After all, for a system to remain safe and reliable, it must somehow handle unforeseen situations in ways that forestall unintended consequences.

### Attributes of HROs

Researchers have identified a number of unique properties of HROs.<sup>5,6,8</sup> Although these specific attributes vary between scholars, there are a number of commonalities. Several properties, such as outstanding technology and task and work design, highly trained-personnel, continuous training, effective reward systems, frequent process audits and continuous improvement efforts,<sup>30</sup> are ubiquitous and found in many high-performing organisations. Nevertheless, other properties such as an organisation-wide sense of vulnerability, a widely distributed sense of responsibility and accountability for reliability, widespread concern about misperception, misconception and misunderstanding that is generalised across a wide set of tasks, operations and assumptions, pessimism pertaining to possible failures, redundancy and a variety of checks and counter checks as a precaution against potential mistakes are more distinctive.<sup>9,15</sup>

It is important to note that reliable performance in complex systems is complicated because it is a dynamic, non-event<sup>6</sup> that is difficult to specify and visualize. It is dynamic because safety is preserved by timely human adjustments; it is a non-event because successful outcomes rarely call attention to themselves. Because reliable outcomes are constant, there is nothing to pay attention to. This can decrease vigilance, the sense of vulnerability, increase the propensity towards complacency and inertia and decrease the quality of attention across the organisation. This can be deadly. Although adverse outcomes, sometimes, occur because of performance and execution mistakes, there are flaws in that portrayal. Mistakes in perception, conception and understanding lead to much greater harm.<sup>31</sup>

HROs are distinctive because of their efforts to organize in ways that increase the quality of attention across the organisation, thereby enhancing people's alertness and awareness to details such that they can detect subtle ways in which contexts vary and call for contingent responding. Some researchers have referred to this as mindful organising.<sup>9</sup> Mindful organising forms a basis for individuals to interact continuously as they develop, refine and update a shared understanding of the situation they face and their capabilities to act on that understanding. Mindful organising proactively triggers actions that forestall and limit errors and crises. Mindful organising requires that leaders and organisational members pay close attention to shaping the social and relational infrastructure of the organisation,<sup>17,32</sup> and to establishing a set of interrelated organising processes and practices, which jointly contribute to the system's (e.g., team, unit and organisation) overall culture of safety.<sup>1,6,29</sup>

More specifically, HROs focus on building a group and organisational culture, where it is the norm for people to respectfully interact. Second, they foster a culture where people interrelate heedfully so that they become more consciously aware of how their work fits in with the work of others and the goals of the system. Third, HROs establish a set of practices that enable them to track small failures, resist oversimplification of what they face, remain sensitive to current operations, maintain capabilities for resilience and take advantage of shifting locations of expertise. We explore these ideas in detail in the following section.

## Organising for high reliability

### *Respectful interaction*

People in all organisations often face situations where their private views come into conflict with a majority view. These situations frequently threaten social life.<sup>33</sup> Furthermore, they make it harder for people to speak up about safety threats. These dynamics may be much more acute in health-care settings where patients' conditions evolve and change over time, where there are frequent transitions or handoffs between providers, where team compositions change and where care is provided by multiple professionals who differ in social status, power, professional languages and ways of communicating.<sup>34–36</sup> To counteract these tendencies, it is critical to create a context of respect.

In fact, respectful interaction is the bedrock of shared understanding. In contexts where respect is the norm, people are both more likely to communicate their interpretations to others and, in addition, are more likely, through such communication, to generate a shared interpretation.<sup>32</sup> When people interact with respect, their behaviours are consistent with three moral norms.<sup>33</sup> First, they respect the reports of others such that they are willing to base their beliefs and actions on them; in sum, they trust others. Second, they themselves report what they perceive honestly so that others may use their observations to come to valid beliefs; in sum, they are honest in interaction. Third, they respect their own perceptions as well as the perceptions of others such that they attempt to integrate their own perceptions into a socially shared perception without deprecating their own perceptions or those of another; in sum, they have self-respect. The combination of trust, honesty and self-respect increases the likelihood that people will speak up about issues of concern, share their perspective and ask others questions about their interpretations. Furthermore, whenever one or more of these three components are missing, an adverse event is more likely to occur.<sup>32</sup>

### *Heedful interrelating*

Studies show that when the crews of aircraft carriers are more heedful in their relationships they tend to have fewer serious accidents and errors.<sup>37</sup> Heedful interrelating is a social process through which individual action contributes to a larger pattern of shared action and in which individuals understand how their actions fit into the larger action.<sup>37</sup> When people interrelate heedfully, they first understand how a system is configured to achieve some goal and they see their work as a contribution to the system and not as a standalone activity. Second, people see how their job fits with other people's jobs to accomplish the goals of the system. Third, they maintain a conscious awareness of both as they perform their duties. It, sometimes, is easier to understand heedful interrelating by thinking about its opposite – heedless interrelating – when someone simply does his or her job ignoring what is going on around him or her.<sup>37</sup>

Respectful interaction and heedful interrelating generate shared interpretation and shared action and form the relational foundation for high reliability organising. We draw attention to the importance of developing and enhancing people's abilities to work effectively with their colleagues because, without a strong relational foundation, high reliability organising is much more difficult to attain.<sup>32</sup>

Respectful interacting and heedful interrelating have real consequences for patient safety.<sup>17,38</sup> When respectful interacting is absent – for example, when trust is lacking – health-care providers, often, do not speak up about potential errors, either because they think speaking up will not make a difference or that speaking up might harm their image or relationship with their supervisor.<sup>34,35</sup> Vogus demonstrated that higher levels of respectful interacting and heedful interrelating were associated with lower levels of medical errors and patient falls.<sup>17</sup>

### *Organising practices*

Studies of the best HROs show that a social-relational infrastructure of trust and heed is necessary for reliable performance, but it is not sufficient. In addition, their nearly error-free performance results from attitudes and practices that enable their members to pick up on problems earlier and to act on them before they grow bigger.<sup>9</sup> Susceptibility to failure appears to be determined, in part, by the extent

to which these organisations establish processes and practices aimed at (1) examining failure as a window on the health of the system, (2) avoiding simplified assumptions about the world, (3) being sensitive to current operations and their effects, (4) developing resilience to manage unexpected events and (5) understanding and locating expertise and creating mechanisms for decisions to migrate to those experts. Collectively, as shown in Table 1, these principles and associated practices focus attention on the very perceptual details that are lost when people coordinate their actions and share their interpretations.<sup>29</sup>

#### *HROs are preoccupied with failure*

A preoccupation with failure is an ongoing caution that drives proactive and pre-emptive analysis of possible vulnerabilities and treats any failure or near-miss as an indicator of potentially larger problems.<sup>9,15</sup> This means that people in HROs pay close attention to identifying what needs to go right, what could go wrong, how it could go wrong<sup>29</sup> and what has gone wrong. This does not mean that HROs are paralysed by worries about screwing up. Rather, it means that people actively search for surprises and weak signals that the system is acting in unexpected ways. In part, this concern with failure is an effort to avoid hubris, or the arrogance of optimism.<sup>39</sup> It is also a preoccupation with learning and acknowledgement that small problems and discrepancies are, often, symptoms or precursors of larger problems.<sup>40</sup> Small things gone wrong, in addition, are clues to how the system might unravel again. Most organisations handle a failure by eliminating that action. HROs handle failure by trying to make it happen again. By recreating it, they know more about their system and what can interrupt it.

HROs push for continuous improvement across many fronts. In fact, no routine in an HRO is beyond the reach of re-evaluation and reassessment.<sup>21,30</sup> HROs fear that if there is no continual improvement, what has been gained might quickly erode.

**Table 1**  
HRO organizing principles and illustrative practices.<sup>16</sup>

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.



### *HROs avoid simplifying interpretations*

Reluctance to simplify interpretations means actively seeking divergent viewpoints that question received wisdom, uncover blind spots and detect changing demands.<sup>9,12,41</sup> People frequently handle complex tasks by simplifying the manner in which they interpret a current situation. However, simplifications are troublesome because they give people a false sense that they know exactly what they face. Furthermore, they limit the kinds of precautions people take and the number of undesired consequences they imagine. People in HROs know that it takes a complex mental picture to register the kind of complex environment most HROs face.<sup>6</sup> To compensate, people in HROs are socialised to make fewer assumptions and to bring more perspectives to bear on issues, problems and decisions.<sup>12</sup> People in HROs know that they do not know, but they do not know what it is that they do not know. They expect to be surprised and struggle for alertness. Prevailing norms in HROs convey such messages as, 'take nothing for granted', 'don't get into something without a way out', etc.<sup>9</sup> In part, this is an issue of requisite variety and the idea that, to regulate variety, sensors must be as complex as the system which they intend to regulate.<sup>6</sup> Complex technical systems have more variety than a single individual can comprehend. Teams and networks of divergent individuals are the only ways through which people can match this variety. A team of divergent individuals has more variety than a team of homogeneous individuals.

### *HROs are sensitive to current operations*

Sensitivity to operations means creating and maintaining an integrated big picture of current situations through ongoing attention to real-time information. An image unique to HROs is that of 'having the bubble', which is similar to the notion of situational awareness.<sup>9</sup> If someone is sensitive to what is happening here and now, they can forestall the compounding of small problems or failures by making a number of small adjustments. Small adjustments are opportunities to stop mistakes and errors from lining up in such a way that they grow into a bigger crisis. Human factors psychologist Jim Reason's 'Swiss cheese model'<sup>20</sup> suggests that many unexpected events originate in latent failures; loopholes in the system's defences such as defects in supervision, training, briefings and hazard identification. Being in close touch with what is happening here and now means that latent problems can get the attention they need.

### *HROs cultivate resilience*

A commitment to resilience involves ongoing enlargement of capabilities to recover from unexpected events. Such capabilities include greater skill at improvisation, learning, multitasking and adapting. We noted, earlier, that effective HROs have well-developed skills at anticipating possible dangers before damage is done. They spend time improving their capability to anticipate, in part, by creating, improving and revising plans and procedures to incorporate the lessons from their experience. Nevertheless, they know that they cannot create procedures to anticipate all situations and conditions that shape people's work. They know they cannot totally reduce uncertainty. Thus, they have a strong commitment to developing a capacity to cope with unanticipated surprises as they come up.<sup>9</sup> Capabilities for resilience are a consequence of an extensive action repertoire, which is built through training and simulation, varied job experiences, learning from negative feedback and *ad hoc* networks that allow for rapid pooling of expertise to handle unanticipated events. The more people can do, the more problems they can see, because no matter what they see, they can do something about it. If you cannot deal with the problems in front of you, you are less likely to notice, acknowledge and be willing to act on them.<sup>9</sup>

### *HROs encourage flexible decision structures*

Lastly, a final distinctive feature of HROs is their tendency to shift decision-making to experts when problems begin to materialise.<sup>9,42</sup> Typically, in hierarchical organisations, important choices are made by important decision-makers who can participate in many choices. HROs have a different priority. When unexpected problems arise, effective HROs loosen the designation of who the 'important' decision maker is in order to allow decision-making to migrate in tandem with problems.<sup>42</sup> The result is that hierarchical rank is subordinated to expertise, which increases the likelihood that new capabilities will be matched with novel problems, and that emerging problems will get quick attention before they blow up. In other words, the organisation has more skills and expertise to draw on. This flexibility enables the system to deal with inevitable uncertainty and imperfect knowledge.



In summary, HROs perform safely and reliably in the face of uncertainty and change because of their efforts to create a mindful infrastructure.<sup>9</sup> Organisations that act mindfully organize in such a way as to create a quality of attention that enables people to pick up on weak signals that things are not going as expected, and also to act more resiliently as things begin to unravel. Mindfulness is an antidote for being taken by surprise. Mindful organising decreases the probability of being blindsided by events that people did not see coming and disabled by events that do catch people unawares.

Mindful action in dynamic, uncertain contexts is a key not only to anticipating and becoming aware of the unexpected but also to being able to deal with the chaos after it arrives. We know that the majority of accidents and failures are not the result of the actions of any single individual (although there is a tendency to blame single individuals). Nor are they the result of a single cause. Small incidents often link together and expand. That is why it is important to be able to catch and correct small mistakes and errors before they grow bigger. When problems are small, there are, often, more ways to solve them. When they get bigger, they tend to become entangled with other problems and there are fewer options left to resolve them.

### **A culture of high reliability**

Research on HROs often intersects that of safety culture, a concept that is often cited as a key contributor to organisational accidents and crises. Safety culture is a facet of organisational culture, with the latter often defined as an emergent ordered system of meaning and symbols that shapes how an organisation's members interpret their experience and act on an ongoing basis. In health-care organisations, culture encompasses what is valued, beliefs about how things work and behavioural norms that determine the degree to which all organisational members direct their attention and actions towards minimising patient harm during delivery of care.<sup>1,43</sup> Furthermore, safety culture entails an ongoing struggle to detect and correct misidentifications, misspecifications and misunderstandings that pose threats to safety.<sup>15,20</sup>

The question of whether culture should be understood as something an organisation is (its beliefs, attitudes, and values) or whether it should be understood as something an organisation has (its practices and controls) continues to be debated.<sup>29</sup> Some scholars<sup>20</sup> argue that it is easier to directly change behaviours, how people act and what they do, than attitudes and beliefs (what people think). Acting and doing are influenced by practices – policies and norms that, over time and in the context of one's group affiliation, shape attitudes and beliefs.<sup>29</sup> Thus, it is not surprising to find that recent research in health-care settings shows that components of mindful organising are common across efforts to enact a safety culture.

For example, Roberts and colleagues,<sup>30,44</sup> in their multi-year qualitative study of a paediatric intensive care unit (PICU), found that the introduction of HRO practices led to a more integrated picture of operations in the moment and earlier detection of potential threats to safety. Caregivers were continuously alert to the possibility that they had missed something (preoccupation with failure). Constant in-service training contributed to caregivers' abilities to interpret and question data that appeared relevant to their working hypotheses (reluctance to simplify). Collaborative rounding by the entire patient-care team created an up-to-date picture of potential threats to safety for each patient (sensitivity to operations). Frequent post-event debriefings enlarged the repertoire of possible actions caregivers could take in the future to recover more quickly from unexpected events (commitment to resilience). In addition, patient-care decisions migrated to bedside caregivers who had more experience with a specific patient (deference to expertise). The enactment of mindful organising was associated with lower levels of patient deterioration on the unit – an exceptional achievement given the medical fragility of PICU patients. Vogus and Sutcliffe<sup>16,17</sup> provide additional support for these ideas by showing that higher levels of mindful organising were associated with fewer medication errors and patient falls over time. Furthermore, the detrimental effects of less mindful action were documented in one analysis of the cardiac unit of the Bristol Royal Infirmary, where shocking levels of excess deaths among infants forced a governmental inquiry.<sup>45</sup>

### **Conclusion**

This article examines the mechanisms of system safety and accident prevention from the perspective of the high reliability organisation paradigm. The high reliability theory is not a prescription or roadmap for success. Rather, it is one lens through which researchers, caregivers and administrators can better

understand how safe and reliable performance, under trying conditions, can be pursued. HROs are distinguished by their processes and ways of organising. Specifically, the best of the best HROs organize for reliability by pursuing safety as a priority objective, building in redundancy, decentralising decision-making, shaping culture towards reliable performance, investing heavily in training and simulation, learning from close calls, aggressively seeking to know what one does not know, emphasising communication of the big picture and where people fit into the big picture and rewarding people who report failures.<sup>32</sup> Organisations and their members that pursue these activities repeatedly and continually are likely to achieve greater reliability than those organisations that do not – in part, because of the binding safety culture that is created through enactment of these practices.<sup>1</sup> If we seriously consider the idea that the only realistic goal of safety management in complex health-care systems is to develop an intrinsic resistance to its operational hazards,<sup>46</sup> the literature on HROs provides insight into how to foster this intrinsic resistance. Studies showing the efficacy of high reliability organising for medicine and health care are in their infancy, but evidence is building that suggests that the HRO paradigm is worth paying attention to.

### Practice points

- Continuously evaluate failures, mistakes, near misses and close calls using an appropriate ‘after action review’ protocol. Winston Churchill’s debriefing protocol may be helpful: Why didn’t I know? Why didn’t my advisors know? Why wasn’t I told? Why didn’t I ask?<sup>29</sup>
- Develop richer forms of communication. The STICC protocol<sup>29</sup> may be useful in situations such as handoffs: S = Situation (“Here’s what I think is going on”); T = Task (“Here’s what I think we should do”); I = Intent (“Here’s why”); C = Concern (“Here’s what I think we should keep our eye on”); C = Calibrate (“Now, talk to me”).
- Encourage people to mentally simulate their work in order to help them build capabilities to cope with disturbances once they appear.<sup>32</sup> What activities lie upstream and downstream from them? How can their work unravel? How can disturbances be corrected?
- Identify pockets of expertise and encourage people to self-organize into *ad hoc* networks to provide expert problem solving when problems or crises appear.<sup>12</sup>
- Encourage conceptual slack – a divergence in team members’ analytical perspectives and a willingness to question what is happening rather than feign understanding.<sup>1</sup>

### Research agenda

- There is little fundamental research examining the efficacy of high reliability organising in health-care settings. Thus, there are many places to start. For example, it would be useful to examine the efficacy of these ways of organising in controlled settings such as the operating suite. To what extent do surgical teams enact practices consistent with the five organising principles, and what is the association with surgical outcomes? The study by Vogus and colleagues<sup>16,17</sup> provides a methodology that may be appropriate.
- A hallmark of HROs is their prioritisation of safety and attention to balancing competing values (safety and production). Safety in medicine is complicated because medical harm tends to be individualised, distributed and insidious.<sup>15</sup> Consequently, other values such as efficiency and cost control often receive higher priority. Research is needed to better understand how leaders signal priorities (safety and efficiency), how caregivers perceive these signals and how they make sense of competing priorities in real time.

### Conflict of interest

None declared.

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