Innovator's corner: Complex Systems and Patient Safety Outcomes

Health systems are complex environments where outcomes aren't always predictable. Patient safety researchers have shown us that there are simple rules that can help us manage safety outcomes in complex systems. These rules involve continuous learning, positive feedback loops, and collaboration.

Complex Systems and Patient Safety Outcomes

Healthcare systems and their subsystems can be both complicated and complex. A complicated system like an aircraft engine is knowable by a trained expert. The system has a high degree of predictability in terms of behavior and response. In contrast, the predictability of outcomes across a complex system like a hospital and its many departments is poor[1]. Safety improvement initiatives achieve limited success in a complex system because they use tools and methods that are best suited for analyzing complicated systems.

The impacts of dizzying complexity in the healthcare industry on patient safety and care quality are not hard to find. The World Health Organization has estimated that 1 in 10 patients were harmed in inpatient settings and suggested that as many as 4 in 10 patients are harmed in ambulatory settings[2]. Medical errors also have wide ranging impacts on staff that are involved with and experience safety events.

There is an important link between adverse event management practices, safety culture and care quality. A just culture of safety, an inclusive and collaborative approach to safety event reviews, and the right analytics tools are necessary for setting up insights-driven event management practices that can help bridge safety and quality gaps.

Communications challenges in safety practices

The lack of support for dealing with complexity had a lasting impact on the ability of safety professionals to capture and act on safety concerns. Oversimplified tools, underdeveloped collaboration channels, and poor feedback loops have had an adverse impact on the ability of safety staff to capture and act on safety events. Common challenges that safety and quality leaders face include:

- **Context stripping.** Information about the complexity surrounding safety events is often stripped out during the event submission process.

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[1] Pisek, P (2001). Institute of Medicine (US) Committee on Quality of Health Care in America. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington (DC): National Academies Press (US); 2001. Appendix B, Redesigning Health Care with Insights from the Science of Complex Adaptive Systems. Available from: https://www.ncbi.nlm.nih.gov/books/NBK222267/

[2] Retrieved from: https://www.who.int/news-room/fact-sheets/detail/patient-safety

- **Oversimplification.** Software solutions oversimplify patient safety events to treat them like help-desk tickets.

- **Workarounds.** Safety teams spend tremendous amounts of time creating workarounds to help them manage regulatory reporting, investigations, and to monitor activity.

- **Minimal learning.** Leaders have limited time and opportunities to create a learning ecosystem to help manage and mitigate impacts of future patient safety concerns.

- **Too many forms.** A proliferation of custom forms and datasets creates a mountain of poor-quality data. Expensive IT resources are required to separate the signal from the noise.

- Rather than use event reports to identify and prioritize high impact or emerging risks, organizations **count and chart the different event categories** and workflow milestones.

- **An overreliance on quantitative methods** has limited the ability for safety teams to glean actionable insights necessary to make improvements in care.

Strategies to improve patient safety outcomes

Embrace the complexity:

Hospitals are complex systems where a variety of actors, each with diverse skills, experience, and knowledge respond to each other's actions in unpredictable ways based on unit and system-level feedback loops[3].

Using methods that work in a complicated system can prove wholly inadequate when applied to a complex system. As an example, organizations tend to use the category assigned when an event is reported to identify and prioritize high impact or emerging risks. This overlooks the fact that situations reported are not always what they seem. Due to the complex nature of caregiving by many actors across interconnected departments, events often have multiple contributing factors undetectable to the reporter, which may only be identified when investigated. Counting the different event categories as a measure of safety performance trend is another example, given that event categories differ widely in their complexity.

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[3] Liukka, M. et. al. Action after Adverse Events in Healthcare: An Integrative Literature Review. Int. J. Environ. Res. Public Health 2020, 17, 4717; doi:10.3390/ijerph17134717.

The ability to adapt to unpredictable behaviors in real-time requires us to create a learning environment. Leaders need to be able to observe the system, the decisions that people make, and the spontaneous collaborations that emerge when people align on shared objectives. From a patient safety perspective, healthy horizontal and vertical communication channels are necessary to allow safe reporting, transparent feedback, and a collaborative approach to resolving causes. We need structures and systems that support robust safety management practice.

Adopt human centered design:

Collaborating on safety and quality initiatives in complex work environments requires formal and tribal communication channels to be robust, supported, and active[4] because relationships between actors in a complex system are "massively entangled", and actions can produce unpredictable responses[5]. Systems that incorporate human factors principles in their designs acknowledge the contextual needs of an organization. They support the right emergent behaviors, provide safe spaces for collaboration, and accelerate team-based learning. An example of the use of human-centered design in a safety system is its use of open and dynamic taxonomies that can flex as the industry and organization evolves. Such a design allows teams to adapt workflows as safety trends shift over time in a way that doesn't overwhelm or distract users and supports staff turnover gracefully.

Use AI-driven tools to remove barriers:

Artificial Intelligence (AI) powered designs can reduce perceived barriers to reporting. The number of event submission forms can be reduced dramatically and shortened. AI-driven rules allow harm score updates to be routed to those that have the skills and the experience to capture them accurately. Safety events can be automatically categorized and routed to appropriate reviewers. AI-powered designs allow for a fuller representation of each event and its complexity. Most importantly, AI-powered approaches create unprecedented value by making it easy for customers to quickly separate the key safety signals from the noise in their proliferating safety data.

Find ways to amplify human effort and reduce burden:

The use of AI to amplify human effort and reduce cognitive load is common. Rules-based solutions such as filtered drop-down lists and automated screen flows are commonly used in electronic medical records and decision support systems. Similarly, AI and machine learning algorithms have a key role to play in the creation of robust communication pathways in patient safety management practices. They can easily support workflows to summarize and

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[4] Pronovost PJ, Marsteller JA. Creating a fractal-based quality management infrastructure. J Health Organ Manag. 2014;28(4):576-86. doi: 10.1108/jhom-11-2013-0262.
[5] Begun, J. W., & Zimmerman, B. M (2003). Health care organizations as complex adaptive systems. In S. M. Mick and M. Wyttenbach (eds.), 2003 Advances in Health Care Organization Theory San Francisco: Jossey-Bass, pp 253-288.

communicate lessons learned to both frontline staff as well as executive leaders and industry stakeholders.

Enable a Culture of Continuous Learning and Improvement:

A strong reporting culture is necessary to identify risks. However, it is insufficient to create a strong learning culture. AI-powered approaches can yield dramatic improvements in safety culture through improved learning pathways and practices. Feedback rates to reporters can improve. Safety analysts can see problems across units and entities that would not otherwise be readily visible. They can escalate these problems for systemic resolution, shifting the dialogue from 'what happened here?' to 'how do we resolve this problem everywhere?'.

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