Use of High-Reliability Principles in the Evolution of a Hospital Command Centre

Barbara E. Collins

Abstract

Hospitals and health systems across the world strive to achieve consistently safe care delivery and reduce patient harm. In November 2017, Humber River Hospital became one of the first hospitals in North America to implement a hospital command centre to manage patient access and flow. The command centre outputs relevant real-time data that have been integrated from multiple automated systems and uses predictive analytics to support early identification of patients at risk of harm and deterioration. The aim of this descriptive article is to present the conceptual development of Humber River Hospital's Command Centre.

Introduction

Nearly 20 years ago, the Institute of Medicine published its report, *To Err Is Human*, which impelled healthcare organizations to enhance the safety and quality of care delivery (Kohn et al. 2000). Although there has been significant focus on developing and implementing initiatives to reduce patient harm in several hospitals, an estimated 1,600 adult patients continue to experience harm in hospitals across Canada every day, and no hospitals or health systems have achieved consistently safe care delivery (Chan and Cochrane 2016; Chassin and Loeb 2013). By contrast, achieving and sustaining ultra-safe conditions have been possible in the business sector, for example, in commercial aviation and nuclear power (Weick and Sutcliffe 2007). *High-reliability science* provides the opportunity to understand the characteristics and behaviours that enable hospitals to create the conditions for high-reliability healthcare (Hines et al. 2008).

In November 2017, Humber River Hospital (HRH), North America's first fully digital hospital, switched on the lights to its command centre (CC) and became second only to Johns Hopkins Hospital (JHH) in implementing this unique approach to managing patient access and flow (Kane et al. 2019). With the success of improving hospital operations through the Command Centre – Generation 1 (CC1) – Access and Flow infrastructure, HRH rapidly identified the potential for using predictive analytics to support the early identification and real-time management of patients at risk of harm and deterioration and eliminating never events.

Command Centre – Generation 2 (CC2) – is a world's first, applying the principles of high reliability and using predictive analytics and defined protocols with the goal of alleviating and eliminating patient harm. The aim of this article is to describe the conceptual development of HRH's CC2 from the perspective of the hospital's key strategic direction to achieve *high reliability*, that is, consistently delivering the safest, highest-quality care alongside compassion, professionalism and respect – the core values of the hospital.

Background

HRH is one of Canada's largest community hospitals, serving a population of more than 850,000 people in the northwest Greater Toronto Area. The multi-site hospital currently operates out of its acute care site and reactivation care centres with over 700 beds, almost 5,000 employees, approximately 700 physicians and more than 1,000 volunteers. HRH's digital infrastructure includes completely automated laboratory services, robots sorting and mixing medications, electronic health records, patient computer bedside terminals and tracking systems that update families through their cellphones for patients undergoing surgery.

The HRH CC1 was designed to optimize the transfer of patients from the emergency department (ED) to in-patient units with the goal of expediting admissions and reducing the time patients are held in the ED following the decision to admit. Similar to the Judy Reitz Capacity Command Center at JHH, the HRH CC1 co-locates staff who have the primary responsibility for coordinating patient admissions, including the bed allocation clerk, patient flow manager, homecare manager, support services supervisor, medical imaging flow technologist, operating room schedulers and nursing resource team manager (Kane et al. 2019). Studies across various industries identified co-location as a mechanism to improve efficiency in the coordination of work because of the direct and immediate communication that shared workspace enables (Fesko et al. 2003; Ginsburg 2008). Eccles et al. (2010) investigated the benefits of co-location environments on team effectiveness and found that co-locating teams had overall benefits, including increased knowledge and information sharing and an enhanced feeling of involvement and inclusion. At HRH, the CC team is co-located in an effort to merge the collective skill and expertise of the staff responsible for synchronizing patient admissions.

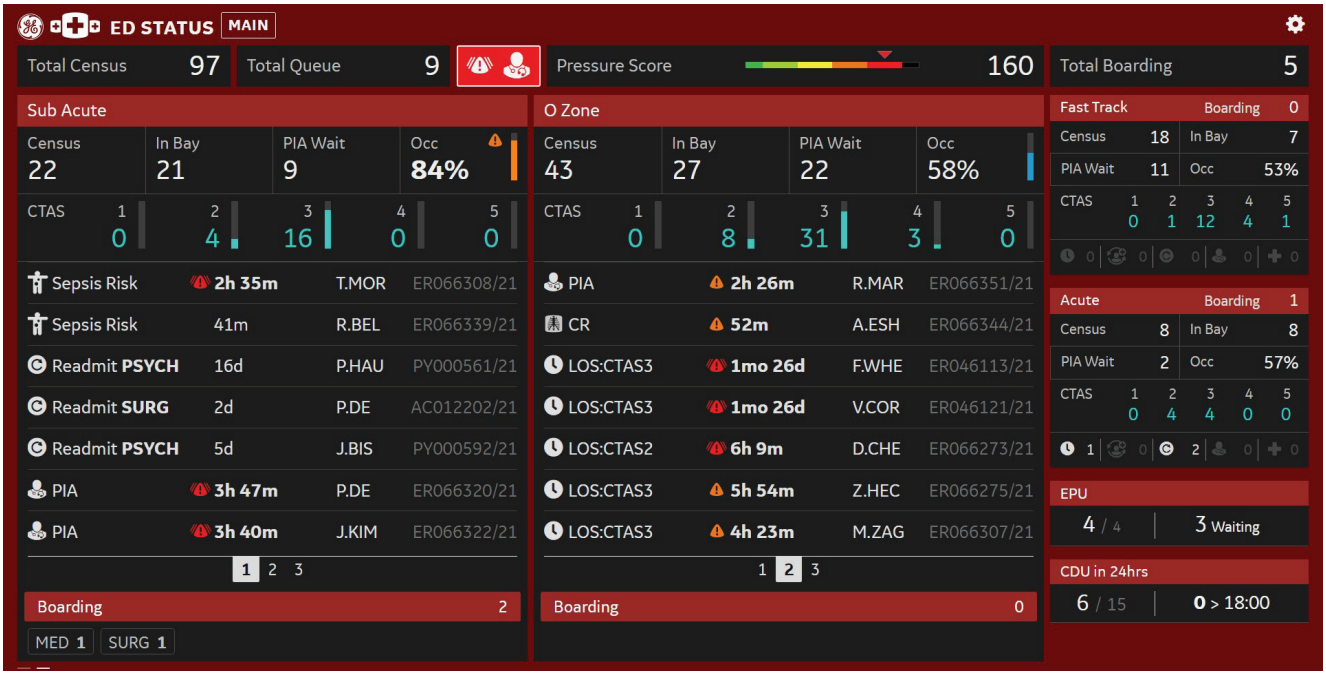
The centrepieces of CC1 are the *tiles* that illuminate relevant real-time data that have been integrated from multiple automated systems. In combination, the tiles form an analytical control panel on large-screen monitors from which actionable interventions can be implemented to maximize access and flow related to *input* and *throughput* in the ED and *output* to in-patient units. Asplin et al. (2003) suggested that the input–throughput–output model applies a systems approach to understanding the interdependent components of the ED care continuum, which is necessary for developing integrated rather than fragmented solutions for managing access and flow. The input component of the model includes any condition, event or system characteristic that contributes to the demand for ED services (Asplin et al. 2003). The throughput component includes any factor related to ED length of stay (LOS) (Asplin et al. 2003). Internal ED processes that potentially affect throughput time and may lead to overcrowding include triage, room placement, initial provider evaluation and diagnostic testing and treatment modalities. The output component of the model relates to the factors associated with the disposition of ED patients (Asplin et al. 2003). CC1 tiles display essential data representing the input, throughput and output variables of the interdependent components of the ED care continuum in real time, thereby enabling timely and strategic operational efforts using pre-established standard operating procedures (Figure 1).

FIGURE 1.
Sample CC1 tiles, HRH bed summary and HRH ED status board

BED SUMMARY

Clinical Program	Census	% Occupancy / Surge Beds	Unoccupied: Clean	Unoccupied: + Dirty	Unoccupied: - Assgn	Unoccupied: = Avail	Discharge: Conf	Discharge: Pos	Trans Reqs	Unas Reqs	Δ	Closed
Med	316	95% (6 / 20)	16	6	16	0	19	0	0	6	13	-
Surg	69	66% (0 / 24)	32	3	9	26	18	0	1	2	43	-
M&B	19	79% (0 / 24)	5	0	0	5	6	0	0	0	5	-
Paeds	12	43% (0 / 8)	14	2	1	15	2	0	0	4	13	-
Psych	63	105% (3 / 6)	0	0	0	-3	1	0	0	1	-3	-
ICU	37	84% (0 / 4)	7	0	0	7	0	0	0	5	2	-

FIGURE 1. – CONTINUED



Since the implementation of the CC1 tiles in November 2017, HRH has seen tremendous success in optimizing patient access and flow. Thirty-five additional in-patient beds have been generated as a result of CC1, making hallway medicine non-existent at HRH, despite an 8% growth in ED visits. HRH has also continued to maintain and improve the safety and quality of care delivery across several indicators, such as infection control, medication errors, pressure injuries and patient satisfaction (Figure 2).

High-Reliability Principles Applied in CC2

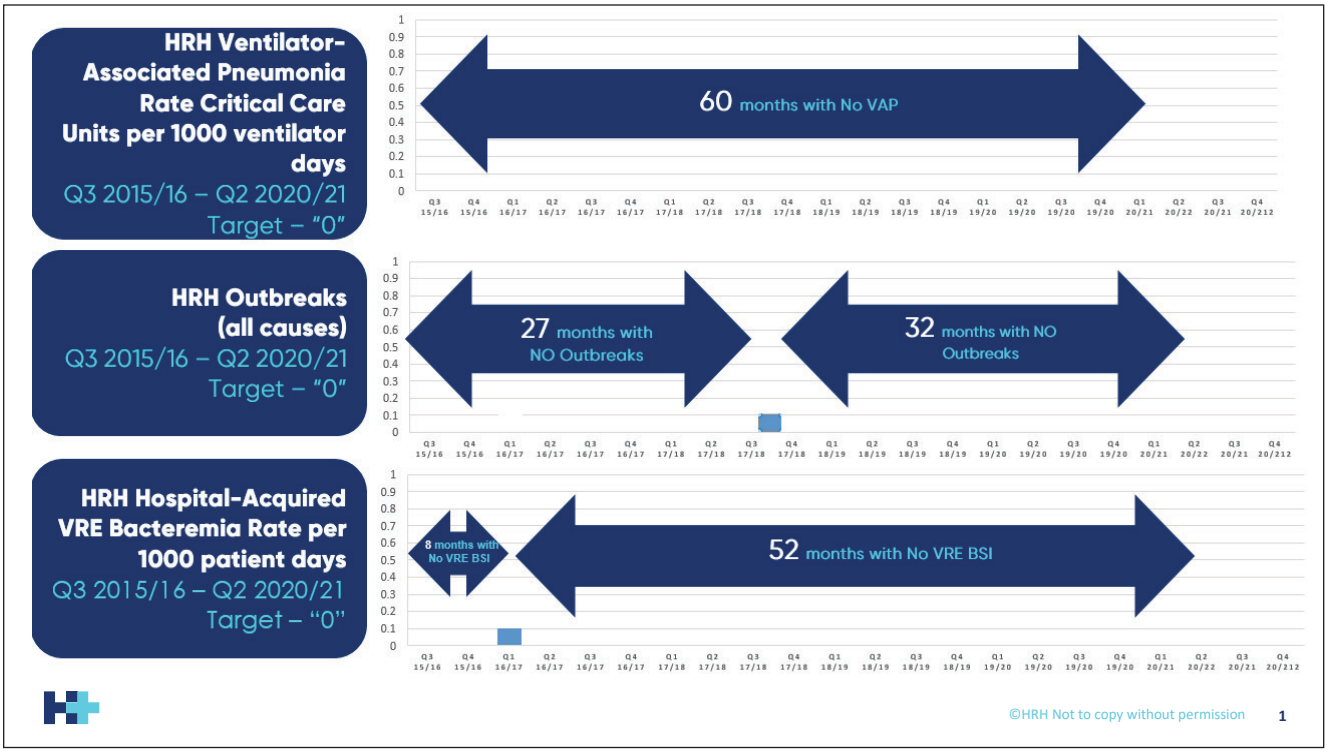
Recognizing the challenge of sustaining safety and quality improvements and the frequent experience of *project fatigue* in hospitals, HRH established a strategic direction to embed the concepts of high reliability through its digital landscape. Studies have suggested that information and communication technology has the potential to improve patient safety by automating highly reliable processes (Chassin and Loeb 2013; Rouleau et al. 2017; Silow-Carroll et al. 2012). The concepts of high reliability are the motivating force behind CC2, with the advanced use of predictive analytics (tiles) aimed at eliminating risks of patient harm, deterioration and never events (Figure 3).

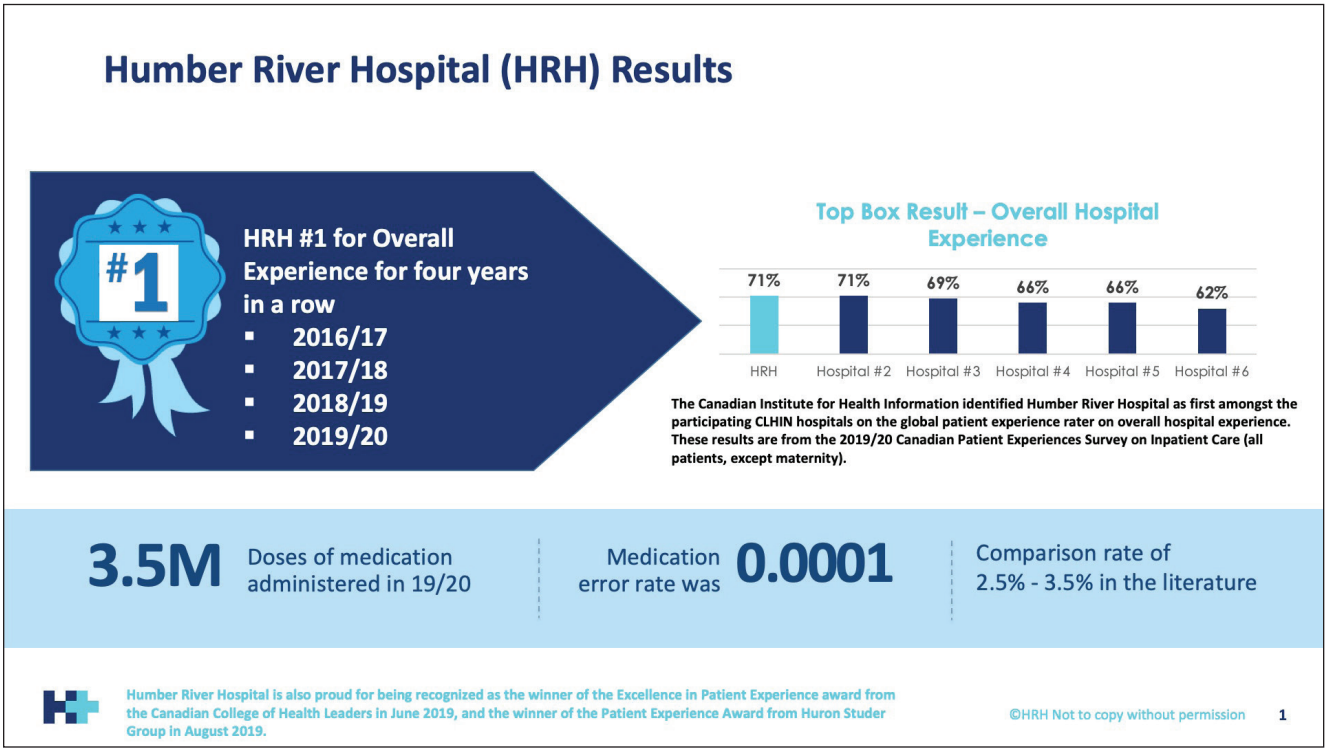
One of the most compelling aspects of high-reliability organizations is *collective mindfulness*, whereby staff are on the constant lookout for unsafe conditions that can be resolved before errors or accidents occur (Chassin and Loeb 2013). In an environment of *mindfulness*, the five principles of high reliability are integrated. These include preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience and deference to expertise (Weick and Sutcliffe 2007). With a commitment to these principles, HRH is endeavouring to create the conditions in which remarkable levels of safety can be sustained.

At HRH, failure is not accepted as an inevitable occurrence in the sequence of delivering care. Adhering to the principle of preoccupation with failure, HRH has established several safety indicators with a target of *zero*, such as falls, pressure injuries and medication errors. According to Chassin and Loeb, "The goal of zero is important because one of the most salient characteristics of high-reliability organizations is that they are not satisfied with whatever their current level of safety might be" (2013: 468).

Along with constant vigilance for safety threats, all HRH staff are expected to be attentive to subtle changes that may be an indication of unsafe conditions. This reluctance to simplify by paying attention to even minor deviations in expected performance allows HRH to address safety concerns when they are easier to correct and have not become a major threat (Chassin and Loeb 2013). Accordingly, CC2 tiles integrate standardized early warning systems with predictive analytics to generate real-time data drawn from several automated systems that identify subtle changes in patient conditions and provide early recognition of safety threats. The ability to intervene early, when typically unrecognized changes occur in a patient's condition, enables clinicians to respond and mitigate safety threats before they exacerbate.

FIGURE 2.
Summary of HRH patient outcomes





According to Chassin and Loeb, "One of the most pervasive safety problems in hospitals relates to their failure to be sensitive to operations" (2013: 463). Sensitivity to operations is reinforced through the co-location team design of the CC infrastructure, whereby the staff intimately involved in operationalizing patient admissions are constantly monitoring and correcting any irregularities in standard performance. With CC2, the role of *clinical expediter* was added to the team with the responsibility for intervening in circumstances wherein safety threats arise based on changes in patient status

FIGURE 3.
Sample CC2 tiles

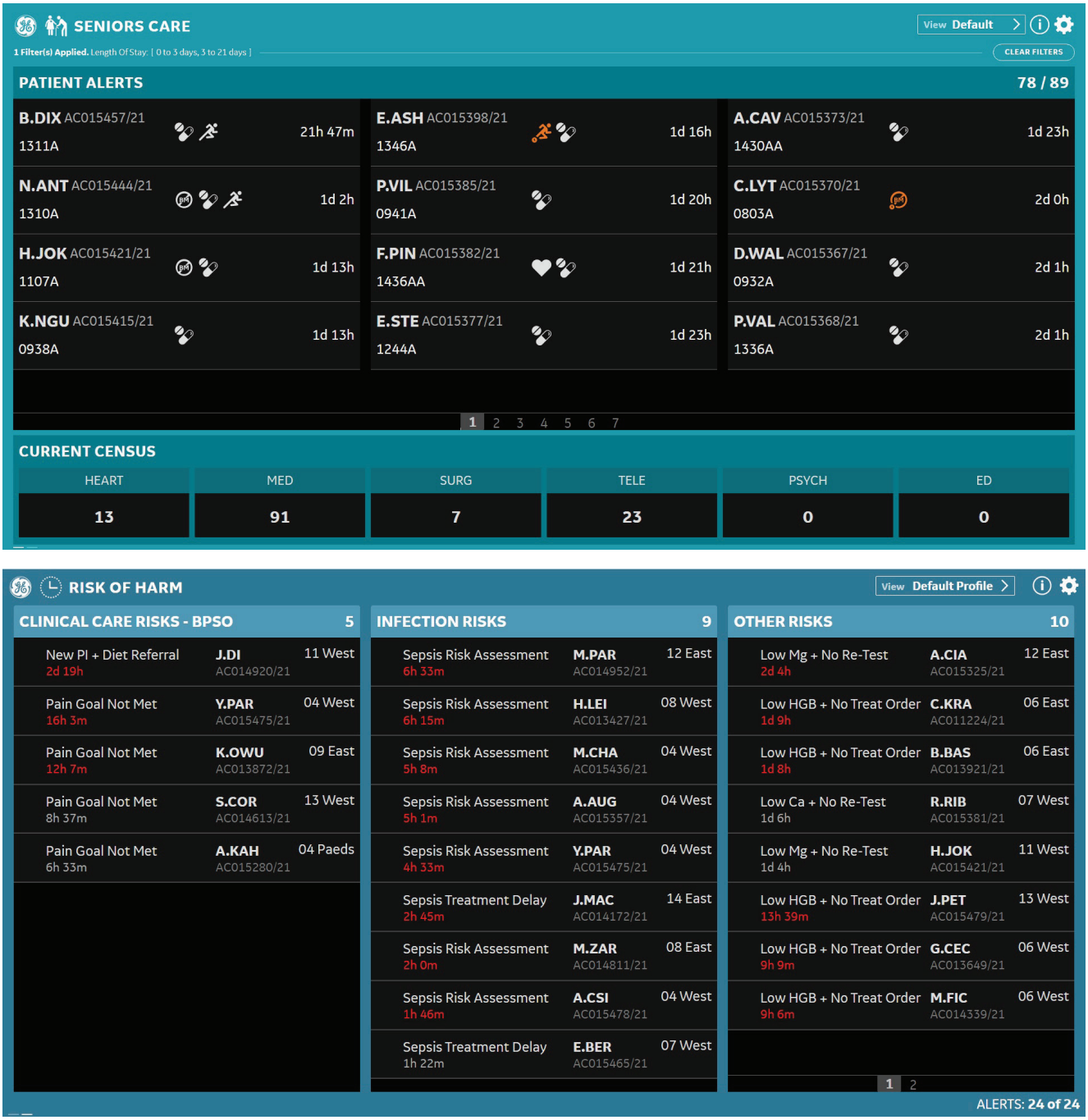


FIGURE 3. – CONTINUED

and deviations from best practices. This heightened level of operational sensitivity provides the opportunity for otherwise undetected patient safety threats to be addressed quickly and effectively. Finally, in the event that harm has occurred, CC2 facilitates rapid remediation by those with the greatest expertise in managing the incident, fostering both resilience and deference to expertise.

Conclusions

At HRH, the five principles of high reliability have been applied to the expansion of the CC with the aim of reaching a new level of safety. CC2 is a world first, applying the principles of high reliability and using predictive analytics and defined protocols to alleviate and eliminate patient harm. This is early days, but it is encouraging that patient lives have already been saved.

Over the next year, data collection and analysis will clarify the impact of CC2 in relation to both patient and provider outcomes. For now, some of the key learnings we derived from this work stem from three themes. Bluntly put, a solid business case, sound project management and fulsome engagement are essential success factors. Establishing a command centre requires funding, but a lack of funds should not deter hospitals from moving forward on a similar initiative. A dedicated team is needed to execute this type of high-intensity project over several years. Money alone will not make that happen; committed leaders are also needed.

Managing an initiative of this magnitude requires meticulous planning, monitoring, agility and resilience. At HRH, setting aggressive yet realistic goals helped keep the project moving and sustained the excitement necessary to achieve our objectives. Great designs do not always make for effective workflows. An iterative process of continuous improvement during the building phase of the project should be expected and planned to avoid apathy.

We used multiple sessions with stakeholders from across the hospital to gather ideas about how the CC tiles should be built. The final tiles were developed in conjunction with clinicians and other key internal stakeholders to maximize engagement and investment in the initiative. Communication about the project through many forums, such as open houses, fireside chats and question-and-answer sessions, amounted to the input of almost 1,000 staff and physicians shaping the final tiles. The result is a CC that supports the unique needs of staff and physicians in the delivery of highly reliable care. HQ

References

Asplin, B.R., D.J. Magid, K.V. Rhodes, L.I. Solberg, N. Lurie and C.A. Camargo Jr. 2003. A Conceptual Model of Emergency Department Crowding. *Annals of Emergency Medicine* 42(2): 173–80. doi:10.1067/mem.2003.302.

Chan, B. and D. Cochrane. 2016, October. *Measuring Patient Harm in Canadian Hospitals*. Canadian Institute for Health Information. Retrieved October 16, 2020. <https://secure.cihi.ca/free_products/cihi_cpsi_hospital_harm_en.pdf?>.

Chassin, M.R. and J.M. Loeb. 2013. High-Reliability Health Care: Getting There from Here. *The Milbank Quarterly* 91(3): 459–90. doi:10.1111/1468-0009.12023.

Eccles, M., J. Smith, M. Tanner, J.-P. Van Belle and S. van der Watt. 2010. The Impact of Collocation on the Effectiveness of Agile is Development Teams. *Communications of the IBIMA* 2010(2010): 1–11.

Fesko, S., J.C. Timmons and A. Cohen. 2003. *Case Studies on the Implementation of the Workforce Investment Act: Focus on Co-location*. Issue 4. Institute for Community Inclusion, University of Massachusetts, Boston. Retrieved October 16, 2020. <https://www.communityinclusion.org/pdf/cs4.pdf>.

Ginsburg, S. 2008. Colocating Health Services: A Way to Improve Coordination of Children's Health Care? *Issue Brief (Commonwealth Fund)* 41: 1–11.

Hines, S., K. Luna, J. Lofthus, M. Marquardt and D. Stelmokas. 2008, April. *Becoming a High Reliability Organization: Operational Advice for Hospital Leaders*. Agency for Healthcare Research and Quality. Retrieved October 16, 2020. <https://archive.ahrq.gov/professionals/quality-patient-safety/quality-resources/tools/hroadvice/hroadvice.pdf>.

Kane, E.M., J.J. Scheulen, A. Puttgen, D.Martinez, S. Levin, B.A. Bush et al. 2019. Use of Systems Engineering to Design a Hospital Command Center. *The Joint Commission Journal on Quality and Patient Safety* 45(5): 370–79. doi:10.1016/j.jcjq.2018.11.006.

Kohn, L.T., J.M. Corrigan and M.S. Donaldson, (Eds.). 2000. *To Err Is Human: Building a Safer Health System*. National Academies Press.

Rouleau, G., M.-P. Gagnon, J. Côté, J. Payne-Gagnon, E. Hudson and C.-A. Dubois. 2017. Impact of Information and Communication Technologies on Nursing Care: Results of an Overview of Systematic Reviews. *Journal of Medical Internet Research* 19(4): e122. doi:10.2196/jmir.6686.

Silow-Carroll, S., J.N. Edwards and D. Rodin. 2012. Using Electronic Health Records to Improve Quality and Efficiency: The Experiences of Leading Hospitals. *Issue Brief (Commonwealth Fund)* 17: 1–40.

Weick, K.E. and K.M. Sutcliffe. 2007. *Managing the Unexpected: Resilient Performance in an Age of Uncertainty* (2nd ed.) [MP3 CD]. Jossey-Bass Inc.

About the Author

Barbara E. Collins, RN, BScN, MBA, is the president and CEO of Humber River Hospital in Toronto, ON. Collins oversaw the design, construction and activation of the new 1.8 million-square-foot Humber River Hospital. She can be reached by e-mail at bcollins@hrh.ca.