Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Going Boldly…Into Digitally Enabled Care Models
Bonnie Clipper, DNP, MA, MBA, RN, CENP, FACHE, FAAN

The health care ecosystem is experiencing a turbulent time, specifically the accelerated churn and attrition among the nursing workforce resulting from the COVID-19 pandemic. The loss of many long-tenured nurses means that short-staffed units, high utilization of temporary staff, and decreasing experience levels require additional support for nurses to continue to provide safe and quality patient care. The adoption of technology into care delivery models is 1 way to amplify the work of nursing in a safe and consistent manner and should be accelerated for care delivery. The workforce alone cannot meet the demands of patient care in today’s environment.

The COVID-19 pandemic has dramatically impacted the nursing workforce, triggering burnout, turnover, and attrition. This has impacted the supply of nurses and has accelerated the need for different patient care delivery models. This challenge weighs heavily on nurse leaders. In fact, a 2021 survey of nurse leaders conducted by the American Organization for Nursing Leadership, identifies the adoption of new staffing models to be rated as the highest “temporary advancement that will be most important to maintain beyond COVID-19” at 36.8%. COVID-19 has reframed the Structure, Process, and Outcome needed in planning new patient care delivery models inclusive of workforce and technology needs.

An opportunity for consideration is previous models of care used with success, such as team nursing in the 1990s, and how these models might technology as a force multiplier and amplifier of safety and efficiency in the care environment.

E-ICUS AS TRAILBLAZERS
The utilization of technology in the patient care setting has been occurring at a slow but steady pace for the past many years and this may feel like déjà vu for those who experienced the e-ICUs in the late 1990s and early 2000s. The e-ICUs were introduced as a “technology” and SaaS (software as a service) model, and were a way to monitor or care for critically ill patients in an intensive care setting. Typically, there was a camera mounted in the room that monitored the patient, coupled with a shared feed from the physiologic monitors, all of which were directed to a remote location where registered nurses “monitored” the patients, and/or physicians were accessible to provide orders and direction if a patient’s condition deteriorated and necessitated rapid treatment. Although both the technology and service received some adoption, it did not see the expected uptake, which was likely due to the cost of both equipment and the service. This may also be an example of technology implemented before providers and caregivers were ready to support the paradigm shift that was required for successful adoption. However, these early e-ICUs paved the way for the current technologies, as well as lessons derived regarding change management for care delivery models. After all, automating a broken process isn’t transformative.

The remainder of this article focuses on technologies that may be leveraged as we rapidly work to find new patient care delivery models, care locations, and environments, and even redesign the roles of our workforce, as each of these is known to enhance safety.

KEY POINTS
- As the disruption continues among the clinical workforce, nursing must lead the transformation of care delivery by leveraging technology.
- Reimagining the roles of the patient care team and integrating technology will support nurse decision-making and streamline workflows to improve patient safety and outcomes.
- Through innovation, care team roles should be redefined, and new models developed using digitally enabled care delivery.
and outcomes or strengthen/support decision-making through monitoring patients, analyzing data for assessment and evaluation purposes, assisting with decision making, and sometimes just offering an extra “set of hands.” Simply put, care transformation will require digitally enabled care, which may include technologies such as robotics, remote patient monitoring, artificial intelligence, predictive analytics, and natural language processing (NLP).

**ROBOTS AS CARE PARTNERS**

Although robots are not new to the patient care scene, they continue to be upgraded and are gaining traction in health care, specifically in hospitals, to take on tasks that would free up or redeploy the humans that currently provide essential and low-risk tasks. This is true of robots that are utilized to “pick” medications from pharmacy shelves to fill patient-specific medication orders, and to deliver pharmacy items, supplies, and linen, as well as meal trays. This can be advantageous because it frees up the humans from the redundant, low-risk tasks, who can then operate at higher levels or who with the appropriate training can take on different, perhaps even clinical, roles.

**PATIENT SURVEILLANCE AND MONITORING**

This is often referred to as remote patient monitoring, or RPM, and is an area that is experiencing a rapidly growing adoption rate in both acute and post-acute inpatient settings. Patient surveillance and monitoring have become high-tech means to obtain frequent or constant input from different sources to determine a patient’s status or condition. The sources might include 1-way cameras with or without audio, physiologic monitors, or even the most novel patient monitoring devices that are automated, ambient, intelligent computer monitoring systems.

Although not a new concept, RPM continues to advance, and there are new ways to accomplish this goal. Hardwiring rooms with cameras and audio, coupled with real-time physiologic monitoring data feeds, allows a remote setting to gather the patient data and is monitored by a person, ideally a registered nurse. The nurse at the remote site can observe the patient and their data for signs of problems or distress, and immediately alert the caregivers in real time at the patient’s location to intervene with the appropriate care.

**AMBIENT COMPUTER VISION**

A novel and emerging technological means of patient monitoring or surveillance is through computer vision. This is a high-tech solution that is capable of monitoring patients and uses artificial intelligence (AI), computer vision, environmental sensing, an internet of things (IoT) connection, and operates via Bluetooth Low Energy. This ambient-type monitoring system can provide constant, real-time, environmental sensing and, through its use of AI, does not require a person to be monitoring the system. Rather, artificial intelligence is trained through the machine learning process to understand what patient movements and behaviors are purposeful and safe, and can alert the care team when patient movements are outside the “learned limits.”

This is beneficial with high-risk patient populations because the system can alert staff when patients identified as high-risk are trying to get out of bed unassisted. Systems such as this are continually evolving and are improving outcomes, such as reducing falls and enhancing the efficiency of the clinical teams. The integration of AI negates the need for someone to sit and monitor the system, thus “freeing” up the humans to perform other patient care-related activities where they can add more value. This type of ambient system can also assist staff to ensure best practice care protocols such as hourly rounding and bedside shift report occur consistently and can even provide data on which type of caregiver is in the patient’s room and for how long, often leading to improved patient safety and outcomes.

**E-SITTERS**

Another type of patient monitoring and surveillance is the use of e-Sitters. This is not entirely new and has been around since approximately 2010; however, this technology continues to improve at a rapid pace. Mobile observational devices that can be moved to the appropriate patient room where sitter services are needed, contain cameras and audio monitoring devices. These can also integrate with bed alarms so a more robust picture can be observed by the person performing the monitoring at the other end of the technology. Many e-sitter providers also provide outcome analytics for performance improvement, or if necessary, video footage for risk management concerns. Although these systems improve efficiencies by relieving humans of the activity of physically sitting or observing, humans are still required to monitor the screens and intervene when necessary. This is a helpful force multiplier, especially if several sitters are required at the same time. However, the real innovation will be eliminating humans from the need to observe in the first place, which is in process as AI continues to improve its accuracy through machine learning models and is available in other technologies that perform the service of monitoring patients as noted above.

**DECISION SUPPORT ASSISTANCE**

One way to transform current care models is to improve the work environment and patient safety is through decision support technologies. These technologies continue to increase in importance as consistent nurse staffing becomes more difficult and the experience level of nurses decreases due to attrition. Nurses
who are inordinately busy often don’t have the ability to focus on 1 critical thinking task at a time and may have several disruptions that impact their concentration as the demands of the care environment interrupt them. This could potentially create the situation of a decision that may be made without adequately processing all the inputs to make the best decision for the patient. 

Many of these inputs, such as lab results, monitoring data, vital signs, provider notes, and nurse’s notes can be continually evaluated by artificial intelligence and, through predictive analytics, have the goal of identifying the trends and patterns that may warrant quick intervention. Although artificial intelligence can learn patterns through machine learning algorithms, combined with predictive analytics these platforms can model and predict a trend, which is especially helpful in the case of an unanticipated negative event that may require immediate lifesaving intervention. The impact of this type of decision support provides a sense of security for the patient and another set of intelligent “eyes and ears” to assist the nurse in decision-making and safely providing insights into the care of the patient. Examples of this include AI and predictive analytics applications that evaluate the patterns and trends in patient data and can predict sepsis and lethal arrhythmias. This type of technology is available today and can provide a safer practice environment for busy nurses and better outcomes for patients.

NATURAL LANGUAGE PROCESSING

One seemingly obvious way to digitally enhance patient care and quickly improve nurse satisfaction is to free nurses up from the laborious task of pushing around a computer on wheels or writing down notes until they get to sit down at a computer to enter the necessary data into a patient’s electronic medical record. Physicians have been using NLP for dictation of everything from post-procedure notes to their evaluation and treatment plan. This is no longer novel, but rather mainstream, and is used in our homes regularly. Think Siri, Google, or Alexa. The integration of NLP for nurses to “speak” their documentation has the potential to greatly reduce the amount of time spent on documentation. The training process requires frequent use with close documentation review to ensure that the NLP programs accurately capture in writing the words that the speaker is using. However, in time and through voice training, these programs can become very accurate. There are several vendors in the marketplace, and this technology would dramatically improve the workflows of nurses as well as other disciplines.

INNOVATION IN CARE DELIVERY TRANSFORMATION

Although these technologies exist and are available for adoption the real challenge is how to begin the process to create technology-enabled staffing models. Using a human-centered design framework and convening nursing staff, physicians, other interdisciplinary team members, and even patients is essential. When attempting to transform care models to incorporate an increased level of technology, the lack of robust evidence to support the desired changes may become apparent. Don’t let this become a deterrent. Innovation often requires trailblazing, which means the iteration cycle will continue to lead to ideating, prototyping, and testing, and the evidence will be created along the way. Prioritize safety and simplicity of use. Transformation and major change often require building a culture of innovation so that the “persona” of the organization doesn’t sink the transformation with “this isn’t how we do it here” kind of thinking. The disruption in the health care ecosystem caused by the pandemic and associated staffing challenges provide a unique timing opportunity for new ways of doing things. The “old way” (or current way) simply will not work going forward.

APPROACH/DISCUSSION

The framework to build a digitally enabled care model requires careful consideration of the goals, whether streamlining workflows, improving efficiencies, decision support, or increasing safety. The possibilities are vast and limited only by the budget and willingness of the organization to transform the existing care model and incorporate technology into the care delivery team. For example, when exploring the adoption of remote patient monitoring on inpatient units, this would create opportunities for the remote or “virtual” nurse to answer or triage call lights, provide medication, pre-procedure, or discharge patient education, or even round with the provider, which can free up the nurses on the units to expand the care and services to the patients within their scope or do other things. This is a space where a modern approach to team nursing may flourish. Virtual nursing will continue to evolve rapidly in inpatient settings to supplement the technology adopted in patient care delivery.

It is staff nurses that will implement and essentially identify success/modifications of the new care model on a shift-by-shift and unit-by-unit basis. Their input is paramount, as are ways to build trust into a reimagined patient experience. Tech savvy nurses are up for the challenge and can become champions of care transformation. In the scenario of incorporating RPM and virtual nursing, consider providing the patient with a way to communicate with the nurse at the “other end” of the camera whether via picture-in-picture–type television monitors or another way that allows for the patient to develop a sense of comfort and confidence with the remote nurse that can enhance credibility and trust in the system. This type of monitoring should trigger changing roles among the care team since
patients will have multiple “eyes and ears” monitoring their condition to ensure the highest safety and quality-related outcomes and this may open the door to including other disciplines or assistive personnel on the care team. Creating a strong safety message for patients is also a helpful way to build trust.

Technology adoption can be expensive and as with any largescale change management initiative, the return on investment is perhaps among the top factors for consideration along with safety and quality outcomes in adoption of a new model. Additionally, a thorough cost-benefit analysis should be performed with a line of sight to evaluate the impact of the current and future labor situations even if only anticipated. Implementation-, utilization-, and maintenance-associated costs need to be evaluated, as well as the cost of not adopting technology-enabled care delivery. Yet a large part of innovation in care delivery is successfully executing change management and removing barriers.

The transformation of care delivery models takes considerable time and resources, and cannot be done overnight, yet based on the availability of labor, there is a sense of urgency in the need to change. Other industries have been significantly transformed and have a track record to indicate the time required for adoption and acceptance. For example, farming took nearly 100 years to become fully “automated,” whereas initiated in the 1970’s automobile assembly lines are approximately 90% automated at present time and even air travel now contains several automated workflows, aside from ticket purchases, such as self-check-in, biometric security processing at airports, baggage weighing and checking, so this industry too is well on its way.

Although health care is more complex than other industries the paradigms for change exist and each time demonstrate the disruption, resistance, tension, and eventual change that come about. Having said that, we do not have 100 years to integrate technology into our care delivery models.

The hurdles to care delivery transformation are different this time. There are significant pressures, including shortages of clinical and caregiving staff at all levels and in all settings. Organizations that embrace technology are likely to be better positioned to provide consistently safer care going forward due to the ongoing disruptions in the workforce and may even become an attractor for nurse recruitment. Even though capital and budgetary concerns are likely to persist. The largest barrier will be the integration of technologies into clinical workflows. A bright spot as that while the nursing workforce is becoming younger, there is less of a resistance to utilizing technology in general. Among millennials, 74% report that technology makes their lives easier, and 53% report that they would give up their sense of smell over their use of technology. As Millennial nurses lead the way, technology adoption in care delivery models may occur with less resistance than in the past. This will need to be studied as we learn more about the impact of technology enabled care models.

CONCLUSION

The technologies that will assist us in creating digitally enabled staffing models most likely include robotics, remote patient monitoring, artificial intelligence, predictive analytics, and natural language processing. This is not to say that these are the only technologies, because we know several new technologies such as medical wearables and tools to improve clinician assessments are rapidly emerging and are promising additions to the patient care ecosystem and will be meaningful ways to improve efficiencies, reduce waste/redundancy, and improve customization of care, safety, and outcomes. Driving the process of care transformation and the leveraging of technology among the care team is one that is perfectly positioned for nurses to lead and advance, as nursing must become both high touch and high tech.

REFERENCES

1. Joslin D, Joslin H. AONL COVID-19 yearlong study follows top challenges for nurse leaders. Voice Nurs Leadersh. 2021;November:18-22.

2. Clipper B, Batcheller J, Thomaz AL, Rozga A. Artificial intelligence and robotics: a nurse leader’s primer. Nurse Leader. 2019;16(6):379-384.

3. Sun CJ, Fu CJ, Morelli JD, Levin A. Improving bedside shift report and hourly rounding using remote surveillance. J Inform Nurs. 2021;62(6):16-22.

4. Cianelli R, Clipper B, Freeman R, Goldstein J, Wyatt TH. The Innovation Roadmap: A Guide for Nurse Leaders. 2016. Available at: https://www.nursingworld.org/globalassets/ana/innovations-roadmap-english.pdf. Accessed December 14, 2021.

5. Carroll WM. Emerging Technologies for Nurses: Implications for Practice. New York, NY: Springer Publishing; 2021.

6. Rogers S. Why Millennials need VR. Forbes. 2018. Available at: https://www.forbes.com/sites/solrogers/2018/10/23/why-millennials-need-vr/?sh=46dc87836260. Accessed December 1, 2021.

Bonnie Clipper, DNP, MA, MBA, RN, CENP, FACHE, FAAN, is chief clinical officer at Wambi and chief catalyst at Innovation Advantage in Austin, Texas. She can be reached at bclipper@innovationadvantage.com.

1541-4612/2022/$ See front matter
Copyright 2021 by Elsevier Inc.
All rights reserved.
https://doi.org/10.1016/j.mnl.2021.12.015