THE BLUE RIDGE ACADEMIC HEALTH GROUP

Harnessing Emerging Virtual and Digital Health Technologies to Transform Health Care

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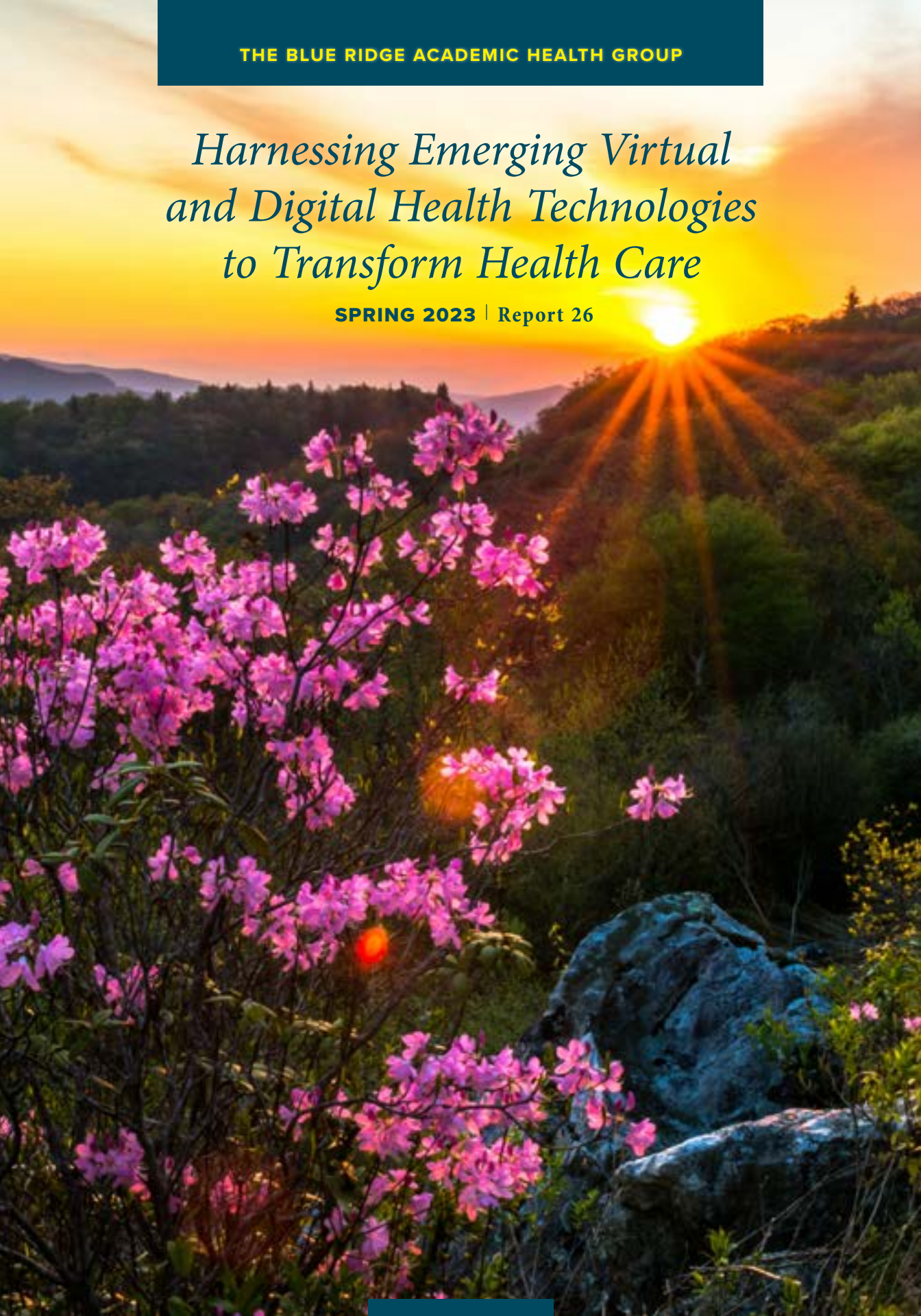

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(June 2022 Meeting, Boulder, CO)

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Contents

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Mission: ***The Blue Ridge Academic Health Group*** *seeks to take a societal view of health and health care needs and to identify recommendations for academic health centers (AHCs) to help create greater value for society. The Blue Ridge Group also recommends public policies to enable AHCs to accomplish these ends.*

Introduction: Harnessing Emerging Virtual and Digital Health Technologies to Transform Health Care

A Time of Change

Digital technologies have transformed many industries, enabling new business capabilities, more efficient and productive staffing models, and a closer connection to consumers. New entrants, supported by digital technologies, have disrupted numerous industries. Digital streaming upended the television network and cable television industries and the video/DVD rental market. Online banking reduced the need for bank staff to provide in-person services and gave consumers more direct and efficient control over their accounts. The addition of digital cameras on mobile phones and tablets reduced the demand for stand-alone cameras and turned everyone into novice photographers.

Health care's adoption and integration of digital technologies have followed a different path. Many digital innovations and technologies have been introduced – from electronic health records to digital imaging to robotic surgery – but due to a myriad of factors, including but not limited to the complexity of the health care delivery system, the digital transformation process has occurred more slowly than in other industries.

However, several market forces and global trends are now increasing the pace of change. For example, consumerism has become a stronger force than in the past, at least partially spurred by the increase of health care costs being shifted to employees and patients. A growing portion of the population prefers digital access to scheduling, health records, and interactions with health care professionals. In addition, with the push into virtual care during the pandemic, significant investments in digital health solutions are being made by technology firms and investors. Finally, financial pressures in many health care organizations – rising operating costs and shrinking patient revenues – are increasing the urgency to find more efficient ways to operate. These forces are catalyzing a period of significant and rapid digital transformation of health care.

Overview of Virtual and Digital Health Technologies

As summarized in the Table below, virtual and digital health technologies are being continuously developed to advance all aspects of health care. These tools have the potential to improve and expand patient access; to improve the efficiency and augment quality and outcomes of care; to alleviate staffing challenges and elevate performance; and to optimize business operation systems. Overall, these technologies will enhance patient satisfaction and outcomes, improve staff engagement, and positively impact the experience of health professionals.

TABLE | *Virtual and Digital Health Technologies*

DIGITAL VIRTUAL / DIGITAL SOLUTION CATEGORY	STRATEGIC VALUE	TECHNOLOGY / SOLUTION EXAMPLES
Expand Access: Locally, and to Reach a Broader Patient Cohort	• Connect digitally with new & existing local patients; build the foundation for longer-term health care relationships • Through telehealth and other digital connections, reach patients in a much broader geography, many of whom have difficulties with access • Build loyalty through patient engagement across all patient cohorts	• Digital front door, side door, and stage door • Online scheduling • Online reviews • Online health records • Digital platform to communicate directly with providers/customer service • Virtual primary and specialty care
Transform Care Models to Improve Efficiency and Augment Quality and Outcomes	• Enhance connectivity between clinician and patient, and among clinicians • Improve quality and outcomes • Drive clinical workflow efficiencies and top-of-license activities • Expand clinical service offerings	• Remote patient monitoring and wearables • Hospital-at-home, hospice-at-home, and other home health care models • Remote procedures/surgery (in trials) • Disease management apps • Pregnancy apps • Virtual care (also improves access) • Virtual consults • Virtual conferences • Digital therapeutics
Alleviate Staffing Challenges	• Introduce digital solutions that can reduce human staffing need, and/or allow human staff to operate at the top of their licenses	• Robots (Moxi – see sidebar) • Workforce and capacity optimization algorithms
Digitize and Optimize Business Operating Systems	• Improve efficiency and productivity	• Robotic process automation/AI-driven back-office functions
Operating Systems	• Improve unit economics • Optimize asset utilization	• Continuous costing • Real-time location systems • Purchasing and Inventory management tools

Telehealth: A Prototypical Story of Rapid Technology Adoption

Broad scale adoption and integration of virtual and digital health tools into medical practice have been slower than in almost every other part of our lives. This slow adoption is often due to multiple factors: the time investment required to learn new tools that may not be well integrated into existing provider workflows; the significant investment required to purchase new technologies that may reduce net revenues; the potential for lower reimbursement for digital care; and concerns that safety and outcomes may be negatively impacted by using digital tools. Furthermore, many patients historically have preferred seeing a doctor in person; have been skeptical about a computer informing them of diagnoses and next steps in care management; and are uncomfortable with new and unfamiliar digital health tools incorporated into their care.

However, COVID-19 has made telehealth a necessity – a safe way for patients to interact with health care professionals in a non-contact manner. The rapid and enormous growth in telehealth usage during the early stages of COVID-19 has demonstrated that both clinicians and consumers can learn to efficiently use digital tools, can become comfortable with virtual care or other forms of telehealth (e.g., telephone, email), and can have meaningful and continued clinician-patient interactions through digital platforms. An analysis conducted by Epic Research and the Kaiser Family Foundation found that the share of outpatient visits done via telehealth in 2019 was less than 1 percent.[1] Then, between April 2020 and April 2021, 64 percent of all U.S. households reported using telehealth at some point in that time period.[2] In addition, virtual care use was not confined to a narrow cohort of Americans. For example, all age groups had high telehealth usage rates. A study at a Boston academic medical center found that telehealth use ranged from 48 percent of outpatient visits to 62 percent across all age groups, with the oldest age cohorts having the highest rate of telehealth use – though the senior cohorts were less likely to use video technology and more likely to use the telephone than the younger cohorts.[3] Interestingly, that same study found that Blacks and Whites had higher usage rates than Hispanic or Asian patients, indicating that "rapid implementation of telehealth [did] not follow prior patterns of health care disparities."[4]

Perhaps more importantly, quality and outcomes have not suffered with the emergence of digital care. In a study of over half a million patient encounters from March 1, 2020, to November 21, 2021, patients who had a virtual primary care visit had comparable or better performance on quality measures than those who only had an in-person visit.[5] Another study examined encounter data from 40.7 million commercially insured adults. They compared 14-day post-index encounter rates (14 days after the initial encounter) for those who had a virtual visit to those who had an in-person visit. The study hypothesis was that if telehealth was not as effective as in-person visits, those with telehealth visits would have a higher rate of secondary visit(s) within 14 days. Instead, they found that using telehealth to manage chronic ambulatory care sensitive conditions (ACS) was "comparable, or even more efficient, than in-person care when follow-up encounters were assessed." It should be noted that the study found that patients with acute ACS conditions who had a telehealth visit "appeared to require additional follow-up compared to patients with an initial in-person ambulatory encounter."[6]

Although use of telehealth in most clinical specialties dropped after the initial COVID-19 infection wave subsided, the positive experience made clinicians and consumers more open to telehealth as a modality to provide and receive care, respectively. In an American Medical Association and COVID-19 Healthcare Coalition survey of 1,600 physicians, 68 percent told researchers they were personally motivated to increase the use of telehealth in their practice after trying it during the pandemic, and 71 percent said their organization's leadership was motivated to continue as well. For the 2,000 telehealth patients also surveyed, 79 percent were very satisfied with the care they received; 73 percent planned to use telehealth for care in the future; and 41 percent would have chosen a virtual visit over an in-person appointment for their last in-person visit given the opportunity.[7]

The lessons from the adoption of telehealth during the pandemic are that clinicians and consumers can use a digital tool for a health care encounter, outcomes did not appear to suffer, and a large proportion of clinicians and consumers had a positive experience and plan to use telehealth in the future. Clinicians and health care organizations that are typically slow to change were able to make rapid adjustments to their care delivery model, and populations that were previously thought to be resistant to technological solutions, such as the elderly, were among the most avid adopters.

Discussion and Commentary

Opportunities and Risks for Academic Health Centers

Many of the myriad potential advantages of digital health solutions summarized in the Table on page 4 pose opportunities for academic health centers (AHCs). At the same time, many of these benefits are accompanied by significant costs, including direct capital expense. Beyond the cost-related risks, the benefits of digital health should be evaluated carefully prior to widespread implementation. While many of the benefits of digital care will be realized, many may not. Indeed, some will not, and some may indeed result in negative outcomes that may not have occurred with standard in-person care. For example, solutions that have what seem to be obvious, intuitive benefits, such as earlier diagnosis and treatment for patients, improved health equity, and expanded regional or even transcontinental care access, may not prove to have benefits when evaluated against standard care, or worse can provide negative outcomes. For example, remote patient monitoring (RPM) systems employing digital technologies can alert clinicians when a patient's condition worsens, may enable care sooner, and may improve lifestyle change and medication adherence. Indeed, RPM may even reduce hospitalizations, including readmissions, leading to a lower total cost of care, better health, and a better patient experience. At the same time, there are many examples in the literature where these well-intended interventions have failed to yield the desired outcomes. For example, a 2016 study on the widely deployed sepsis early warning system, EpicSepsisModel, found that only 12 percent of alerts occurred on sepsis patients and only 33 percent of sepsis cases were flagged by the system.[8] Even worse, IBM's Watson, powered by an AI algorithm built with 'synthetic' data (not from real patients) from Memorial Sloan Kettering Cancer Center, resulted in "multiple examples of unsafe and incorrect treatment recommendations."[9] These examples suggest that like all clinical interventions, careful, controlled evaluation of digital technologies is essential prior to changing care practices at scale.

Given the vast potential of digital health technologies, AHCs have both an obligation and opportunity to leverage our formidable research enterprise capabilities to aggressively pilot and evaluate, and where beneficial implement, digital health technologies. AHCs are inherently designed and supported to evaluate capabilities that have the potential to improve care, and digital health technologies – including those impacting back-office infrastructure – are no exception. Moreover, the newest competitors entering the health care landscape, including some of the world's largest technology companies (e.g., Amazon, Apple) and payers (e.g., UnitedHealth/Optum) are quickly moving to leverage digital technologies to offer patients low-cost and high-efficiency services through their own offerings. AHCs, like all health systems, will undoubtedly see patients evaluating and using these offerings, and are obliged to understand how best to replicate and/or build bridges with these new market entrants. Finally, AHC educational programs and curricula should also be adapted to facilitate the understanding, ongoing clinical evaluation, and seamless utilization of the full array of effective and beneficial digital health technologies.

Building a Digital Strategy

Incorporating digital tools into an AHC's clinical and business operations requires a comprehensive approach that considers the AHC's overall value proposition and strategic goals. Specifically, digital transformation cannot happen overnight – implementing most digital technologies requires evaluation to assure not only clinical benefit in

the local care-system context, but also to assure cost-benefits that are consistent with institutional standards.

As shown in the Table on page 4, each digital technology solves unique problems and/or enhances some aspect of clinical or business activity. Choosing the "right" set of digital tools to implement will depend on what an AHC or health system seeks to achieve, what it believes its workforce will be able to adopt, and how much can be accomplished over what time frame. Examples of digital tools and the strategic value they may provide are described below:

- Virtual care platforms and tele-robotics provide a way for specialists to see patients without being in the same physical location. This can support an AHC's strategic growth aspirations while also improving access to advanced care to more patients in broader geographies. These solutions can also improve health equity by offering easier access to AHC-level care to patients who may be too far away to travel to the AHC, or who lack the means to do so. Virtual critical care and tele-ICU has been shown to improve outcomes at owned or affiliated locations away from the primary hub of an AHC (see the Emory example in the sidebar below), and eliminates travel required for critical care specialists to travel to these off-site locations, increasing efficiency as well as physician satisfaction.
- Digital monitoring tools and wearables support patients in managing their health, while allowing health care professionals to monitor a patient's health status and interact remotely when needed. These tools may avoid primary admissions and reduce readmissions and may enable reductions in the total cost of care while potentially impacting reimbursement through value-based/risk-based contracts.
- Artificial intelligence can inform diagnoses and personalized treatment plans, improving efficiency, outcomes, and lowering costs to patients.[10]
- Acute care-at-home, also known as hospital-at-home, supported by remote monitoring and digital data transfer from the patient's home to the health care institution, can reduce readmissions, improve facility-based length of stay, and improve outcomes. These programs can also help alleviate capacity constraints at an AHC, creating room for more complex inpatient cases. While the challenges are many, hospital-at-home has the potential to reduce costs and impact future inpatient bed-related capital requirements.[11,12]
- Robots (such as Moxi, see sidebar) can take on low-complexity tasks such as transporting supplies, medication, or lab specimens within a hospital. These robots can free nurse and pharmacy staff time enabling them to focus on more complex tasks improving efficiency and job satisfaction, and potentially alleviate pressures related to staffing shortages.

SIDEBAR | Moxi robots at Cedars-Sinai

In 2020 two Moxi robots were introduced at Cedars-Sinai Medical Center ("Cedars-Sinai") in Los Angeles, CA. The robots automate simple nursing workflow tasks, primarily staff-requested point-to-point deliveries. Each has a secure storage compartment as well as a utilization log for workflow insights. Moxi allows staff to spend more time with patients and focus on more complex activities.

- The four tasks initially assigned to the robots at Cedars-Sinai were non-tubed lab specimen transport, supply transport, discharge medication transport and delivery, and retrieval and delivery of patient belongings.

- The metrics used to assess the Moxi robots' impact were number of tasks performed, availability (queue time), distance traveled (steps saved for staff members), staff feedback, and other indicators related to the quadruple aim (improving the health of populations, enhancing the experience of care for individuals, reducing the per capita cost of health care, and addressing the needs of health professionals so they may attain joy at work).[13]

- Utilization of Moxi was high from the start and has continued to grow. Depending on what type of tasks are requested, Moxi can perform hundreds of tasks a day. The queue time at the most recent measurement was less than four minutes; total distance traveled after 150 days in service was 1,400 miles or 2.8 million steps saved. Staff has responded very positively.

- Cedars-Sinai is adding two additional Moxi robots to its "fleet," is expanding their presence on new nursing units, and is looking into additional applications and use cases.[14]

- Digital portals enable patients to have self-service for tasks such as appointment scheduling, access to medical information, and prescription renewals. This tool can reduce the number of required call center or appointment scheduling staff, reducing costs, improving efficiency, and increasing patient satisfaction.

- Artificial-intelligence powered tools such as Robotic Process Automation (RPA) can tackle claims processing with greater accuracy and improved efficiency.[15] These programs can reduce operating costs by reducing the number of claims processing staff needed.

Understanding the Requirements to Achieve and Sustain Value

As with any new tool that requires changes in clinical or operating processes, implementation is not necessarily straightforward, and change is not easy – particularly in health care delivery. Successful clinician and staff adoption, and meaningful value creation, requires these new tools to be fully understood and training and roll-out plans must be carefully designed. Failure to do so will impede adoption (e.g., the tool simply goes unused), and a failure to realize the full value potential of these tools and their associated investments.

Successful implementation and adoption require:

- *Redesigning care models and clinical processes*: New protocols at different points in the patient's evaluation and treatment, new or adjusted roles for clinical staff, and different decision-making processes must be explored and implemented. For example, hospital-at-home programs require a substantial capital investment for equipment and achieving sufficient scale to achieve a return on investment. A commitment to evaluating and directing patients into the program is therefore required. Staff must be trained to evaluate patients who are potential candidates for the program, an eligibility flag or criteria should be built into the electronic health record, emergency department processes must change to redirect some patients home, a management team needs to be assembled (or outsourced) to set up a patient at home and monitor them, and a process put in place to go to the patient's home or send an ambulance when needed.

- *Educating clinicians and patients*: The implementation of digital disease management and monitoring tools provides an example of the needs for effective training and education. To make these effective, patients must be taught how to use them, and mechanisms created for assistance when they run into problems. Clinical staff must be trained to monitor patients in this way, to interpret the data and to understand what to do when a red flag reading is transmitted. This will require implementation of

new processes for evaluating patients for eligibility, educating patients on the benefits of the tool and how to use it, and monitoring patient readings.

- *Translating data into appropriate clinical decision-making*: Consistent achievement of this necessary objective regarding how tasks are allocated between physicians and other health care professionals and how time is allocated across each role is perhaps the most challenging aspect of digital tool implementation.

- As data becomes increasingly central to clinical decision-making, the traditional role of a physician as the individual expert shifts to a clinical team analyzing many data points to make a collective decision. To achieve value from digital tools (meaning raising quality and convenience while lowering cost), clinicians will have to embrace their roles as data interpreters to be high-performing team leaders and team members. Though this may well be a change that is challenging for many physicians, it presents a tremendous opportunity for best patient care and will benefit from the support that AHC-based education, training, and continuing education platforms can provide.

Examples of digital technologies and how they change physicians' and clinical team members' roles are detailed below.

Select Examples of Digital Health Technologies' Impact on Clinical Processes and Roles

"Health care today is clinical science enabled by data – it will become data science enabled by clinicians."

– Nick Reddy, Chief Digital Officer, Baylor Scott & White Health

1. The acceptance of and demand for telehealth grew by orders of magnitude when the first COVID-19 waves arrived. Beyond the necessity of telehealth care modalities during the pandemic, consumer expectations have been changing for years and the preference for more convenient care access options has grown.

Kaiser Permanente (KP) conducted a survey in 2020 to understand consumer expectations around telehealth. The results found that members wanted a secure, intuitive interface, easy-to-use options that help connect "people who do not know how to do internet things," compassionate interactions that feel "roughly equivalent to meeting with a health professional in person," and multiple options for communication that are fast and coordinated.[16]

KP designed its telehealth programs with the goal of offering care for members, wherever they were located, and allowing clinicians to interact with patients remotely – preserving the clinician-patient relationship though not through traditional, in-person interactions. KP offers over seven options for telehealth, including phone and video visits, email, e-chat, "get care now," personalized e-visits to receive care plans and prescriptions.

Every clinician in every market served by KP is connected to KP's integrated telehealth system, which requires interacting, diagnosing and/or treating patients virtually. Clinicians had to learn different patterns of practice, how to view and process available digital data and information since they could not examine the patient in-person and changes in their daily routines. The result has been a dramatic uptick in telehealth usage across all the modalities listed above – it has allowed clinicians to continue to deliver care in a way necessitated by the pandemic and based on changing patient preferences, enabled by virtual and digital actions.

2. Tele-ICU/e-ICU leverages virtual and digital technologies to enable a physician in one location to monitor a critically ill patient in a different location and to communicate and collaborate with the care team members who are physically present in the critical care unit. Contemporary installations of tele-ICU "cockpits" enable surveillance and support by multi-professional teams. These stations typically include multiple monitors and dashboards, about 15 applications, alarms and alerts, echoes of EMR, echoes of bedside monitors, PACS, and parallel communications (phone, text, video) between the remote site and the patient in an ICU.

Tele-ICU's ability to provide advanced care virtually, without the physician being physically on-site with a patient, can help reduce geographic disparities in access to critical care and create efficiencies in how the time of physicians and others on the care team is deployed. In addition, tele-ICU models typically make extensive use of advanced practice providers (APPs) at the bedside communicating electronically with the remote critical care physician. This approach helps alleviate the impact of the growing shortage in the critical care workforce by leveraging a variety of types of APPs at the physical site.

At Emory Healthcare in Atlanta, the e-ICU program was created to bring higher-quality ICU care to more people across Georgia, without having to place faculty critical care physicians at each site. Studies of e-ICU implementation and outcomes found that there was an almost $1,500 reduction in Medicare funds spent per episode of ICU care from this program compared to nine Georgia hospitals providing similar ICU care. Readmissions after 60 days were reduced by about 2 percentage points, discharges to skilled nursing facilities and long-term acute care hospitals were reduced by almost 7 percentage points, discharges home increased 5 percentage points, and there was a reduction in length of stay. In addition, one of the rural hospitals to which Emory provided e-ICU services saw a 54 percent reduction in ICU mortality in six months, and a 30 percent reduction in ICU patient transfers to another hospital. With the realization that many ICU patients are admitted during the "overnight" Atlanta hours, Emory partnered with Macquarie University's MQ Health in Sydney, Australia, as well as Royal Perth Hospital in Perth, Australia, to "turn night into day." Emory clinicians in Australia monitored Georgia's nighttime ICU activity while in the daylight Australian hours – a creative approach to reducing the potential risks and lifestyle challenges for clinicians who are expected to provide expert care over extended hours daily. The Emory physicians, nurses, and other care team members who rotated through the Australian program from Atlanta, spending time in Perth and Sydney, found the experience to be educational, unique, invaluable, and unforgettable.[17]

An essential part of making the e-ICU successful at Emory was reallocating tasks across team members and using different data presentations visible at the point of care and in the remote monitoring "cockpits," all of which enables the team to work together to make clinical decisions. To drive the associated changes in behavior in the ICU, critical care leaders coached the teams to endorse the new roles and care processes and ensured that future performance goals, related to the care process changes, emerged from shared decision-making. The leaders discussed and set new standards in a collaborative process with the ICU teams, talked about how each role makes an impact, set specific targets, made new behaviors the "easy" thing to do, and created incentives to reinforce the desired behaviors.

3. Tele-robotic interventional procedures, such as tele-stenting and other robotic percutaneous coronary interventions (PCI), allow interventional cardiologists, interventional radiologists and/or other interventionists/surgeons to perform procedures while in a control booth or room, not touching the patient. While long-distance robotic interventional procedures are not widespread yet, and there are several regulatory, licensing and credentialing questions to be answered before that is a possibility, the technology and testing continues to advance. A transatlantic remote laparoscopic cholecystectomy was performed in the early 2000s,[18] and Dr. Tejas Patel performed the first telestenting in five humans over a distance of 20 miles in India in December 2018.[19] Spectrum

Health in Michigan is testing remote robotic surgery with the interventionalist at the control center in the same room as the patient or in an adjacent room.

The benefits of robotic PCI include "significant reductions in physician radiation dose," and improved comfort/range of movement for the interventionalist as he/she/they do not have to wear lead. Robotic PCI "has recently been demonstrated to be associated with reduced patient radiation doses."[20] In addition, geographic disparities in access to PCI and endovascular procedures can be reduced. A tele-robotic approach would improve access to care for acutely ill patients in remote or underserved areas, would reduce patient and surgeon travel time, and if treating acute stroke or peripheral artery disease, could shorten the time from the acute event to lifesaving surgery.

The use of tele-robotics dictates new and different roles for the clinical team members. First, the interventionalist is not touching the patient and in the truly remote scenarios is not even near the patient – he, she or they has a "virtual presence," enabled and guided by digital data. The clinical team located with the patient is no longer handing instruments to the interventionalist, but instead is communicating electronically with him, her, or them and monitoring the patient and robot via digital dashboards. There is still a high degree of interaction between interventionalist and team, but on both ends the roles have changed and digital clinical data is driving the entire surgical process.

4. Real-time virtual care is not always possible due to lack of high-speed broadband. For example, the U.S. Military must provide medical support where and when it is needed, both for garrison and deployed troops. They have an established Virtual Medical Center whose mission underscores "increasing readiness, enhancing access and experience of care, reducing per capita cost and improving population health." When possible, virtual visits can be done through MHS Video Connect. Clinicians and medics in the field can connect with clinicians in the U.S. via the ADVISOR (Advanced Virtual Support for Operational Forces) program or the Mobile Medic program, which provide a full spectrum of urgent and emergent on-demand consultation.

When high-speed broadband is not available, making virtual visits and consults impossible, a Global Teleconsultation Portal is utilized. The consults through this program are asynchronous – a store-and-forward system. Although not a real-time consult, over 85 percent of response times were within 24 hours; the remaining were in 24-72 hours.

The U.S. Military does not consider these programs to be service lines in themselves – rather, they are considered modalities of care, necessary for providing medical support to troops stationed across the globe with varying needs and local limitations. The modalities are seen as different processes to deliver consultations and care, supported by technology, people, and policy. Each operates under a slightly different process, but they all require clinicians on each end of whatever connection is possible to interpret data and translate into clinical decisions.

5. Acute Care-at-Home and other home-based care models (e.g., ED-at-Home, SNF-at-Home, etc.) reimagine how traditional facility-based care is delivered. Care comes to the patient, rather than patients coming to a physical site of care. To accomplish this, organizations must orchestrate a wide array of clinical and ancillary services to ensure patients receive the same or better care than they would within a facility.

For example, hospital-at-home patients still have an attending physician, but they may round on their patient panel virtually. Field nurses, community paramedics, respiratory therapists, and other allied health professionals provide care, administer medications and infusions, and perform a variety of other functions typically provided in the hospital. DME, medical supplies, and medications are delivered to the home. Mobile diagnostics, point-of-care testing, and specimen collection required for labs can all be conducted in the home as well.

Typically, a central command center helps to coordinate these logistics and activities. This central function also monitors patient vitals through sophisticated remote patient monitor-

ing solutions and helps facilitate the overall care plan. Furthermore, the command center plays an important role in triage, issue escalation, and resolution when required.

This emerging technology-enabled approach to care is accomplished through the marriage of creative care model and clinical pathway design, refinement and introduction of new workflows, and innovative technologies. Beyond simply developing this new operating model, organizations launching such programs also must address a variety of other issues. These include updating policies and procedures, negotiating reimbursement, ensuring compliance, defining governance models for quality and safety, structuring finance and accounting systems, to name a few. Finally, since these models are only viable at scale, organizations must also invest in change management to promote organizational readiness, create buy-in, and ensure all relevant stakeholders are well-trained in this new way of providing acute care.

6. Updating curricula for GME and UME: AHCs must embrace digital technologies to be able to educate both current and next-generation health care professionals in approaches to care that will become increasingly important during students' professional careers. AHCs that fail to develop and incorporate new digitally enabled approaches to care into their student, trainee, physician and professional staff training programs are at risk of having their programs fail to meet needs and expectations.

Key Challenges and Potential Solutions

Among the most significant ongoing challenges to successful adoption of virtual and digital technologies are: 1) the sizeable investments required, competing with other needs at a time of significant workforce and other inflationary cost challenges, and 2) the changes in team member roles and responsibilities required to make the investments in these technologies worthwhile.

Many digital technologies, implemented at the scale required to support an AHC, have substantial up-front capital and operating costs. To alleviate the cost burden, AHCs can consider finding dedicated technology partners or start-up companies looking to test a new technology, and willing to absorb some of the costs in return. Outsourcing of teams to operate or monitor a digital platform can also be considered if that is deemed more efficient than hiring or retraining staff within an AHC. Partnering and collaborating – and sharing costs – with other schools within a university, such as a school of engineering, could also help defray costs to the AHC.

Changes in care team member roles and responsibilities – as well as more fully incorporating digital data into clinical decision making – require buy-in from all team members involved. For example, changes to appointment templates required to enable online scheduling may be met with resistance from clinicians, in part due to compensation incentives to maximize individual RVU production and the desire to control the timing/availability of clinic sessions for personal or professional reasons. A variety of approaches can be used to encourage adoption. First, it is essential that clinical enterprise leaders make the case that these new care models will enable AHCs to increase the number of patients served, which will provide additional revenues in support of not only direct compensation, but the vital missions of research and training that AHC clinicians value. Second, the opportunity for individual AHC clinicians to be leaders in technological and care model innovation should not be understated. AHCs are uniquely positioned to lead in these areas, and AHC clinicians often desire to work at the vanguard. In support of these efforts, research dollars can support digital technology implementation, through NIH, PCORI, or private funding sources such as technology companies. These funds can also be coupled to opportuni-

ties for technology transfer, generating funds for research and other investments to enhance faculty experience. Further, the unique opportunities to collaborate across AHCs on these and closely related topics, such as care model innovation and maximizing the value of digital tools, should be considered and advanced.

As digital tools are adopted, successes should be shared and celebrated. Setbacks or hurdles should be acknowledged, including through publications in the peer-reviewed literature.

Conclusion

Health care's digital transformation is already underway and has the potential to unlock enormous value. To engage in leading this transformation, we recommend that AHCs:

1. Identify the highest priority areas in which virtual and digital care can help improve access to patients, improve efficiency, and support all health professionals in their work. Success will require a reassessment of enterprise-wide strategic priorities. Developing use cases based on their potential value and feasibility will be helpful in this work.

2. Define the underlying financial, clinical, operational, and technical requirements and associated performance measures for the highest priority areas.

3. Build alignment of the business case and transformation roadmap across relevant stakeholders (e.g., physicians, clinical staff, operations, finance, marketing, IT, patient experience, etc.).

4. Establish an effective governance and operating model to enable disciplined execution and portfolio management.

As leaders in innovation, AHCs must play a vital role in charting health care's digital transformation in ways that improve access to care, outcomes, and value. While recognizing the significant change-management challenges and financial margin headwinds in the health care industry facing most AHCs, there are substantial risks to delaying the incorporation of digital and virtual technologies and tools. These include lost market share through failure to adopt digital advances important to patients and employers purchasing health care with an increasingly consumer orientation; loss of longer-term financial performance improvements that digital technologies can yield in both clinical and back-office areas; failure to advance the nation's health care workforce by incorporating digital technology into AHC-led education and training programs; and, missing the opportunity to identify our AHC institutions and research enterprises as a core testing ground and essential thought leader for adoption of digitally enhanced care models and other key digital health care solutions.

Throughout the process of digital transformation, health equity must remain a central focus. Digital tools provide opportunities to advance health equity, yet when inadequately tested or poorly evaluated prior to full-scale use in local settings, they can inadvertently exacerbate inequities – for example, by requiring use elements that those without broadband or a smart phone cannot access. Health equity should be considered not just across population segments, but also across clinical service areas to improve consistency of care outcomes, quality, and safety.

Considerations for Policy Makers

The highly complex and regulated nature of health care has contributed to slower adoption of the digital technologies and tools required to modernize clinical and business operations, as compared to other industries. Regulators should encourage and enable adoption of digital technologies in health care given their significant potential to improve access, outcomes, and value.

Returning to the telehealth example above: the pandemic pushed us into a virtual model of care out of necessity and use rates skyrocketed. Waiving restrictive regulations on providing telehealth across state lines, and providing reimbursement parity, enabled rapid and widespread adoption of telehealth. Once these barriers to adoption were removed, patients and health care providers quickly used this new approach to access care, albeit encouraged by the pandemic. While use

of virtual care modalities has declined, they remain well-above pre-pandemic levels and are here to stay.

Final Considerations

Digital transformation is crucial for AHCs to remain at the forefront of patient care, innovation, and education. Incorporating a wide variety of digital technologies into health care delivery can no longer be viewed as an "enhancement" to how care is traditionally delivered. Rather, they provide profound transformational opportunities – expanding access and broadening patient reach; transforming care models to increase cost efficiency while improving quality and outcomes; alleviating staffing challenges and facilitating care model efficiencies; and optimizing business operations. It is clear the power of digital transformation is not in the technology alone, and the sizeable capital investments required will not capture the needed value without accompanying, and often challenging, workflow and role-specific change management efforts that AHCs must make a priority to design, validate, and lead for our nation.

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The Blue Ridge Academic Health Group studies and reports on issues of fundamental importance to improving the health of the nation and its health care system and enhancing the ability of the academic health center (AHC) to sustain progress in health and health care through research—both basic and applied—and health professional education. In 25 previous reports, the Blue Ridge Group has sought to provide guidance to AHCs on a range of critical issues (See titles, above).

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