Implementing Virtual Care in Neurology - Challenges and Pitfalls

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ABSTRACT

Virtual care is here to stay. The explosive expansion of telehealth caused by the SARS-CoV-2 pandemic is more than a necessary measure of protection. The key drivers of this transition in healthcare delivery to a virtual setting are changes in patient behavior and expectations and societal attitudes, and prevailing technologies that are impossible to ignore. The younger population - Generation Z - is increasingly connected and mobile-first. We are heading to a world where we expect to see healthcare in general and neurology, in particular, delivered virtually. The medical community should prepare for this overhaul; proper implementation of virtual care from the ground up is the need of the hour. In an era of virtualization, it is up to the medical community to ensure a well-informed patient population, overcome cultural differences and build digital infrastructure with enhanced access and equity in care delivery, especially for the aging neurological patient population, which is not technologically savvy. Virtual care is a continuum of care that needs deeper integration at systematic levels. The design principles of a patient's journey need to be incorporated while simultaneously placing physician satisfaction with a better user experience at the center of implementation. In this paper, we discuss common challenges and pitfalls of virtual care implementation in neurology - logistical, technical, medicolegal, and those faced in incorporating health and medical education into virtual care - intending to provide solutions and strategies.

KEYWORDS: virtualcare, neurology, virtualneurology, telehealth, telemedicine, teleneurology, telestroke, digitalhealth

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Introduction

The increasing gap between the supply and demand of neurologists necessitates a geographic redistribution of the workforce to provide urgently needed neurological care to patients. Virtual Care is the only way to provide access to neurological care to an ever-aging population efficiently. However, it has its challenges and requires implementation strategies that consider specific challenges unique to neurological disorders. Definitions of common terms are discussed in Table 1.

A retrospective observational study conducted by McGinley, et al at Neurological Institute at Cleveland Clinic revealed an increase of virtual visits from 3.9% - before the SARS-CoV-2 pandemic - to 94.6%. The overall no-show rate was higher for in-person visits (13.6%) than virtual visits (2.2%).[1] A prospective study by Craig J et al reported a decreased length of hospital stay in patients with neurological disorders who were provided consultation through video link telemedicine. This data emphasizes the ability and efficacy of institutions to convert in-person care into virtual care efficiently and quickly.[2]

Virtual care is now accepted and appreciated by both providers and patients. Given, the availability of neurologist sooner, faster, and without borders have been a huge win. In neurology specifically, there is also a trend for a high level of patient satisfaction. Furthermore, more sub-specialized neurologic care is now available in remote areas that were previously inaccessible.[3,4] A recent survey by GoodRx concluded that virtual care increased from 17% to 47% after the impact of COVID-19, and 60% planned to continue telecare and in-person care. Similarly, 70% of providers reported increased continuity of care by patients through telehealth and 47% felt more safe providing care via telehealth than in-person care.[5] Another survey documented increasing confidence in virtual care, both access and quality.[6] Economically, virtual care is also a great opportunity, estimated to become a quarter-trillion-dollar industry post-COVID.[7]

The American Academy of Neurology (AAN) supports the expansion of teleneurology[8]; The AAN leadership has also been advocating for formal teleneurology education[9] and has provided guidelines regarding telemedicine implementation, neurological examination, and coding systems.[10] What remains a challenge is the proper implementation of these services. A vision of a fully integrated service line that not only complements in-person care but rather improves care delivery where

Table 1. Definitions of Common terms.

VIRTUAL CARE	COMPLETE CONTINUUM OF CARE WHERE LABS, RADIOLOGY, AND OTHER SERVICES ARE COMPLETELY VIRTUALIZED WITH THE FINAL EPITOME OF VIRTUAL HOSPITAL AT HOME
Telemedicine	Treatment of the patients that involves physician and pharmacy using video, audio and messaging digital tools
Telehealth	Telemedicine + Allied care (pt, ot, st, nursing support, respiratory therapist) + Remote patient monitoring
TeleNeurology	Neurologist providing telemedicine care
TeleCare	Used interchangeably with telehealth to provide care at home

Legends: pt: physical therapy, ot: occupational therapy, st: speech therapy.

appropriate. This paper discusses the need, challenges, and pitfalls in implementing virtual neurological care.

Logistical Challenges and Limitations

Neurologist supply versus demand. One out of 7 people suffers from neurological disorders worldwide, accounting for 1 billion affected globally. The neurological patient population is aging, in addition to people with disabilities or limited incomes who find it hard to travel long distances to get benefits from in-person care. This is where teleneurology steps in provides the patients affordable, easily accessible, and long-term healthcare. The AAN has appreciated and encouraged the travel cost reductions and effective healthcare delivery in areas with insufficient neurologists achieved by implementing Teleneurology.[11]

With the increasing burden of neurological disorders worldwide, a dedicated workforce of neurologists is required. A lack of neurologists is a global problem. A mismatch between the demand and supply of trained neurologists is greater in low-income countries (median of .03/100 000 population) than in high-income countries (median of 4.75/100 000 population). Globally, the median number of neurologists available to the population is .43/100 000 Meanwhile, the decreased availability of neurologists, especially in rural areas, and long waiting hours highlight the already existing shortfall of neurologists that will increase to 19% by 2025 and is expected to increase even further. This discrepancy of neurologists negatively impacts the effective availability of neurological care.[12-14]

A study analysis by Gooch et al (2011) reported 100 million Americans are affected by at least 1 neurological disorder. It has increased to 200 million Americans due to the aging population, as analyzed by the GBD study in 2017. The patient burden is even worse in rural areas.[10,15]

Special needs in neurological care. According to the Global Burden of Disease report, neurological disorders are among the 6 leading causes of disability. A decrease in technological adoption with increasing age[16] and additional disabilities such as blindness, hearing impairment, decreased vision, motor weakness, and mental retardation, including cognitive deficits[17] mandate the presence of a caregiver (a family member or care-team member) to assist in evaluation and management of the patient.[18] Travel also increases the risk of injury and fall. The study by Saverino et al[14] reported that 50.2% of the total participants experienced at least 1 fall associated with neurological conditions. Teleneurology improves access, equity and convenience, but in certain neurological conditions, it is safer for the patient as the risk of fall is less in familiar settings.[19] These factors prioritize the implementation of teleneurology to address these deficiencies so that proper care can be provided to the patients.[20]

Communication with the patient, family members, and providers is a major concern while implementing teleneurology as lack of confidence about the use of telehealth,[21] angle of the camera, and gestures such as nods or hand movements during video-conferencing can influence communication by healthcare professionals. Other hurdles in communication are cultural differences, language barriers, and resources available to the patient.[22] Virtual Care can enhance with multiparty telepresence to bring relevant family members virtually. And they can contribute to history and are first-hand apprised of current clinical situations and plans, especially useful for dementia patients.[23] Interpreters can be added virtually more easily and quickly than in-person interpreters, reducing travel costs.[24] A review study done by Joseph et al[25] concluded that the level of satisfaction experienced by video interpreting and in-person was the same regardless of the presence of provider and patient in the same space.

Outreach clinics have and can be applied and have been used extensively. However, it does not solve the core issue of the lack of neurologists. Virtual care with a geographically distributed workforce can enhance accessibility to neurological care with pure/hybrid outreach clinics. A cost analysis done by snowswell in 2019 compared the cost and outcomes of different healthcare services provided to the patients. The marginal per-patient cost was $692 for patient travel, $482 for clinic outreach, and $284 for telehealth. The study also highlighted that if telehealth services replaced patient travel, it saved about $517. Similarly, replacing outreach clinics with telehealth would save approximately $3961.[21] However, given the nuanced needs of the neurological exam, we believe a hybrid approach with the nurse and/or nurse practitioner at the bedside with a neurologist at the web-side (virtually) can bring the best of both worlds.

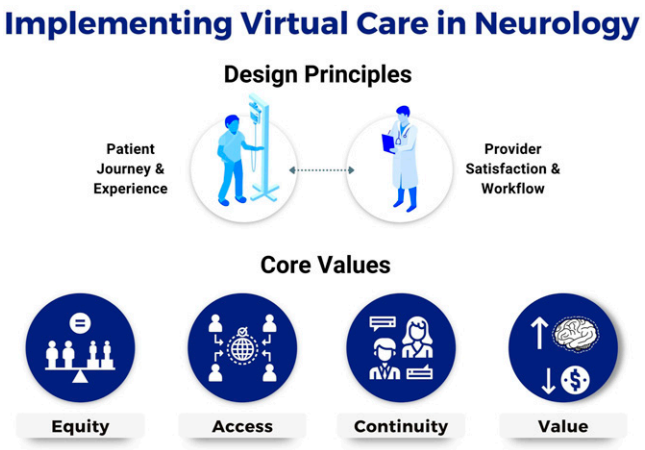

Figure 1. Principles and Values for implementing virtual care in Neurology.

Electronic health records are a widely used system to get patients' data in the healthcare system as it increases the productivity and quality of the data provided. But the limitations to its use are the loss of data, data errors that are difficult to amend, and no proper guidelines about data sharing among different providers.[26] Another issue is the health system's ability to get patient data from other sources or EMRs. Sadly, this is not in practice to date, although the Office of National Coordinator has been trying to bring this to life.[27]

Continuity of care is extremely important in chronic neurological care for patients with dementia and multiple sclerosis. The physician who has been taking care of the patient on a longitudinal basis is best suited to this patient. We need to have a pathway to virtualize the patient's primary neurologist if possible. This also builds trust in the provider and the overall health system and improves compliance and prevention strategies.[28,29] Figure 1 demonstrates the principles and values for implementing virtual care in neurology.

Fragmented care. Unfortunately, fragmented care is the norm, and if virtual care is not implemented correctly, the fragmentation that already plagues our care paradigms will only worsen. In providing neurological care, even a task as simple as history taking requires further corroboration with family members as many neurological patients have dementia. Given the complexity of the care paradigm requiring different medical specialties to work together for 1 patient, eg, cardiology, hematology, neurosurgery, etc., contextual communication becomes a priority by design.[29-31]

Interoperability is 1 of the biggest hurdles in creating a comprehensive care platform for virtual care services, reducing fragmentation and episodic care. In some cases, the lack of interoperability is expensive and can result in delays that devastatingly impact patients.[32] The Office of NC (ONC) has taken significant strides to improve interoperability and transparency under the Cures Act.[33] The Act has now penalized information blocking and mandated the adoption of standardized processes for exchanging information. The other 2 aspects that would further improve information sharing include the wide use of Application Programming Interface (API) to create two-way sync and the Trusted Exchange Framework and Cooperative Agreement (TEFCA). Thirty-six billion dollars of public money has been spent to increase the adoption of EMR, but unfortunately, this has led to more data silos.[34] Some have proposed creating and advancing centralized data repositories for the public good, and continued annual federal funds are used.[35] With enhanced interoperability, overall fragmentation will decrease, but a true virtual care ecosystem will also be realized.[36] Table 2 summarizes care location-based recommendations and common pitfalls.

Technological Challenges and Priorities in Virtual Neurological Care

There are many important technical challenges in the appropriate implementation of virtual care in neurology. Table 3 summarizes and provides a checklist to review before selecting and finding an implementation partner/vendor. We have difficulties divided into 2 categories: 1) Software and 2) Hardware

Design should concentrate on the patient journey, experience, and provider satisfaction from a software perspective. Key implementation and vendor choice should include cybersecurity and interoperability. Hardware is specific to clinical settings, and the choice of hardware is dictated by acute/inpatient, outpatient, chronic care management. The choice should include special attention to integrating multiple remote patient monitoring platforms. Virtual care is the opportunity to create a more inclusive, modern, secure, and vendor-neutral system with deeper integrations. Picture Archiving and Communications System (PACS) is an integral part of any modern medical imaging system. We recommend starting with a short lease option to test services and support before committing to a long-term financial agreement. When implementing or choosing a vendor, special attention should be given to technical support and back-office workflow integrations.

Virtual Physical Examination

There are limitations of clinical neurological exams over telemedicine that need to be recognized. We propose that virtual care is a tool to be used where appropriate. There are clear areas of neurology where the virtual exam is not feasible. AAN also identified suitable teleneurology examination components such as Functional strength testing and sensory examination, Cerebellar and gait testing, Mental status examination, Cranial nerve examination, and Various measurement scales including the NIHSS and UPDRS. Inappropriate aspects of assessment included comprehensive vestibular, neuro-ophthalmologic, neuromuscular, and Brain death examination despite the availability of peripheral devices.[9] Ansary et al scaled virtual telemedicine exam that included II/III cranial nerve

Table 2. Virtual Care Values, Challenges, and Pitfalls By Care Setting.

NAME	VALUE	CHALLENGE	PITFALLS	PREFERRED DEVICE
Acute	Time is Brain	Interoperability	Integration	Built-in/Carts
			Interoperability	
			Contextual communication	
Outpatient	Convenience	Continuity of care	Patient journey	Smartphone
			Patient experience	
			Continuity of care	
Chronic care	Prevention	Medical compliance	Remote patient monitoring	Tablet
			Digital health education	

examination in the low-feasibility group, motor bulk/tone, and pallor in the medium-feasibility group while the rest of the neurological examination was in the high-feasibility group. With the advent of meaningful AI algorithms, these challenges in the study can be addressed.[37]

Given all these limitations, we encourage virtual care to be embedded within the system with limitations recognized. Where the needed patient should be referred to an in-person visit or experience tele-presenter to be present. Also of note, technologies are being developed to improve assessment on an episodic evaluation in the clinic and on more continuous assessment. For eg 1. The retinal exam was near impossible, but the plethora of devices is not available to capture retinal images. Scientists are working to develop a mobile app using artificial intelligence algorithms to examine the retina.[38] 2. Robotic motor assessment tools are being developed as well that not only do an assessment but also quantify objectively over a long period this will enhance assessments even more so than in-person in the future.[39,40]

The neurological examination requires some special tools depending on the patient's needs. Technological advancement has met some of these challenges, eg, physicians use different mobile apps to perform examinations in neuro-ophthalmology. These include Peek equity and Vision Home to address visual acuity, Eye Handbook to examine color vision, and Melbourne Rapid Fields to access visual fields in patients.[41] Device embedded cameras are currently used to assess cognitive function in patients with Alzheimer's disease. It involves tracking eye movements by webcams during various visual paired comparison tasks. The main hurdle in implementing this technology is the lack of insight into the use and efficacy of these apps among both providers and patients.[42] But we still lack the validity and reliability data regarding these apps' usage and their efficacy.

In terms of neuromuscular disorders, wireless sensors to assess balance problems for the last 15 years address the advancement of technology in healthcare. Static and dynamic posturography are used to label balance issues in patients with the use of wireless inertial sensors and surface electromyographic sensors. The advent of these devices while implementing virtual care will allow physicians to assess balance problems in the labs and their use at the domestic level.[43]

Optimizing Patient and Provider Experience

One of the key challenges is to create a user experience that should be very friendly,[44,45] intuitive, and delightful to use. Elderly patients will be using the system frequently, and special accommodation, eg, large icons and text, should be a design priority.[46] On the same note, the software UI/UX design is crucial for providers to match their workflow to decrease care latency and improve documentation times.[47] The key struggle is to ensure communication between different providers and other clinical and non-clinical staff. So, the software needs to have a patient-based team communication portal.[48]

Privacy, Cybersecurity, Ransomware

There are few places where cybersecurity is more important than in the arena of healthcare. It is not just about patient privacy, which is essential, but electronic medical records contain the most comprehensive picture of a patient, including finances, employment history, and physical addresses. Breaches to health records can significantly lose personal liberty and have a significant personal and financial cost attached to it. The Health Insurance Portability and Accountability Act (HIPAA) was initially designed to solve health portability issues and is now considered a gold standard for patient privacy. However, the inception of those standards back in 1996 is not outdated and is in desperate need of revitalization.[49,50]

The dire consequences of ransomware for health systems are especially devastating, as systems are locked, and ransomware precludes further care delivery. This results in care delays that may cost limbs or lives. Mere compliance with HIPAA standards is sometimes not enough to protect patient privacy. We advocate for systems with two-factor authentication and end-to-end encryption as standard. However, to make the process seamless, once authentication is complete, further prompts of login attempts need to be eradicated, and 1 login should enable physicians to access all

Table 3. Technological Challenges and Priorities in Virtual Neurological Care and Checklist For Implementation.

SOFTWARE	
Interoperability	
Two-way sync	Deployment of required APIs; and adhere to ONC requirements of data sharing
Multiple EMR support	Supported by multiple certified EMRs
Billing and coding support	Improved workflow of back-office operations
Integrated ecosystem	Built has support to bring in other plugins and systems like voice assistant etc. to enhance
Cyber Security	
Two-factor authentication	Current industry standard for security and needs to be implemented
Biometric authentication	Technologies like fingerprint and face detection should use to enhance security
End2End encryption	We recommend systems that have end-2-end encryption
UI/UX	
OS Agnostic	Supports multiple operating systems on both desktop and mobile
Web-based	Preferable to have a web-based user-interface in addition to dedicated mobile apps
Mobile/Tablet apps	Dedicate Mobile/Tablet apps necessary for remote and universal access
Patient journey	User experience designed towards patient journey; easy to use with simple navigation
Provider workflow	Reduce redundancies, improve workflow and contextual communication
Communication	
Care team	Patient centered care team-based communication should be a priority
Patient to provider	Secure, fast easy protocol for communication should be implemented
PACS	
Integration	Need to have swift efficient access to images and radiology reports
UI/UX	Great user experience to view images quickly and securely and on a mobile device
Mobile apps	Have complimentary mobile applications for end users including pinch to zoom support
Reporting/Key images	Key images to be pulled into EMR for documentation
Technical support	
Chat/Text	We recommend that chat-based option is available for both provider and patient
Voice/Video	Elderly patient may require video/audio support and this option should be available
Feedback/Improvement	
Patient feedback	There should be easy, unobtrusive way to collect feedback to improve
Clinician feedback	Feedback given needs to be evaluated monthly
Hardware	
Multi-device support	
Built-in	Built-in/Wall mounted systems are great for ER/ICUs and decrease physical footprint
Mobile Cart	Concentrate on size to reduce footprint for storage and room occupancy
Tablet-based	Used in mobile clinics, school nursing offices etc.
Smartphone	Outpatient and home use
Sound	
Speakers	Good quality sound with highly sensitive sensors essential as patients may have hearing impairment
Mics	Far-field mics to improve comprehension especially in dysarthric patients
Camera	
Pan-tilt-zoom	This is essential for tremors, pupil, gait examinations
1080p Output	Resolution should reach 1080p to see clearly on video assessments
Integrations	
Addon devices	Vendor neutral support to different and upcoming special devices
Remote patient monitoring	Ability to integrate with multiple other RPM vendors

Legends: API: Application Programming Interface, ONC: Office of the National Coordinator, EMR: Electronic Medical Records, ER: Emergency, ICU: Intensive Care Unit, UI: User Interface, UX: User Experience, RPM: Red-hat, Package Manager.

systems seamlessly, including EMR, PACS, Voice recognition software, and other information systems. Similarly, initial authentication needs to be strong for patients, but repeated prompts to log in should be eliminated to create a seamless experience once authentication is complete.

Medicolegal Challenges in Implementation

The challenges do not stop at technology. Medicolegal challenges around virtual care delivery need to be streamlined to help healthcare systems and providers to implement virtual care effectively, efficiently, and securely in various clinical settings. Here we discuss issues related to 1) licensing, 2) credentialing, and 3) reimbursement.

Licensing

In the USA, licensing is state-specific to provide care; each provider is licensed in their specific state. The very essence of utilizing the neurologist workforce to its fullest demands geographic redistribution, and the ability of neurologists to practice in multiple states is crucial. Interstate compact medical license is one-way people circumvent increased delays in licensing.[51] However, we need a strategy to have qualified physicians practice in all 50 states; Potentially considering a federal level telehealth physician license. This problem is exponentially more complex if applied on an international level.

Credentialing

Similarly, credentialing is extremely fragmented, and there are massive redundancies in the process. Credentialing needs to be streamlined with a central, secure repository of credentialing data that can be constantly updated and verified. Also, continued medical education verification needs to be revamped to have access where needed. The Neurotracker™ tool by the AAN is a good example where a provider can accumulate their data; however, this should also include a central credentialing repository where health systems can quickly access and verify provider status.[52,53]

Reimbursement

The primary reason for the expansion of telehealth during and post-COVID is reimbursement. Before the pandemic, the reimbursement was limited to special circumstances; however, given the need for contactless care during the pandemic, reimbursement was allowed under the emergency act and technically temporarily.[54] However, we need to make sure that telehealth is reimbursed. Not only virtual care is reimbursed, but we believe there should be pay parity, ie, the amount of reimbursement should be similar to an in-person visit. To date, only 22 states have addressed the reimbursement of telehealth services, but only 14 states (Arkansas, California, Delaware, Georgia, Hawaii, Kentucky, Minnesota, Missouri, New Mexico, Texas, Utah, Vermont, Virginia, and Washington) are truly providing payment parity, and this needs to be expanded to all 50 States.[55] Though the Congress of the USA is working towards it slowly, this needs to be a priority to implement virtual care services.[56] In parallel, AAN strongly supported this and was 1 of the prime agendas in their advocacy "Neurology on the hill" 2020.[57] Recently, the American medical association (AMA) has been heavily advocating for an expansion of telehealth by calling out to broaden the provider licensure across the states of the US.[58] Center for connected health CCHP tracks telehealth policy in each locale and is a great resource to check updated policies in your specific areas.[59]

AAN made recommendations about the expansion and permanence of telehealth changes implemented during the Covid-19. Points highlighted were modifications in the limitation of the number of inpatient visits and supervision requirements, coverage of telephone, audio-video technology, and monitoring codes.[28] Following that, AAN declared a consensus statement in January 2021, which focused on travel and internet issues faced by patients, healthcare professionals maintaining licensure standards, expanding and accelerating licensure across the states, and the support of governors and state legislatures to provide netizens the choice of care they want.[60]

Equity and Access

Any digital divide in society can result in disparities in the healthcare provided to the people. Thus, necessitates the provision of strategies to provide infrastructure (broad bandwidth internet, digital devices, digital literacy) to both the provider and patient. Challenges like illiteracy, older age, low income, the requirement of higher bandwidth internet, less familiarity with the digital world, marginalized communities if not addressed properly while implementing virtual care in neurology can further worsen existing healthcare disparities. Lack of private space to have video interaction can be a hurdle in virtual care, and patients can switch to telephone telehealth visits.[60]

Complex technologies demand increased digital literacy to motivate patients' use of these technologies. The following 3 strategies are important to optimize patient and provider experience: 1) Healthy decision-making systems to track strategies used to provide virtual care and maintain access. 2) Develop clinical decision tools to specify the use of video, telephone conferencing, or any alternative means. 3) Measures to ensure the availability of digital devices and high-speed internet to the patients.[61]

Virtual care can bring subspecialized neurological care to underserved rural communities. Special programs like Federal Communications Commission (FCC) telehealth have grants allocated to expand rural healthcare via virtual care. Neurology should be an essential part of this program, and requirements

should include acute and specialized neurological care as a priority.[54] Furthermore, to ensure equity in virtual care, we must simplify interfaces, employ intermediaries, and encourage patient feedback, allowing them to be active participants in their healthcare.[60]

Having access to broadband internet is now a healthcare issue. Though implementing virtual care benefits rural and underserved areas the most, the effective availability of high-speed internet is the foremost requirement. About 25 million people across the United States lack access to the internet at home analyzed by American Community Survey in 2019.[62] According to the Federal Communications Commission, about 30% of the rural population lacks high bandwidth internet availability. This renders the policymakers to put forth laws regarding the availability of high bandwidth internet infrastructure in rural areas.[63]

Remote Education Integration in Virtual Care

Virtual medical education. For decades, the mainstay of clinical training has been based on the apprenticeship model, learning the clinical craft by close observation, but the system no longer fits our modern world.[64] We need to pay close attention to the virtualization of the world and how that affects education in both training and learning. The virtualization of medical education and training, especially in neurology where history, exams, and clinical cues picked up during in-person encounters are considered essential, is challenging but not impossible. Pre-rounding, case presentation, and post-exam discussion during rounds are all necessary to train neurologists of the future. We can virtualize these processes by enabling multiparty with screen sharing to review neuroimaging and labs and discuss relevant plans virtually.

Virtual medical training is now gaining momentum with the use of technology. Tele-proctoring can assist or monitor procedures and surgeries from a remote setting, which helps manage patients in remote areas and helps to build a network of connected neurologists sharing experiences and expertise. Furthermore, the field of Augmented Reality (*AR*) offers educators the opportunity to create learning environments where students and trainees become familiar with clinical settings and are free to learn from their mistakes.[65] We need to promote and formalize virtual neurological training. The AAN has worked up a set of basic equivalencies that need to be met by any neurologist hoping to practice teleneurology; these range from basic knowledge about the technical aspects of teleneurology to an evaluation of attitude and skills.[9]

Remote Patient Health Education

One of the key advantages of virtual care is remote education. People increasingly use the web and YouTube to get information about their common ailments. This is a great opportunity for the medical community to create authentic, trustworthy sources of information accessible to patients and their family members in a mixed media, on-demand format. This improves patient engagement and instills a sense of autonomy in patients required for treatment compliance. Patient education is tied hand-in-hand with improved health outcomes.[66] Patients need to be partners with providers on their health journey. Just-in-time learning for both patients and providers should be part of any truly innovative virtual care solution roadmap.

The literature tells us that the most effective method of patient education is via video, software, and telephone support.[67] Furthermore, *AR* is not limited to educating medical practitioners but can also teach patients.[12] When implementation is ground up with the above principles, we will see outcomes improving with a decreasing cost curve. This will provide providers with respite, decrease moral injury, and improve satisfaction.

Conclusion and Vision

Success in virtual care in neurology is dependent upon proper implementation. The implementation should revolve around the tenets of patient and provider satisfaction. With the goals of equity, access, continuity of care, and value in mind (illustrated in figure 1), we can advance virtual care to the level that will help us bring high-quality healthcare practice globally. To improve, we need to be able to measure. Data reporting needs to be instantaneous, and feedback provided to care teams should be near real-time, actionable, and constructive. This requires diligent work to adhere to practice parameters and targets and create new, value-based scoring systems to measure utilization more effectively at a patient and provider level.

Provider satisfaction is at its core a function of the patient experience. A seamless, integrated virtual experience will require attention and focus on patient care. Integration, intelligence, and contextual information are key to provider satisfaction. Similarly, the patient experience needs to be built around the patient's virtual journey. Important data is ported from each encounter, knowledge, and education are integrated. Systems are built from the ground up to provide easy navigation that is device and OS agnostic.

We are increasingly moving toward a future where virtual care will be the norm. Virtual hospital settings at home will be the ultimate expression of that reality. Virtual Care in Neurology needs to evolve with systems of care approach with deeper and more meaningful integration at both software and hardware levels. The design thinking needs to be in place with patient experience and journey at the core and provider satisfaction achieved with seamless, unobtrusive user experience to achieve the real goal of improving outcomes with decreasing cost.

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