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Review

Bridging the healthcare gap: Building the case for epilepsy virtual clinics in the current healthcare environment

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ABSTRACT

Access to quality healthcare remains a challenge that is complicated by mounting pressures to control costs, and now, as we witness, the unprecedented strain placed on our healthcare delivery systems due to the COVID-19 pandemic. Challenges in healthcare access have driven a need for innovative approaches ensuring connectivity to health providers. Telehealth services and virtual clinics offer accessible disease management pathways for patients living in health resource limited areas or, as in the case of the COVID-19 pandemic, where there may be potential barriers to existing healthcare resources. Those suffering with serious chronic disorders often cannot be seen by a healthcare specialist due to their limited availability, or the lack of a specialist within a reasonable proximity. Epilepsy represents such a disorder where most of the world's population lacks the availability of necessary specialists. Virtual clinics allow for specialist care and an ability to perform necessary ambulatory electroencephalogram (EEG) monitoring by placing the technologies directly in patients' homes or at local clinics near the patients' homes. By moving the diagnostic process out of the hospital or epilepsy center, it becomes possible to overcome growing gaps in neurology services. Virtual clinics have the potential to expand access to high-quality, cost-effective care for the patient. The virtual clinic remotely connects those in need of medical support with specialists anywhere in the world, at any time of the day.

1. New solutions to the widening healthcare gap

Defining Virtual Clinics
A "virtual clinic" refers to digital access to healthcare services through remote clinical consultation, as opposed to a face-to-face visit. It is conducted for the purpose of receiving a diagnosis, health screening, advice, and/ or treatment. It can be conducted through telephone contact, telemedicine, video-link, or teleconference.

According to the World Health Organization (WHO) and the World Bank, half of the global population continues to lack access to essential healthcare services [1]. Even those with access to healthcare services frequently suffer under the strain of enormous out-of-pocket costs or overburdened health delivery systems. Indeed, healthcare expenses represent at least 10% of the household budget for over 800 million people [1]. Despite progress in access to immunization services, family planning, human immunodeficiency virus (HIV) treatments, and communicable disease prevention, wide gaps remain in access to care. It has been recognized that this gap is prevalent in Low- and Middle-Income Countries (LMICs), but even those higher income countries able to provide greater access to healthcare services are not capable of reaching all citizens equitably, resulting in global, regional, and subnational care gaps [1]. Maintaining quality care while controlling costs is an issue for today's healthcare systems. Additionally, shortages of healthcare professionals, particularly specialists, are well publicized. Staffing shortages have a very real impact on quality of care and patient safety. In fact, a study by *The Lancet*, involving nine European countries, found that an increase of nurses' workload by one patient, increased the likelihood of an inpatient dying within 30 days of admission by 7% [2], illustrating the risks of inadequate staffing resources for the patients, not to mention the burn-out risk for healthcare practitioners.

In response to increasing pressures on health systems, policymakers and healthcare providers are turning to new digital technology solutions to help ease cost and capacity constraints. Technology-enabled remote care, broadly referred to as "telehealth," now accounts for a

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significant portion of the dialog on building resilient and sustainable health systems of the future. Virtual clinics, a unique and evolving innovation in telehealth, represent a holistic solution to many of today's health systems challenges, with the differentiated ability to maintain quality, while controlling costs and ensuring patient access to appropriate care in a more private setting.

2. Taking telehealth to the next level with virtual clinics

The taxonomy and terminology of telehealth is constantly evolving and has yet to be standardized. Today, there are multiple terms applied to different forms of remote care or telehealth. Most commonly, telehealth is defined as the "use of digital information and communication technologies, such as computers and mobile devices, to access healthcare services remotely to manage one's healthcare" [3]. Even though terminology is largely unsettled, we can say that telemedicine is a subset of telehealth. Telemedicine implies the "virtual" presence by a clinician, whether it is a provider delivering advice to a patient via live video-conferencing, offering guidance to another clinician during a medical procedure or other intervention, or in an asynchronous form, where the patient sends health data and information to a clinician to evaluate [4].

The Growing Field of Teleneurology & Virtual Clinics

BioSerenity, a Paris-based remote diagnostics technology company with offices in Atlanta, has established remote EEG recording and interpretation throughout the United States, France and the Caribbean island of Martinique. They soon plan to implement a Virtual Epilepsy Clinic model elsewhere in the Caribbean, Latin America, and in rural areas of the US, where trained Epileptologists are scarce.

The concept of "virtual clinic", or "digital clinic", continues to evolve within the telehealth space. Virtual clinics serve as a form of telemedicine that digitally convene a diverse set of clinicians to collaborate in providing patient care, like a hospital or multispecialty clinic. Virtual clinics' ability to facilitate quick diagnoses would mitigate the need for repeated patient visits over an extended period while attempting to provide the proper diagnosis and treatment plan, a frustrating situation for both the clinician and the patient. The virtual clinic also allows the provider to interact and assess the patient in a safer and more familiar setting, such as at home, where longer-term evaluation of sleep or neurologic and seizure or cardiac disorders may be more reliable. It may also take place at specialized local diagnostic clinic hubs where more elaborate assessments may be made conveniently for the patient, especially when no such capability exists for them at home or at their physician's office.

3. The transformational power of virtual clinics for neurology

Teleneurology is a rapidly growing field within telemedicine that connects patients with neurology specialists for a host of neurologic disabilities, such as epilepsy, stroke, and Parkinson's Disease. One such teleneurology program at Mass General allows patients to meet with a neurologist via teleconference, alleviating access barriers associated with a lack of on-site staff neurologists within hospitals. Patient satisfaction with these virtual visits is high, at over 90%, and follow-up visit duration has been reduced by an estimated 33% [5]. As part of the broader Mass General Teleneurology program, the hospital provides remote specialty care for communities throughout New England. The benefits of virtual clinics are difficult to overstate, where a team of dispersed clinicians and specialists can provide care from any location at any time, translating to on-demand care, and can monitor chronically ill patients after they leave the hospital [6,7].

Acute stroke care represents an early area of teleneurology innovation. Acute strokes are incredibly time-sensitive, requiring rapid assessment by a neurologist or other stroke specialist. A virtual clinic model allows for immediate assessment by a neurologist without a costly medevac transfer to a metropolitan medical center or a less-effective telephone consultation. A survey by the American Academy of Neurology revealed that most stroke specialists and emergency physicians agree that teleneurology reduces geographical disparities in stroke management and is superior to telephone consultations [8].

Epilepsy is one of the most prevalent neurological conditions globally, behind dementia and Tourette syndrome [9], and provides a good example of the promise of virtual clinic care. The epidemiological profile of epilepsy, coupled with its treatment needs, make it particularly well-suited to management via the virtual clinic. More than 50 million people globally have epilepsy, with an estimated 2.4 million people developing the condition every year [10]. This growing population in need places significant demands on already overburdened health systems. Further, close to 80% of people with epilepsy live in LMICs, and while high-income countries report between 30 and 50 new epilepsy cases per 100,000 people annually, the figure in LMICs is thought to be up to two times higher [11,12].

According to the 68th World Health Assembly Resolution on the Global Fight against Epilepsy, people living with epilepsy need to be better connected with experienced healthcare providers and have better access to care despite limitations in resources [13]. In developing countries across the world, there are few epilepsy specialists to provide much needed care. However, even in developed countries, people that live in rural areas must travel far to receive the specialist care that epilepsy demands. Teleneurology generally, and virtual clinics specifically, have the potential to deliver on the global mandate to provide high-quality, convenient, and cost-effective epilepsy management for all. This mandate was emphasized in the Global Action report entitled "Epilepsy: A Public Health Imperative", which was a joint initiative of WHO, International League Against Epilepsy (ILAE), and International Bureau for Epilepsy (IBE), which was written as the response to the World Health Assembly Resolution on Epilepsy [14].

Remote monitoring and interpretation of EEG data for the diagnosis of epilepsy is one of the most common forms of teleneurology, and is proven as a feasible, secure, and effective method of providing a so-called "Tele-EEG" in settings where a local clinical neurophysiologist or epileptologist is unavailable [15]. Lack of imaging and EEG services is a known barrier to epilepsy care, particularly in Latin America and the Caribbean [16]. Virtual clinics expand the concept of Tele-EEG monitoring by placing brain-monitoring technologies directly in patients' homes, moving the diagnostic process out of the hospital or epilepsy center, thus addressing persistent shortages in EEG services. The virtual clinic remote connection with patients may be accomplished through internet, mobile cellular link, or a computer- or mobile phone-based "hotspot" provided to the patient by the clinic.

Through the virtual clinic, people with epilepsy can be referred for consultation with an epileptologist for their initial visit and may engage with the practitioner remotely from the patient's home or a digitally equipped virtual clinic hub in their local area (Fig. 1). The remote follow-up care is important; inadequate follow-up is common in epilepsy care, with one study showing that more than 50% of participants had not seen a specialist in the past year [17]. With the virtual clinic, a remote device used in the patient's home can monitor and report EEG and other physiologic data to the epileptologist, providing an objective and reliable source of information to aid clinical decision-making in lieu of in-person follow-up appointments. The remote EEG and other diagnostic devices would be provided to the patient either through their local physician, through a local clinic hub, or directly from the remote consulting

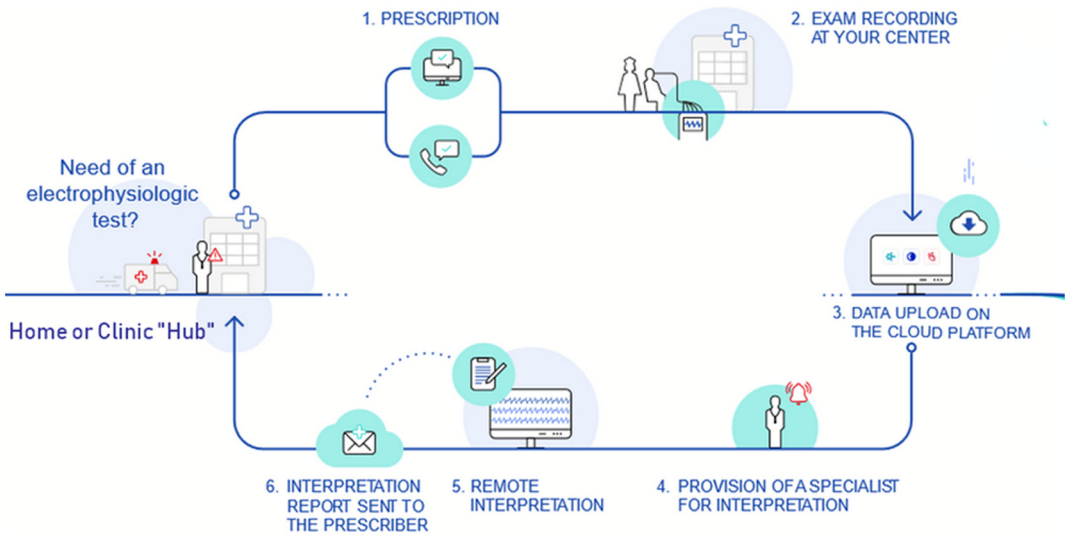

Fig. 1. Virtual epilepsy clinic remote diagnostics journey between patient–prescriber–specialist (From BioSerenity – Serenity Medical Services).

epileptologist. Such devices and services would be offered at no cost to the patient and may be reimbursed through private or public insurance or support, or through regional health grants. Training in the use of such devices may be conducted by the health providers or technologists through the local clinic hubs or remotely by technologists, through a phone or computer link with the patient, to ensure proper use of the EEG devices.

The advantages in terms of diagnostic capabilities are difficult to overstate; because patients may wear the device over extended periods of time, clinicians can effectively review more useful data before, during, and after a seizure event. In addition, the recording takes place in a safe and familiar environment for the patient, which increases the chance of collecting higher yielding data as the patient is in a more "natural" setting. Moreover, data recorded by the device can be sent to physicians or EEG technicians who have experience in reading EEGs, demonstrating the power of a disaggregated team of specialists that collectively form a virtual clinic. This data-collection technology can be complemented by access to education about epilepsy, and access to community-based Patient Navigators or Liaisons, who are specially trained to provide educational and emotional support to the patient.

There are several benefits to the virtual clinic that are unique to the management of epilepsy. People managed with the involvement of an epileptologist experience fewer seizures and may more likely become seizure-free with appropriate therapy than their peers managed by a general neurologist [18]. Further, several studies have demonstrated that increased epilepsy education improves medication adherence and reduces emergency department utilization [19]. For example, a 2013 study from the United Kingdom illustrated a correlation between those who scored poorly on an "epilepsy social knowledge scale" and a greater number of emergency department visits [20]. Another study in Malaysia revealed that 49% of study participants were nonadherent to their prescribed medication regimen and that adherence is influenced by patient understanding about their illness [21]. The same study also showed that medication adherence is positively influenced by patient satisfaction levels, as virtual clinics are known to offer personal service and convenience for patients, and thus increased satisfaction [21]. Virtual clinic services involving patient education on epilepsy represent a meaningful opportunity to decrease reliance on more costly health services such as emergency room care, and also result in better patient adherence to medication regimens [19,20,22]. In this way, virtual clinics can enhance cost-efficiency, quality, and patient outcomes associated with epilepsy care.

4. The current COVID-19 pandemic has introduced a greater sense of urgency to deploy virtual clinics to ensure greater access to healthcare in a safer environment

Since the emergence of the highly communicable and pathogenic SARS-CoV-2 Coronavirus, which is associated with COVID-19, the way routine healthcare is being delivered has changed dramatically [23]. Often, routine procedures have been postponed or canceled outright. In addition, patients and providers are required to adopt innovative approaches for clinical evaluations and consultations to avoid having patients visit clinics and hospitals for their routine appointments and procedures to avoid potential exposure to COVID-19 infection. Additionally, it is necessary to avoid adding such medical interactions at overburdened health facilities to limit further strain to an already overtaxed healthcare system from the high numbers of ill patients with COVID-19 undergoing treatment. This creates an environment no different than what may be found in resource limited areas around the world, where there are an insufficient supply of providers, and overburdened healthcare system, and potential inaccessibility for the patients.

Patients are also apprehensive about the risk of Coronavirus exposure and are often faced with the anxiety of seeking care at crowded medical facilities and clinics or may be faced with lengthy delays in diagnosis and treatment. A study on severe psychological distress conducted in China during the initial COVID-19 outbreak involved patients with epilepsy, compared to a similar number of age and sex matched healthy individuals, revealed that the people with epilepsy showed higher psychological distress scores (6-item Kessler Psychological Distress Scale) than the otherwise healthy individuals. This was particularly pronounced in those with treatment-refractory epilepsy. Therefore, the Epilepsy Virtual Clinic can serve to not only monitor epilepsy and seizure control, it can also provide convenient guidance and psychological support to patients on a routine basis in their home. Validated screening tools for anxiety and depression, and epilepsy-related health-related quality of life (HRQOL) (most of them free of cost) can be incorporated into the virtual clinic intervention workflow. The screening results would be discussed with the patient and appropriate strategies to treat mental health problems can be offered to the patient.

Epilepsy virtual clinic hubs may also serve as a potential distribution source for affordable and effective antiseizure treatment remotely prescribed by the specialist, in addition to the diagnostic services provided. The virtual clinics can overcome medication access and availability challenges that patients in remote areas may face by ensuring that the

Electronic Medical Record (EMR) is be equipped with electronic prescription writing where the prescriptions are electronically sent to the local pharmacies (or they can be phoned or faxed). The pharmacies can then have the medications delivered to the patient's home or picked up in a controlled (limited exposure) setting at the pharmacy. Besides reducing the risk of COVID-19 transmission, the virtual clinic also offers greater privacy with health provider interaction to avoid the stigma that people with epilepsy face when seeking care in many parts of the world. Additionally, the patients may be more conveniently and regularly monitored at home to assess treatment response that may better guide the provider in epilepsy management decision making.

5. Call to action: creating a favorable environment for virtual clinics to thrive

American Academy of Neurology's Official Policy Position on Telemedicine

"While telemedicine cannot replace many of the hands-on skills and in-office assessments neurologists provide, patients in all US states, territories, and the District of Columbia should have access to telemedicine, regardless of location, and should have telemedicine services included in all subscriber benefits and insurance plans (Medicare, Medicaid, and private insurance). Physicians should be reimbursed equitably for telemedicine services and have access to a streamlined state medical license process. Comprehensive insurance policies are also needed.

The following set of recommendations represents a high-level roadmap for unlocking the enormous potential of virtual clinics for improving neurological care. Simultaneous progress will need to be made within education and awareness-raising, clinical adoption, and health system payment models in order to fully realize the value of virtual clinics.

- Integration into the Healthcare Payment & Reimbursement Infrastructure: For virtual clinics to be sustainable, they will need to be supported by a business model that ensures economic feasibility and service longevity. To that end, virtual clinics must be fully integrated into healthcare payment and reimbursement models. Ultimately, both public and private payors ought to guarantee reimbursement for services provided by virtual clinics. Demonstrating the cost-efficiencies and savings associated with virtual clinics may help smooth the path to reimbursement for virtual clinic services, although, historically this sort of shift has been slow to mature.
- Strong Evidence Base on the Benefits of Virtual Clinics: Agreed upon outcome measures to assess and measure the impact and success of telemedicine programs versus traditional care models would go far in ensuring physician, payor, and patient buy-in alike. Further, the evidence base must demonstrate value to patients by articulating care benefits and improved health outcomes.
- Robust Technology Infrastructure: Affordable and available internet and mobile technologies are critical to the efficacy of virtual clinics. The virtual clinic's technology must be easy-to-use, convenient, and intuitive to ensure user friendliness and the technology infrastructure underpinning the virtual clinic platform must be secure and reliable.

6. Conclusion

Virtual clinics afford us the opportunity to fundamentally transform the way that healthcare is delivered by moving the ongoing monitoring and management of disease outside of a physical facility and into a patient's home, without sacrificing quality or losing the intimacy and benefits of the provider–patient relationship. While virtual clinics offer a more convenient, cost-effective, and comfortable care experience for all patients, patients concerned about COVID-19 exposure, or those living in rural or under-served areas stand to benefit the most from innovations in virtual care delivery. Ultimately, our vision is an affordable, high-value health system that leverages virtual clinics to provide better care and improved health outcomes for everyone, regardless of their geography, condition, or limitations.

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