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Telehealth Revolution in Chronic Pain Management: Lessons from Rapid Pandemic Adoption and Future Directions

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Abstract- In order to avert care breaches for chronic patients, the COVID-19 pandemic necessitated significant adjustments to the expansion and quick implementation of telemedicine. It takes significant adjustment combining operations and clinical practices to address the difficulty of adopting remote medical care in chronic pain offerings, a speciality that heavily relies on doctor-patient rapport, physical examinations, including regular follow-up visits. In response to the COVID-19 epidemic, we describe the outcome of a successful quick transition to the online healthcare approach at a period when access to outpatient medical services for individuals with persistent pain in children and adults was severely limited. This narrative review discusses the most recent research supporting the use of videoconferencing to treat persistent pain and goes into great depth on the difficulties in integrating videoconferencing into mobility impaired clinics from several angles. It is advised to follow best practices while using telehealth. The existing data in the domains of neurology and neuromuscular care contrasting in-person and distant physical examinations is used to support a proposal for online physical evaluation for discomfort sufferers.

Keywords- chronic inflammation, telemedicine, and remote consultation.

I. INTRODUCTION

The introduction of the first infirmary-based telemedicine (TH) program at the Massachusetts General Hospital in Boston in the latter part of the 1960s marked the beginning of the contemporary age of THmultispecialty healthcare company by providing online physical exams to Logan International Airport employees and passengers.39 Since then, TH has become a viable choice for treating individuals who have trouble getting to medical facilities for both emergency and ongoing treatment.Under the general heading of TH, several ideas for delivering distant, superior clinical care that safeguards both the individual receiving treatment and the physician all make use of the latest technological infrastructure. Providing distant diagnosis and treatment, allowing clinician-to-clinician interaction, and reducing travel to treatment institutions are key TH aims. The overall therapeutic advantages of TH methods over in-person therapy have been thoroughly examined over the last 20 years[1]. Teleradiology, telemental health care, echocardiography transmission, the technique, and home remote care provide the strongest data. Savings and therapeutic advantages from avoiding travel and the delays that come with it were among the encouraging results. Telehealth enhances compliance from patients, contentment, and level of life while lowering hospital utilisation in a cost-effective manner. Patient confidence, empowerment, knowledge, and results increase with TH-supported health services, as well as nurse-patient interactions [2]. Lack of evidence-based studies on long-term effects and unanticipated damage or repercussions, as well as possible

disparities in access and usage among groups including the elderly and people with disabilities, are obstacles to the wider use of TH treatments.To encourage telemedicine's use and expansion, the United States Telemedicine Federation has proposed a set of rules.Furthermore, expert regulating organisations have created theirown TH directions for regional implementation.

Current research findings on the use of telehealth to treat chronic pain

Nurse-led telephone programs to monitor in-person interventions at pain centres or promptly address patients' concerns have been the primary focus of distant evaluation [3]. Monitoring postoperative, paediatric, chronic malignancy, and noncancer individuals as well as treating chronic pain has shown that this is both possible and beneficial. There is stronger evidence for nonmedical self-management techniques such psychology, in-person methods, telephone, and online-based methods.

Telemedicine use throughout the COVID-19 epidemic

The COVID-19 pandemic made it necessary to protect the health of patients throughout the closing of outpatient units and nonurgent in-hospital consultation. It also made it possible to comply with new social distancing regulations [4].Some scientific pain connections, like the International Consortium for the Study of Pain & the British and European Organisations of Local Anaesthesia and Pain Medicine, propose integrating telemedicine consultations into therapeutic sessions. Create time was limited due to immediate execution suggestions.

McGill University Health Center's telemedicine strategy for patients with persistent discomfort

The McGill University Hospital Centre provides services to 1.9 million people from many groups and ways of life throughout a very wide geographic region in the province of Quebec, spanning from Montréal near the US boundary to Nunavik, Canada in the extreme north.To provide highly specialised medical treatment closer to the residences of patients, a TH program was launched in 2012. The program brought patients, local healthcare teams, and specialised care centres together at higher-level institutions. A specialised technician, monitoring, surveillance equipment, and the use of advanced videoconference technology (IRIS) to link the patient's neighbourhood medical centre and the college centre were all necessary for this to happen [5]. This expensive remote counselling solution mostly served the far Northeast and provided chronic pain assessments.At McGill College Health Centre, four discomfort departments (adult chronic noncancer, adult cancer, paediatric chronic, and neuromodulation/neuropathic) provide around 17,500 consults annually. Prior to the global outbreak, the only available remote suffering services comprised nurse-led phone advice services including remote handling of symptoms and clinical video calls via the McGill Telehealth solutions mentioned below. Direct patient discussions via Zoom video calling for paediatric pain patients were introduced in September 2019[6].The onset of the worldwide epidemic led to the cancellation of all nonurgent outpatient appointments. Comparing January 15th to March 15th of 2019 with the same time in 2020, a company investigation found a substantial decline in in-person new patient appointments and treatments, while telephone discussions climbed. The frequency of follow-up visits at various clinics rose by 30% to 300% (internal, unpublished statistics). A few months before to the global outbreak, the paediatric pain clinic had begun providing videoconferencing visits as an elective option. All of the paediatric pain clinic's consultations were moved to video calls following Canada's first COVID-19 outbreak, requiring merely a ramp-up of the current service.Every appointment for the adult pain demographic were promptly converted to phone evaluations, and the procedures required to set up TH solutions took a month to design. The new guideline requires follow-up consultations by phone, with video accessible upon request, and newly diagnosed evaluations via video call until approved by the treating practitioner. During the following phase, healthcare instructions stipulate that no more than 50% of visits must be performed in person, and these regulations permit strict adherence to these guidelines. In furthermore,

individuals who are more susceptible, such as those with comorbidities, poor flexibility, or cancer diagnoses, find this choice especially alluring due to their fear of getting infected while visiting a hospital.

Getting used to chronic discomfort treatment remotely

Significant adjustments must be made to administrative personnel, machinery, patient schedules, and medical practices in order to make the switch to a low-budget telehealth network that is not under the control of a department of IT.

Modifications to the administration

The vital role that office workers play in providing distant pain healthcare is seldom fully recognised.Remote consultation need calling each patient individually to arrange the time of the appointment, explain how to communicate, and—above all—remind them not to attend the facility [7]. More recent practices, such suggesting that patients wait for the remote consultation in a calm, private setting, have to be implemented. Patients' contact information, such as an active telephone number and email address, has to be updated with extra care.The Quebec province of Quebec provided health care professionals with ZOOM, TEAMS, REACTS, and IRIS. These platforms all have measures in place to ensure the confidentiality of patients, such as password-protected conferences, encryption relationships, disabled recording features, and multiconference sessions with a virtual waiting space where the host manages membership [8]. An algorithm to assist in selecting among various systems based on requirements is shown in Figure 1. Many practitioners had prior personal and professional experience with Zoom, which is and those that were seeking TH were given a complimentary one-year commercial Zoom customised license that our state health organisation had acquired. Additionally, these licenses allow specified administration workers to schedule appointments on behalf of doctors.There are many laborious stages involved in setting up an audio conference with someone who is sick. Firstly, patients must be at ease with remote consultations and have the tools they require. In order to set up and test the program prior to the appointment, individuals with limited technological abilities need instruction. Online instructional films were produced by our municipal healthcare system for individuals, but often the secretary who is setting up the video conference provides this laborious instruction instead, occasionally testing the staff's and customers' tolerance and cunning.

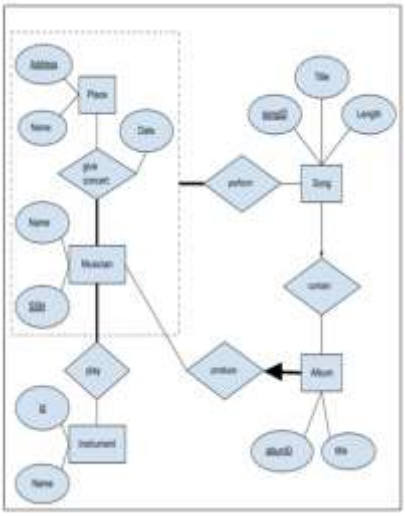

Figure 1: The McGill University Health Institute has proposed a method for selecting which of the multiple sources to use for online conversations. IRIS, Microsoft TEAMS, Zoom, and REACTS logos were taken from respective sites.

The most effective way to schedule a video conference is to send a notification with an immediate connection to the session.Strict moral standards, such utilising an encrypted server and a business email account, must be followed while emailing customers. Visitors from government-funded discomfort clinics that are overworked and underfunded will understand how tough it is to get the little and valuable resources required to hire additional administrative personnel to communicate with patients [9]. To get the appointment information (ID and password) moments beforehand to the consultation, customers can also grab the program and waiting for an appellation. If necessary, the staff or physician may help an individual over the phone with the login procedures.Sometimes the dialogue is not audible, but the picture is. According to the author's own experience, in certain situations, the

interaction may be conducted using a combination telephone for both sound and video for picture after it has been confirmed that the individual's microphones is not muted [10].

Distant visitation tools

Government-run medical facilities may not be unable to cover the expense of upgrading their technology, particularly given the financial strain on government agencies throughout a catastrophic epidemic, even if the instruments needed for remote communication were previously accessible. Systems with loudspeakers or headsets are necessary for phone calls in order to provide hands-free conversations [11]. Telephones with loudspeakers enable students to hear both viewpoints of a discussion during instruction. Healthcare offices seldom ever provide these possibilities, but clerical companies do. Rapid demands for the procurement of hardware were occasionally possible, in our observations.Video, speakers, mics, and enough internet speed are essential for video conferencing. Though they seldom ever have built-in cameras and microphones, many hospital PCs are Internet-connected via landlines. Although computers are likely superior when they are accessible, depending on wireless access to the internet with sufficient speed might be difficult [12]. It was challenging if not impossible, to anticipate that government agencies would give priority to upgrading their IT instruments, purchasing fresh phone settings, headsets, and cameras with built-in microphones during the COVID-19 epidemic.The patients' online connection raises comparable issues about their ability to have a fast enough online connection (at least 10 Mb/sec) [13]. Other cousins could also be utilising the internet connections for telecommuting or tele schooling, especially while experiencing the epidemic's peak. The benefits and drawbacks of receiving therapeutic videoconferencing via laptop or cell phone should be briefly examined, as shown in Table 1. While the majority of telecommunication research has been on desktops or web-based programs, the emergence of mobile communications opens up yet another avenue for patient-physician connection. Videos is recommended as a cornerstone of delivering direct medical treatment but also of giving a grasp of the psychological and behavioural links, even if a basic cell phone connect may offer a comprehension of background [14].It is also advised for medical purposes to use an instrument that can be positioned or adjusted at various degrees to help the practitioner examine the patient; however, using these devices calls for some technical proficiency. Until the equipment itself become more commonplace in pain treatment, there may be a high learning curve.

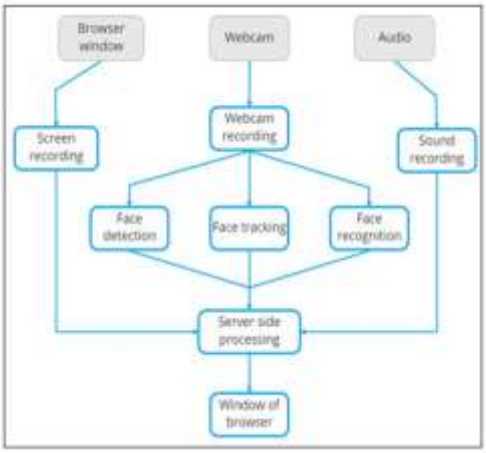

Figure 2: The perfect environment for conducting a video call distant examination

Figure 3: Tele-health consulting

The near future of telehealth for pain management

Although telemedicine for the treatment of individuals with chronic pain existed before to the pandemic, its real use was never promoted. Action

was compelled by the epidemic. When clinical operations resume, a significant analysis must be conducted to determine the speciality of pain medicine's future. Should we continue incorporating telemedicine into standard clinical practice or go back to the earlier clinical paradigm that relied only on in-person consultations?[15] Previous evaluations have shown the benefits of remote clinical treatment. We aim to emphasise that patients are partners in their own pain management, have direct channels of communication for their pain symptoms, are in charge of their treatment, and spend as much time as possible at home. Miscommunication, "broken telephone," and the inability to fully remove a patient from their surroundings are all risks associated with this responsibility; for example, a patient may be with their family rather than by themselves in the clinic, which could lead to less truthful responses to clinical questions. The degree of comfort patients report in their homes may allay this latter worry, but this has not yet been fully examined as in figure 3.

It is difficult to ignore the benefits of telemedicine for managing chronic pain once you have used it. People who live far from the clinic and whose pain is well controlled with the available analgesic medication undoubtedly prefer remote consultations for chronic pain patients, even if they are unquestionably inferior to an in-person clinical examination [16]. Administrative, institutional, financial, and clinical reforms are required before telemedicine may become a standard component of the pain medicine speciality. Additionally, there are consequences to take into account at the scholarly and research levels. Updating patient profiles will be one of the administrative modifications made to enable more rapid and easy phone or email interactions. Email should be used as a regular means of contact between front desk staff and patients, but it's important to take into account its disadvantages, which include identity theft, possible confidentiality breaches, and response delays. This approach is still not ideal for messages from or to patients that are deemed urgent and/or very vital. When it is technically possible and clinically acceptable, patients must have a role in whether a visit is conducted remotely, even if this is still a clinical choice. It will be necessary to create appointment lists that group different appointment types together in order to free up clinical spaces and enable teleworking.

To maximise tele-care, structural adjustments are needed, such as bettering internet connections at medical facilities, upgrading computer software, adding cameras, microphones, and speakers, and modernising phone systems to support hands-free conversations.

Even when treatment is provided remotely, the patient's needs always come first. The same professional standards and deontological obligations established by health authorities and professional colleges apply to remote clinical treatment. It is fair to expect that the compensation of physicians should continue to be commensurate with the quality of care provided, rather than the mode of delivery.Clinicians find it easy to adjust to telemedicine if the clear drawbacks are recognised and technical obstacles are removed. It will be necessary to establish new practices, such as recording permission for remote visits, creating secure and efficient ways to administer treatments, and setting up follow-up consultations. It is necessary to make and teach efforts to remotely recognise symptoms or indicators that point to the development of concerning clinical syndromes or the evolution of a disease. It will be necessary to revise the regulations governing the remote prescription of pharmaceuticals deemed potentially harmful, such as opioids, sedatives, and cannabis [17,18]. The presence of patients and the close observation of trainees by physicians are essential components of pain medicine education. In-person interactions are undoubtedly impacted by telemedicine. Advanced remote techniques like those described in the next section or training at simulation centres may help clinical education, but they will never completely replace in-person treatment.These days, clinical research using remote protocols is a new reality. Clinical data from patients taking part in clinical research initiatives is often gathered via internet-based data gathering tools and apps. In order to perform clinical pain

medicine research in the near future, it will be necessary to use technologies like virtual consent that allow patients to participate virtually.

Aspects to consider for clinicians

Doctors are required to follow the particular guidelines for remote therapy that have been established by their individual professional groups. This evaluation does not include the regulations and other guidelines required for the effective and legal use of videoconferencing. They were freely accessible via publications, conferences, and ongoing instruction before the COVID-19 epidemic [19].Doctors must record the patient's verbal agreement to perform the visit from afar, regardless of if the individual has been reached by telephone or video call. Patients must understand and agree that online appointments have limits and may be less accurate than traditional in-person consultations. In an ideal world, the first meeting with the discomfort clinic would take place in person, and any potential distant follow-up visits would be addressed and agreed upon in person [20].A clinical interview over the phone is obviously possible. The patient's body communication cannot be analysed, and performing a physical exam is difficult. It could be wise to restrict phone consultations to those who the physician already knows, with understanding that follow-up video conversations or in-person meetings might have to be scheduled at the treating clinician's option.Clinicians that have safe access to the individual's file can offer consultations remotely from any location, including homes, clinics, and hospitals. Using telemedicine when ambulatory spaces shouldn't be congested allows for multidisciplinary, simultaneous assessments by several team members operating from various locations. Team employees' communications must adhere to client privacy guidelines; as a result, medical organisations oppose private interaction means (personal email, text messaging, etc.) unless fundamental guidelines are followed to safeguard patients' identities.Considering the possibility of technological issues, first video consultation appointments often take longer. Clinicians are often relied upon by patients to resolve any possible software issues. Basic debugging for these problems and having a backup way to communicate ready for clients in case of issues are among the suggestions made.It is worthwhile to consider the proper conduct for a video interview.Doctors, either operating in a health care centre or at residence, should prioritise competence above pleasure. To enable customers to verify their authenticity, doctors must identify oneself and provide their identification to the cameras. Patient identification requires essential private information from their record and a government-issued picture ID when using videos.Generally speaking, patients prefer to be contacted in the convenience of their own homes, but this ought not to diminish the medical encounter's official significance. One aspect of a courteous professional discussion involves preventing pointless distractions and giving the

Table 1:Comparing several gadgets for making video calls

Parameter	PC	Laptop	Tablet	Smartphone
Internet Connectivity	Wired (Ethernet) – high bandwidth, low latency	Wi-Fi (frequent, variable latency)	Wi-Fi (constant, variable signal quality)	3G/Wi-Fi (frequent, varying bandwidth and latency)
Connectivity Stability	Very stable	Generally stable	Moderately stable	Often unstable
AV (Audio/Video) Tools	External peripherals often required	Integrated webcam and microphone	Built-in high-quality AV components	Built-in AV tools with adaptive capabilities
Portability	Low	Moderate	High	Very High
Clinician Image Render	High resolution, large display	High resolution, large display	High resolution, medium display	Lower resolution, small display
Patient Image Quality	Stable, high fidelity	Stable, high fidelity	Variable depending on handling and lighting	Frequently unstable due to movement and lighting
Usability in Clinical Context	Optimal for static use cases, documentation, and extended sessions	Suitable for mobile setups with good infrastructure	Well-suited for bedside or in-home consultation	Best for on-the-go, low-resource environments

physician your full focus. Homes, hospitals, and clinics may sometimes be loud environments. If ambient noise cannot be eliminated, using an earpiece with a built-in microphone greatly enhances sound reception and transmission.These days, the majority of doctors enter their notes into computerised medical records. When making notes and sharing a video chat on tiny displays like laptops or mobile devices there may be certain annoyances. Alternatively, you might use separate devices to view the digital health record and make a phone call. Using this approach may cause consumers to detect the therapist turning past the camera's view. This has to be considered and addressed because the absence of glances between a doctor and patient might engender annoyance and distrust. Keeping the recording device as near to the workstation as feasible may help to sustain a therapeutic relationship and reassure sufferers that their opinions will be heard.

Remote physical assessment: concerns for clinicians For several doctors, a physical examination is an essential component of the pain evaluation process. Table 2 provides an overview. Inspection is the most straightforward and potentially most effective of the many components of physical testing, including palpation, auscultation, percussive neurologic and orthopaedic evaluation, and inspection. On the other hand, percussion and auscultation may be difficult. The more thorough in-person evaluation can never be replaced by a virtual physical examination, but it may aid in developing a functional diagnosis. Figure 2 shows the suggested parameters for conducting a virtual physical examination. Achieving an ideal examination of the patient and the pain condition is the ultimate objective. Individuals should dress comfortably and move about freely in shoes and clothing that are easy to take off. For certain individuals, taking off their clothes in proximity to an observer might be difficult and awkward. Clinicians must caution clients to keep their video call confidential by drawing behind the curtains and tell them that it cannot be captured using government-provided equipment. To provide an outside perspective of their body the habitus, position, and motions, particularly their gait, individuals should be in an adequately lit environment that has enough area to walk away from the lens. Tablets and smartphone

Table 2:Examples of distant physical test results and examinations (a detailed list of procedures is not given) that might support a clinical judgement

Pain Syndrome	Inspection	Palpation	Auscultation	Neurological Examination (NRL)	Musculoskeletal Examination (MSK)
Low Back Pain Syndromes	Kyphotic or scoliotic posture, antalgic gait, visual asymmetries	Myofascial tight bands, trigger points, palpable masses	Irrelevant	Active Straight Leg Raise Test, Tripod Sign, Dermatomal sensory mapping, Myotomal strength testing	SI Joint Tests (FADIR, FABERE)
Cervical Pain Syndromes	Kyphotic/lordotic posture, antalgic neck posture, visual asymmetries	Tight cervical paraspinal bands, trigger points, palpable masses	Irrelevant	Spurling's Test, Evaluation for cervical radiculopathy, Dermatomal and Myotomal assessments	Active cervical range of motion (flexion, extension, side-bending, retraction/protraction)
Upper Limb Pain Syndromes	Postural asymmetries, color or swelling changes in distal limb	Myofascial trigger points, palpable masses, joint effusion if present	Irrelevant	Tinel's Sign, Phalen's Test, Peripheral nerve testing (motor/sensory), Dermatome & Myotome analysis	Active range of motion of shoulder/elbow/wrist, evidence of bursitis or tendinopathy
Lower Limb Pain Syndromes	Limb asymmetries, color/swelling changes in foot or leg	Myofascial tight bands, trigger points, joint effusion	Irrelevant	Tinel's Sign (e.g., Tarsal Tunnel), Sensory/motor deficits, Weakness evaluation, Heel-to-shin coordination test	Active range of motion of hip/knee/ankle, bursitis or tendinitis screening
Head and Face Pain Syndromes	Facial asymmetries, color changes, visible scars, muscle guarding	Myofascial trigger points (e.g., temporalis, masseter), facial muscular tone	Irrelevant	Cranial Nerve Examination (CN III, IV, V, VI, VII, X, XI, XII), facial tics, twitching, neurovegetative abnormalities	Temporomandibular joint (TMJ) active range of motion, muscle guarding
Abdominopelvic Pain Syndromes	Abdominal asymmetries, skin changes, guarding, visible scars	Palpable masses, fascial tension, deep trigger points	Desirable but not feasible	Evaluation of referred neurogenic pain, visceral-somatic referral patterns	Rebound tenderness, Carnett's Sign for abdominal wall vs visceral pain differentiation

devices are ideal for in-depth examination as they can be manoeuvred and used to point to certain anatomical regions. Certain parts of the anatomy could be more difficult to access while using laptops or PCs unless the internet camera is detachable.

Some pain conditions may be diagnosed based just on inspection. Scoliotic posture, analgia, asymmetric limb oedema, and neurovegetative alterations that precede headaches are a few instances. Although massage is difficult with TH, patients may often determine if a particular anatomical location is tight or very painful by cursory or deep self-palpation. Allowing patients or someone else to apply pressure to the sensitive areas until their nail bed becomes white—roughly equivalent to 4 kg—is one way to determine if trigger locations are present.4. Although it may be difficult, allodynia and excessive discomfort can be self-tested. In place of specialised quantitative sensory evaluation tools, common home items like cosmetics brushes, Q tips, security pins, ice blocks, and cups filled with boiling liquid can be used.

Future potential for videoconferencing in managing chronic pain

Integration of the data from devices and equipment is essential for telehealth consulting. The experience of the patient and the therapist might be enhanced by an arrangement that offers an increased degree of immersion in addition to real-time counselling. VR technology enables clinicians and patients to engage in a 2-multidimensional or 3-dimensional virtual environment. Multisensory input is necessary for augmented reality to construct this environment. Virtual reality encompasses the use of augmented and altered the real world, haptic sensation, HD3D, 3D holographic images, and a mix of those technologies. The high-quality 3D healthcare impact creates the illusion of reality and depth by quickly presenting slightly distinct pictures to each eye. Patients and physicians may communicate diagnostically and/or via HD3D video consultations, which improves the virtual presence experience of "being there."A virtual picture is superimposed on top of real life surroundings in AR. Through the help of pictures, videos, clinical information, directions, and more, the system improves the "real-world" encounter. With a digital item placed into their environment, patients' and providers' perceptions of the actual world are unaffected.20 Rehabilitation has made substantial use of AR. In behavioural treatment, which focusses on enhancing function and lowering suffering in individuals with chronic pain disorders, it has also shown encouraging outcomes. A mentor might provide guidance regarding the 3D model and distant procedure teaching employing AR. Glass technological advances is a wearable computing device that may enhance the wearer's visual experience with additional data. By broadcasting live video, integrated webcams can additionally transmit a wearer's "viewpoint" to a distant device. Tele wound therapy has made use of augmented reality glasses, which may also be used to certain intervention and rehabilitative methods for pain management.At the moment, the scope of physical examinations throughout telemedicine contacts is mostly restricted to what can be seen on camera.A medical professional or a proxy must speak with the person being examined during the physical exam and communicate the results. Haptic technology in conjunction with augmented reality may be able to restore the tactile component that is often absent from teleconference sessions. Instruments that employ haptic innovation may provide a tactile experience by interacting with people via motion, force, or vibration. These gadgets focus on the tactile and dermal sensations of people. A distant observer may feel, assess muscle tone, strength, flexibility, motion, affection, and sensory feeling thanks to haptics technology.

Recovery was clearly improved by the use of haptic instruments in conjunction with AR. Patients' performance may be visually monitored via AR systems, and haptic devices can capture quantitative information as they work out. For individuals with chronic pain, the same idea is readily applicable to both physical therapy and diagnosis.Untouchable supersonic haptic stimulation creates high-acoustic stress spots in mid-air that can be felt with bare hands using electronics regulated phased collection of ultrasonic transducers. Advanced mid-air tactile sensations are directly sent to users' palms and fingers.

Holographic item editing and dynamic immediate time hand engagements are made possible by this new technology. Hapticbioholograms might be the next big thing. This application combines modified the real world, ubiquitous biological sensing and mid-air haptics for synchronised engagement with 3D holograms. Not only can the holographic images be seen, "touched," and felt, but they also respond (both physically and visually) to biosensing information.TH can provide regular care for persistent pain. These fresh innovations and models of service might streamline and simplify important parts of the examination, surveillance, and curative procedures thanks to advancements in telecommunications networks and computing. A new paradigm change in enhanced medical care has been brought about by current advances in robotics that use deep computing. Incorporating AI and massive-data analytics into telemedicine services will revolutionise pain evaluation and management.

Final Discussions

Telehealth's Pandemic Pivot: The COVID-19 crisis forced rapid adoption of telemedicine for chronic pain management, exposing both its potential (improved access) and limitations (lack of tactile exams), while proving virtual care could maintain continuity for high-risk patients during disruptions.

Hybrid Care as Gold Standard: A blended model—initial in-person assessments followed by virtual follow-ups—emerges as optimal, balancing diagnostic accuracy with convenience, particularly for stable patients requiring medication management or therapy adjustments.

Physical Exam Innovation Gap: While inspection and guided self-palpation (e.g., trigger point identification via nail-bed pressure) show promise (Table 2), critical gaps persist in remote auscultation, percussion, and complex neurological testing that currently limit comprehensive evaluations.

Device-Driven Disparities: Hardware variability creates care inequities: PCs enable high-fidelity documentation but lack mobility, while smartphones facilitate home assessments yet suffer from unstable connections and small displays (Table 1), disproportionately affecting elderly/low-income patients.

The Privacy Paradox: Home-based consultations risk confidentiality breaches (family interruptions, unsecured networks), yet paradoxically increase comfort for some patients—necessitating strict protocols for verbal consent, encrypted platforms, and private space guidance.

Opioid Prescribing Dilemma: Remote management of controlled substances demands urgent regulatory updates, as current restrictions conflict with telehealth's need for flexible prescription pathways without compromising safeguards against misuse.

Education Disruption: Trainee development suffers without direct observation of palpation techniques or bedside manner, requiring investment in AR simulations and "tele-precepting" models to standardize virtual pain medicine training.

Workflow Burden Shift: Clinicians face new administrative tasks (tech troubleshooting, virtual consent documentation) that extend visit times by ~30%, highlighting the need for dedicated telehealth support staff.

Sensory Augmentation Frontiers: Emerging haptic feedback systems and AR overlays (e.g., ultrasonic mid-air touch, 3D holograms) could revolutionize remote exams by restoring tactile dimensionality within 5-7 years pending FDA clearance.

Multidisciplinary Scalability: Telemedicine uniquely enables real-time collaboration between pain specialists, psychiatrists, and physiotherapists across locations—though reimbursement models lag behind this team-based potential.

Research Transformation: Decentralized clinical trials using wearable biometrics and e-consent tools are accelerating recruitment but require

standardized validation protocols for virtual pain outcome measures.

Rural Access Breakthrough: While telehealth bridges geographic gaps, 22% of pain patients lack reliable broadband—mandating partnerships with community hubs (libraries, pharmacies) for tech-enabled care access.

Reimbursement Fragmentation: Post-pandemic payment policy instability (e.g., CMS reverting to pre-COVID rules) threatens sustainability, with 68% of pain clinics reporting uncertainty about maintaining virtual services.

Cultural Resistance: 37% of physicians still distrust virtual exams for complex cases (per 2023 JAMA Pain study), underscoring the need for specialty-specific tele-proficiency certifications.

AI's Coming Disruption: Next-gen telehealth platforms integrating predictive analytics (e.g., vocal biomarker analysis for pain severity) and automated documentation could reduce clinician burnout by 2026—if ethical guardrails are established.

II. CONCLUSION

The process of fast-tracking telehealth into routine practice, necessitated by the COVID-19 pandemic, has transformed chronic pain management. Telehealth has provided a critical lifeline for continuity of care. Moving forward, however, the applicability of this method will need to be assessed within a long-term integration. Telehealth has shown to be a viable, effective, and patient-centred approach. It provides access, lends itself to multidisciplinary care, and allows for continuous monitoring of complex pain conditions. To sustain its implementation, challenges to be addressed include closing the chapters on digital equity and regulatory frameworks, introducing training for clinicians, and enhancing virtual tools for assessment. Going forward, a hybrid model that integrates in-person with remote care will allow for the most efficient way of treating chronic pain, combining the ease of remote technology with the subtleties of in-their-face clinical expertise. It must be built on research and policies toward an optimized state when telehealth plays a role in equitable and quality pain management delivery.

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