



Leveraging telemedicine in gastroenterology and hepatology: a narrative review

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Background and Objective: Over the years, telemedicine has played a prominent role in delivering healthcare to patients. Due to its flexibility and many benefits, telemedicine confers physicians the ability to guide and promote medical care remotely. The advent of the coronavirus disease 2019 (COVID-19) pandemic has changed the landscape of medicine and has accelerated the usage of digital and remote healthcare systems for clinical care. Herein, we provide an overview of telemedicine, its applications in managing inflammatory bowel disease (IBD), celiac disease (CD), and liver diseases, its advantages and limitations, and its use in educating the next generation of gastroenterologists.

Methods: We conducted a review of scientific articles published in PubMed and Google Scholar. Articles were selected based on the search terms included in the search strategy summary. The language of the articles was restricted to English only.

Key Content and Findings: We report that telemedicine has the potential to streamline and improve patient care in gastroenterology (GI) and hepatology while also limiting health care expenses. Additionally, we noted the importance of tele-education for training the next generation of physicians who intend on practicing in rural settings. Furthermore, we identified barriers to telemedicine care that exacerbate health inequities and potential solutions to achieving digital health equity. Lastly, we briefly discuss the role of artificial intelligence (AI) in remote patient monitoring.

Conclusions: Although telemedicine has existed for many decades, over the past decade there have been many advancements in telemedicine applications in GI and hepatology. Despite its broad benefits, further research needs to be done to alleviate barriers to telemedicine care.

Keywords: Telemedicine; gastroenterology (GI); hepatology; health inequities

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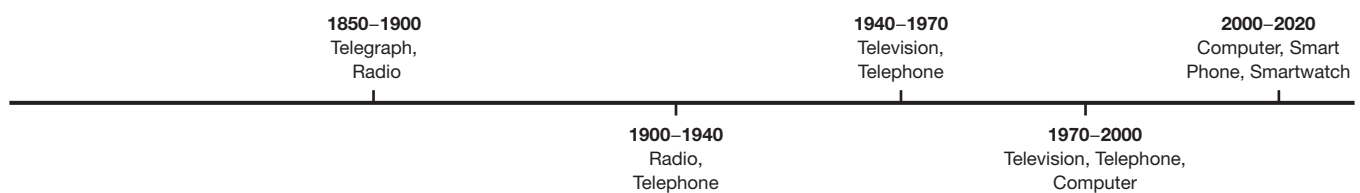
Introduction

The field of medicine is in a rapidly changing state, with rising costs and evolving challenges in healthcare needs, and as such new solutions are continually in development. Telemedicine is one such solution and refers to the two-way

exchange of communication through audio and/or video, thus allowing physicians to provide medical care remotely. Telehealth is a mode of healthcare that encompasses sharing and communicating health data through technological devices across distances to facilitate virtual healthcare.

Table 1 The search strategy summary

Items	Specification
Date of search	August 1 st , 2023
Databases and other sources searched	PubMed Central and Google Scholar
Search terms used	“Gastroenterology AND telemedicine” “Telehealth” “Hepatology AND telemedicine” “Telemedicine AND education” “Telemedicine AND artificial intelligence” “Telemedicine AND health equity OR health disparities”
Timeframe	January 1977 to July 2023
Inclusion criteria	Articles written in English language
Selection process	One author (VA) conducted selection

**Figure 1** Timeline of communication devices used for telemedicine.

Telemedicine is a part of the broader term “telehealth”, and is defined as the direct communication between a provider and their patient across distances, where medical information is communicated virtually (1).

Over the years, especially throughout the coronavirus disease 2019 (COVID-19) pandemic, telemedicine has played a pivotal role in counteracting the changing demands and culture of medicine. While telemedicine has been widely used in certain specialties, its usage in gastroenterology (GI) remains sparse. In this review, we provide an overview of telemedicine, its history, and its applications in regards to managing GI and hepatology care. We present this article in accordance with the Narrative Review reporting checklist (available at <https://mhealth.amegroups.com/article/view/10.21037/mhealth-23-27/rc>).

Methods

This narrative review was written based on searches from electronic databases, including PubMed and Google Scholar. Specifically, we searched for articles that included

the words telehealth, telemedicine, GI, hepatology, artificial intelligence (AI), tele-education, and health equity. There was no specific time frame used during the literature search. Our search strategy is described in *Table 1*.

Historical overview of telemedicine and definitions

Through a series of technological innovations, telemedicine has evolved and adapted to become a plausible method of healthcare delivery to patients with various medical needs. In the 19th century, the development of telegraphs and Morse code allowed for the transmission of medical information across distances. In fact, initial reports of telemedicine explored the idea of using telephones as tools to auscultate lung and heart sounds (2). During the mid-1900s, other forms of communication emerged (*Figure 1*). The radio and the telephone allowed for the sharing of medical information in addition to facilitating communication between providers. In the past two decades, computers and the internet have enhanced access to

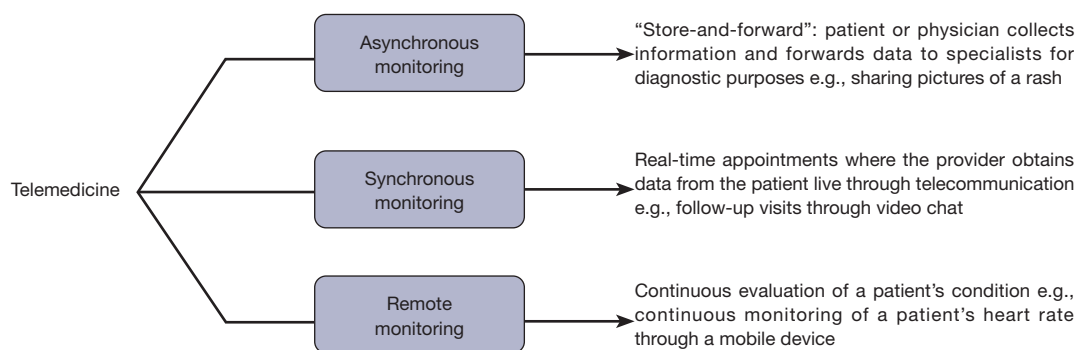


Figure 2 Types of telemedicine.

large clinical data and allowed for the increasing access to telecommunication (3). To this day, advancements in medicine and technology continue to guide the evolution of telemedicine.

Currently, the three types of telemedicine are synchronous, asynchronous, and remote monitoring (*Figure 2*) (4). Synchronous telemedicine consists of the real-time health care delivery through tele-medicine appointments, where healthcare professionals interact with the patients and provide clinical guidance through virtual visits. Asynchronous telemedicine, also known as “store-and-forward”, consists of the collection of patient information and transmission to a healthcare provider for review. Lastly, the remote monitoring type of telemedicine refers to the continuous assessment of a patient’s condition involving medical diagnosis, history, and/or new symptoms, all monitored virtually through different devices. Given its flexibility with different formats, patients can access healthcare through their mobile devices, interact virtually with healthcare professionals, and implement health monitoring devices for managing diseases. In addition to providing benefits for patient care, telemedicine can also be leveraged to provide remote education for residents and physicians through tele-education.

Although the concept of telemedicine has been around for many years, confusion still exists between the terms “telemedicine” and “telehealth”. In particular, telemedicine is commonly confused with the term “telehealth”, which is an umbrella term for the former. The lack of clear definitions results in some organizations, such as the National Cancer Institute, using the words interchangeably (5). Both telemedicine and telehealth consist of the prefix “tele”, which translates to “at a distance” in Greek (6). Telehealth encompasses a wider variety of health services and can be utilized by various health professionals

(e.g., nurses, social workers, pharmacists, physicians). Telemedicine, on the other hand, is usually utilized by physicians for the remote delivery of healthcare (7). Although the definitions of telehealth and telemedicine seem similar, their usage in the medical literature varies. For example, a bibliometric analysis of 11,644 articles found that the term “telemedicine” (n=8,028) was more commonly used in research titles and abstracts compared to telehealth (n=1,679) (8). Furthermore, advancements in telehealth have resulted in the birth of new terms such as mHealth and eHealth (*Table 2*). More specifically, mHealth refers to the utilization of mobile devices for health monitoring, while eHealth involves the use of information and communications technologies in health care (9,10). As technology continues to advance and intersect with medicine, it would be no surprise if we notice an increase in novel terms and modifications to preexisting definitions.

COVID-19 and its impact on GI care

With the onset of the COVID-19 pandemic, telemedicine became a more viable and acceptable option for receiving and delivering medical care. In addition, studies have shown a significant increase in the number of publications regarding telehealth, further indicating the expanding use of this platform (11). For example, in 2019, less than 1% of Medicare primary care visits in the United States were through telehealth; alternatively, in April 2020, this number grew to 46% before dropping to approximately 15% toward the end of 2022 (12,13).

The usage of telemedicine in GI has historically been low relative to other internal medicine specialties. Prior to the COVID-19 pandemic, only 7.9% of gastroenterologists reported using telemedicine in practice, ranking it second lowest across internal medicine specialties (14). Its low usage

Table 2 Telehealth and related definitions

Telehealth and its variations	Definition
Telehealth	Telehealth is a mode of healthcare delivery by a medical team that involves sharing data through technology
Telemedicine	Telemedicine is the sharing of medical information/advice by a physician in one location, and the patient in a different location
Telecare	Telecare involves using technological platforms that serve for patients to independently monitor their health and to connect with their caretakers/support system
eHealth	Electronic (e)-Health refers to the global way of thinking about healthcare, public health, and business through technology such as the Internet and satellite communication to improve local and global healthcare
mHealth	Mobile (m)-Health refers to the use of mobile devices and other wearable technologies to detect biological changes while monitoring patients and relaying this data to health management groups, such as clinics and providers

has changed dramatically since the pandemic, wherein 57% of gastroenterologists reported using telemedicine at least once (15). Before the pandemic, telemedicine in GI was primarily used to manage patients with inflammatory bowel disease (IBD) (16-18) and chronic liver diseases (19,20). Mandated lockdown orders during the pandemic resulted in the need to implement safe and effective practices for the management of various gastroenterologic and hepatologic disorders. Consequently, GI providers relied considerably on technology to deliver safe, remote medical care.

Telemedicine applications in GI and hepatology

Despite its sparse presence in GI and hepatology, telemedicine offers many benefits for patients and physicians. The COVID-19 pandemic has accelerated the use of telemedicine while also providing physicians with more information regarding the benefits and pitfalls of incorporating telemedicine in GI and hepatology care. In the following section, we discuss the applications of telemedicine in managing various gastroenterologic and hepatologic diseases, and its importance in physician education.

IBD

IBD, which encompasses Crohn's disease and ulcerative colitis (UC), is characterized by chronic inflammation of the GI tract and affects over 3 million Americans (21). In addition to the decrease in quality of life (QOL), patients with IBD incur a significantly higher annual direct cost of

care than non-IBD patients (\$22,987 *vs.* \$6,956 per year) and more than twice the out-of-pocket healthcare costs (22). Moreover, treating IBD requires multiple strategies, including achieving tight disease control, adherence to treatment regimens, and monitoring side effects (23). As such, stakeholders in the healthcare system strive to implement treatment plans to alleviate the financial burden associated with IBD care while streamlining and improving patient care.

Several studies have demonstrated the benefits of telemedicine over conventional office visits for patients with IBD. In a study at the Royal Brisbane and Women's Hospital in Australia, out of the first 153 patients surveyed, 94% rated their telehealth experience as "excellent" or "very good", with 99% of patients deciding to continue their treatment via telehealth (24). Another study conducted in the Netherlands aimed to explore differences between telemedicine and conventional office follow-ups for pediatric patients with IBD. In this multicenter randomized trial, researchers demonstrated that the telehealth cohort reported a slight increase in QOL, albeit not statistically significant, and a mean annual cost saving of 89 euros, which increased to 360 euros for those compliant throughout the entirety of the study (25). The cost-effectiveness of telehealth is noted in other studies across various medical specialties (26-28).

Given the often unpredictable nature of IBD due, for instance, to disease flares (i.e., relapses), remote monitoring (i.e., telemonitoring) can be leveraged to monitor disease status from a distance. Telemonitoring platforms such as "HealthPROMISE", a cloud-based app

developed for patients with IBD, allow users to track their symptoms, medications, QOL scores, and quality of care (QOC) scores via questionnaires (29). The information documented by patients is available to providers in real time, allowing providers to track their patients' most current health status. A randomized control trial conducted at Mount Sinai Medical Center investigated the impact of HealthPROMISE in improving QOC and QOL among 320 patients with IBD (30). During a median follow-up of 495 days (± 135), the patients assigned to the HealthPROMISE cohort reported a significantly higher QOC compared to the control cohort (28% *vs.* 9%; $P < 0.01$) along with improvements in QOL. Another study found that patients who utilized HealthPROMISE for one year reported a significant decrease in ER visits/hospitalizations compared to the year before when the app was not utilized (25% *vs.* 3%; $P = 0.03$) (31). Furthermore, patients reported increased understanding of their disease etiology upon using the mobile app, highlighting yet another benefit of telemedicine: increasing patient education.

Another telemonitoring platform called "Constant-Care", developed in 2009 for patients with UC, allows users to document relapse and remission events, and complete disease activity questionnaires (32). By utilizing questionnaires such as the Short Inflammatory Bowel Disease Questionnaire and the Simple Colitis Clinical Activity Index, Constant-Care can project disease activity as a traffic light with three colors: red, yellow, or green. Red light indicates highly active UC, yellow is moderately active, and green is inactive. In the event of a relapse, the program is able to recommend treatment with 4 grams of 5-aminosalicylic acid (5-ASA) and recommends a maintenance dosage when patients enter remission (33). In a randomized trial conducted in Denmark and Ireland, patients who utilized Constant-Care had a shorter duration of relapse in comparison to the control group (median, 18 *vs.* 77 days), in addition to an increase in treatment adherence (34). Furthermore, at the time of relapse, 100% of patients using Constant-Care began the recommended treatment with 5-ASA compared to only 10% of patients in the control cohort ($P < 0.0001$). The success of Constant-Care as a telemonitoring platform is noted across other studies as well (35,36).

Celiac disease (CD)

CD is a chronic autoimmune condition induced by gluten ingestion, affecting 1% of the world population (37).

Currently, the only treatment for CD involves a lifelong diet of gluten-free products. However, given the strict diet regimen for CD, many patients struggle with adhering to treatment plans resulting in a decrease in QOL. Implementing diet and lifestyle changes are essential for improving CD symptoms, preventing intestinal damage, and improving psychological symptoms.

Mobile applications can serve as avenues for monitoring care in patients with CD. MyHealthyGut is the first evidence-based app for patients with CD (38). Notable features of the app include: therapeutic meal plans and recipes, a live Q&A bot, educational content, a virtual health coach, and a report creation platform, allowing users to share information and progress with their physicians in real-time. A 2020 study found that patients who utilized MyHealthyGut were satisfied with the app features, however, they felt that the app would be more helpful to those recently diagnosed with CD (39). Similar to MyHealthyGut, the GlutenFreeDiet application renders users with personalized feedback regarding their dietary profile and other personalized parameters (40). Furthermore, results from a randomized control clinical trial in Iran showed that CD patients who utilized a mobile application for CD care reported significantly lower indigestion scores ($P < 0.001$) compared to the control group, highlighting the role of mobile applications for improving GI related symptoms (41). Another study from the Netherlands found that CD patients who utilized online consultations reported improvements in QOL and a mean saving of 202 Euros compared to the outpatient consultation group (42). Overall, mobile applications are cost effective modalities that can improve the QOL among CD patients.

In recent years, the development of self-monitoring health technology has allowed patients to monitor adherence to a gluten-free diet. Home-based assays that can detect gluten immunogenic peptides in the urine can inform patients about their inadvertent gluten intake (43). Additionally, questionnaires such as the Celiac Dietary Adherence Test (CDAT) have been successfully utilized by clinicians to monitor adherence to gluten-free diets and can potentially be integrated in a telemedicine setting (44,45).

Hepatitis C virus (HCV)

Globally, the HCV affects 58 million people, with 1.5 million new infections per year, as a result of which there is significant clinical and economic burden (46).

Although advancements in antiviral therapies have proven effective in treating HCV, barriers such as distance from providers, treatment adherence, and knowledge of HCV infection can hinder successful treatment (47). For many years, telemedicine has served as an avenue for improving HCV screening and care, especially among people residing in rural areas. One of the most successful interventions for virtual HCV care is the Extension for Community Healthcare Outcomes (ECHO) model. Developed in 2003, ECHO was initially launched to address disparities in HCV care among residents in New Mexico (48). By leveraging digital technology, ECHO serves as a tele-mentoring program that connects rural primary care physicians with HCV specialists via a virtual network. Through ECHO, healthcare providers collaborate in virtual case-based conferences where they share patient medical histories, treatment plans, and lab results. A 2011 study found that patients treated at ECHO sites achieved similar virologic response rates compared to patients treated at an academic health clinic, suggesting the benefits of leveraging technology for patient care collaboration and reaching underserved populations (49). Due to its success, ECHO is now adopted across various medical specialties (50) and is currently used in 194 countries (51).

Telemedicine has also been effective in delivering HCV care to high-risk populations such as people who use drugs (PWUD) and prisoners. PWUDs represent a large majority of HCV infections, yet they are the least likely to seek care due to barriers such as difficulties in linkage of care and low treatment adherence (52). As such, telemedicine can serve as a viable option for overcoming these barriers and guiding treatment among PWUDs. A study conducted at an Italian addiction center found that the implementation of telemedicine resulted in a sustained virologic response (SVR) rate of 98.5%, along with 100% linkage to care among PWUDs (53). Another study at a syringe service program found that telemedicine was successful in achieving a 93.5% SVR in individuals with opioid use disorders (54). Prior to the COVID-19 pandemic, efforts had been made to integrate telemedicine in penitentiaries in order to improve HCV care for incarcerated individuals. For example, a 2019 study performed at a Spanish correctional facility investigated the benefits of telemedicine in an open label program of HCV elimination (55). Prior to the initiation of the telehealth-based program, HCV prevalence among prisoners was 12.4%, which dropped to 0% after the study. In addition to achieving high SVR rates, participating physicians and inmates were highly satisfied with the

program. The success of telemedicine in guiding HCV treatment among inmates is noted across other studies before and after the COVID-19 pandemic (56-60).

Liver transplantation

Liver transplant patients (pre- and post-) may live far from their transplant center, and transplant practices are often highly impacted. As such, telemedicine has the potential to serve as an alternative to traditional clinic visits in this vulnerable patient population. A retrospective study at the Richmond Veterans Affairs Medical Center found that patients who utilized telehealth were evaluated significantly faster than patients in the conventional care group (21.7 *vs.* 79.5 days; $P < 0.01$) and listed on transplant waitlists faster than the control cohort (138.8 *vs.* 249 days; $P < 0.01$) (61). Furthermore, the introduction of the Specialty Care Access Network-Extension of Community Healthcare Outcomes (SCAN-ECHO), a virtual triage program, across the Veterans Affairs Hospitals has shown to reduce futile transplant evaluations, highlighting the potential of leveraging telehealth in hepatology triaging (62). In another study, Wang *et al.* developed a virtual frailty screening tool that can be used in a transplant setting for patients with cirrhosis (63). The benefits of utilizing telemedicine are also seen in post-liver transplantation care. Studies show that post-transplantation follow-ups via telemedicine produce fewer commute and waiting times, promote medication adherence, and are satisfactory for patients (64,65). Although these findings are promising, more controlled studies need to be conducted in the future.

Physician education

With telemedicine widely spreading, tele-education has also become an efficient option to teach residents, fellows, students, and even independent practitioners (e.g., gastroenterologists). Tele-education can facilitate better outcomes in managing chronic GI disease given its accessibility and increased opportunity across different healthcare facilities (66). As mentioned earlier, one notable example of tele-education in GI is Project ECHO. After having success as a tele-mentoring platform for rural providers, ECHO has expanded to over 900 partners and millions of users (67). Additionally, in the past decades, there has been an increase in the number of gastrointestinal endoscopy-related teleconferences, such as the Endoscopic

Table 3 Advantages, disadvantages, and future directions of telemedicine

Advantages	Disadvantages	Where we need to be
Access to healthcare and health education (e.g., tele-education) for remote populations	Access to telehealth and telemedicine depends on the availability of stable Internet, technological devices, and knowledge of patients	Increasing education about different telemedicine platforms
More convenience and time efficient for patients	Risk of an experiencing power outage/unstable Internet connection	Ensuring that patients from different demographics have equitable access to telemedicine services
Cost effective	Possibility of data breach/security concerns	Continue to improve cybersecurity and protection of confidential patient information
Less exposure to pathogens and allergens	Fragmented insurance policies regarding telemedicine reimbursements	Prompting insurance companies to reimburse a wider range of telemedicine services
Effective way to complete follow-up visits, referrals, and long-term patient monitoring	Multiple telemedicine platforms that serve the same function often overwhelming users	Creating robust platforms to streamline patient care

Club E-conference (ECE) (68). Conferences such as ECE have the potential to connect physicians from different areas of the globe, enhance collaboration, and promote learning. The development of digital video transport systems has also allowed for the virtual transfer of endoscopic procedures to various academic centers for educational purposes without compromising patient privacy (69,70). In addition to increasing telehealth education among currently practicing physicians, it is essential to implement telehealth education in the medical school curriculum. Consequently, efforts have been made to increase telehealth education among medical students and residents (71). A study from Germany demonstrated that online telehealth modules were successful in familiarizing medical students with telehealth-based systems and telehealth related clinical skills (72). As technology and medicine continue to intersect, tele-education will likely play an essential role for the next generation of healthcare providers.

Integrating telemedicine in GI: where we need to be

Barriers to telemedicine

Despite its many benefits, telemedicine has its concomitant limitations for patients and physicians (*Table 3*). Patient barriers to virtual care include privacy concerns, limited access to technology and internet, lack of telehealth knowledge, and insurance coverage (73). Although healthcare is a highly regulated industry in the

United States, it remains susceptible to cyber-attacks. Interoperability through cloud computing and electronic medical databases have allowed for seamless transfer of patient data; at the same time, however, patient data can be compromised through cyber-attacks and breaches (74). In addition to cybersecurity concerns, lack of robust internet connectivity and bandwidth in remote areas can also impede virtual care for patients. For example, 33% of rural Americans lack access to high-speed internet (>25 Mbps); thus, they are unable to utilize telehealth services (75). Furthermore, lack of technological knowledge can impose significant barriers to telehealth access. A study from the University of Chicago Medical Center found that patients with low eHealth literacy were less likely to use video technology for their telehealth visit (76). Uncertainty around insurance coverage also pose concerns for patients interested in utilizing telehealth. Although reimbursements for telehealth services before the pandemic have been low, insurers have become more flexible during the pandemic due to the changes in healthcare policies (77). To minimize patient barriers to telehealth services it is essential to develop robust computer infrastructures, provide patients with proper equipment and education, and establish permanent policies for telehealth coverage (78).

Similar to patients, providers also face barriers. Provider barriers include licensures, limited technological literacy, and loss of physical assessments (73,79). The difficulty of accessing multistate licensures is a barrier for implementing telemedicine for many physicians (80). Limited

technological literacy is another potential barrier for incorporating telemedicine. For example, a study consisting of 136 rural providers from a rural Pennsylvania hospital and its satellite clinics found that 72.6% of physicians reported lack of technological literacy as a barrier for telemedicine usage (79). Another potential barrier is the lack of physical assessments as physical assessments play a vital role in patient care and are limited in virtual care. Solutions to the aforementioned barriers are discussed below.

Achieving health equity in telemedicine

Addressing disparities in telemedicine care and usage is essential for achieving health equity for all. Disparities in telemedicine usage can be attributed to a variety of factors including age, socioeconomic status, technological literacy, and culture (81). For example, a study from the University of California, San Francisco found that Black/African-American and Hispanic patients reported lower telehealth usage in comparison to Non-Hispanic White patients, further illustrating racial disparities in seeking telemedicine care (82). Racial disparities in telemedicine usage can be attributed to the lack of proper internet and equipment also known as the “digital divide” (83). Because telemedicine is highly favored among underserved populations, it is essential to address disparities in technology usage in order to achieve digital health equity (84,85). In addition to racial disparities, elderly patients are also less likely to use telemedicine. Elderly patients report technological literacy, language barriers, and difficulty hearing as barriers for telemedicine use (86,87). To alleviate difficulties in seeking telehealth care among older patients, efforts have been made to make telehealth more feasible for older adults (88,89). For example, the Video Visits for Elders Project (VVEP) consists of four intervention goals designed to increase patient knowledge on telehealth and assist with enabling telehealth platforms on patient devices (89). Patients from low socioeconomic backgrounds also report difficulties accessing telemedicine care (90,91). Implementation of loaner tablet programs can potentially alleviate the disparity in technological access seen among minority and low-income individuals (92). Telemedicine remains a powerful tool in health care delivery, and if utilized correctly, it can reduce the no-show rate in minority populations (93). It is also important to note that disparities in choosing telemedicine modalities (phone call or video call) also exist. A study from Duke University found that elderly and non-Hispanic Black patients with liver disease

were more likely to use phone calls over video calls when engaging with their provider (94). Further research needs to be done to determine whether video calls confer advantages over phone calls for patients specifically seeking GI and hepatology care. Overall, in order to achieve health equity in telemedicine, it is essential to understand and dismantle the barriers that minority and elderly populations face in order to prevent further exacerbation of diseases.

In addition to satisfying direct patient needs, uncertainties in health policy and technological security need to be resolved to ensure equitable care. Uncertainty regarding insurance reimbursements can deter minority populations from benefitting from telemedicine services. Recently, Congress passed legislation to extend Medicare flexibilities for telehealth visits through December 31, 2024; however, permanent policies have not been established (95). Without future action from policymakers, millions of Americans are at risk of losing coverage for telehealth visits. Additionally, as discussed earlier, difficulties in obtaining multistate licensure can also prevent physicians from incorporating telemedicine services. A solution to this is adapting legislature that allows for reciprocity for licensure across multiple states (96). By alleviating the burden of licensures, policymakers can play a role in facilitating the implementation of telemedicine among physicians. Lastly, it is essential that telehealth platforms have robust security. Lack of cybersecurity can compromise confidential patient information and result in patient mistrust (74). As we venture into a realm of medicine that is increasingly dependent on technology, telehealth services will become more prominent. As such, it is essential to address barriers to telemedicine in order to achieve health equity for all.

Lack of unified apps

Another limitation to telemedicine usage, as seen for instance in IBD, is the lack of robust telemedicine apps. In hepatology, the Project ECHO platform has proven to be an effective tele-mentoring platform with millions of users. However, telemedicine for IBD remains fragmented. Despite the many benefits of remote monitoring for patients with IBD, the presence of multiple platforms can be daunting for physicians and patients. Efforts to unify and create a robust application to support patients with IBD are needed.

Integrating AI in telemedicine

Currently, AI is a popular topic for many clinicians,

including gastroenterologists. While AI has proven useful for detecting polyps during colonoscopies (97), its implications in GI telemedicine are unclear. In the past, researchers have shown that wearable devices that measure heart rate variability can assist with predicating UC flares, highlighting the role of wearable devices for remote patient monitoring (98). Pimentel *et al.*, developed a mobile app that leverages AI to assess stool form (99). Patients diagnosed with diarrhea predominant-IBS were told to take a picture of their stool, which was then analyzed via AI to determine stool characteristics such as consistency, fragmentation, edge fuzziness, and volume. Although the app determined stool characteristics with a high accuracy, more studies need to be conducted to determine its full potential.

Conclusions

With the pressures imposed by the COVID-19 pandemic, rising costs of health care, and the increasing reliance on technology-based health systems, telemedicine has become an ever-important avenue for managing gastroenterologic and hepatologic disorders. Telemedicine can alleviate the economic burden associated of healthcare, save patients time, and serve as an alternative to in-person clinic appointments. However, the full potential of telemedicine in this regard is yet to be determined. More research into the relative strengths and weaknesses of telemedicine coupled with greater real-life experience with telemedicine will increase global understanding in this respect and provide patients and providers a broader and deeper array of options to coordinate care.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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