Journal of Attention Disorders
2020, Vol. 24(1) 3–9

DOI: 10.1177/1087054719859081
journals.sagepub.com/home/jad
SAGE

Telemedicine in the Management of ADHD: Literature Review of Telemedicine in ADHD

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Abstract

Objective: Telemedicine has been used successfully in several medical specialties with favorable patient outcomes, satisfaction, in a cost-effective manner. However, its use in the context of ADHD remains unclear. Our main aim was to investigate what is known about the use of telemedicine in ADHD. **Method:** We conducted a systematic search of the literature assessing telemedicine in ADHD in PubMed, PsycINFO, and Medline. Included were original articles published in English with the main aim to assess the use of telemedicine in ADHD. **Results:** Only 11 articles met our inclusion and exclusion criteria, coming from only three systematic trials of telemedicine in ADHD. The studies suggest that telemedicine is valued by its users, is well accepted, and is associated with improved outcomes. **Conclusion:** The limited research indicates that telemedicine has potential to expand the delivery of clinical services to patients with ADHD. More work is needed to further evaluate this finding. *(J. of Att. Dis. 2020; 24(1) 3-9)*

Keywords

ADHD, telemedicine

Introduction

ADHD is a prevalent, chronic, highly morbid neurobiological disorder estimated to afflict up to 11% of children and 5% of adults worldwide (Faraone, Sergeant, Gillberg, & Biederman, 2003; Fayyad et al., 2007; Kessler et al., 2006). The effects of ADHD on the individual are pervasive, including academic and occupational underattainment (Barkley, 2002; Faraone et al., 2000; Biederman, Faraone, et al., 2006; Gjervan, Torgersen, Nordahl, & Rasmussen, 2012; Kessler et al., 2006; Wilens & Dodson, 2004), divorce and separation (Biederman, Faraone, et al., 2006), as well as the high risk for costly and disabling complications including major depression, bipolar disorder, anxiety disorders, antisocial disorders and criminality (Biederman, Monuteaux, et al., 2006; Kessler et al., 2006), addictions (Antshel, Biederman, Spencer, & Faraone, 2016; Biederman, 2004; Biederman et al., 1996; Faraone et al., 2000; Kessler et al., 2006; Wilens & Dodson, 2004), traffic accidents (Barkley, 2002; Cox, Madaan, & Cox, 2011; Faraone et al., 2000; Reinhardt & Reinhardt, 2013), posttraumatic stress disorder (Biederman, 2004; Biederman et al., 1996; Kessler et al., 2006), and traumatic brain injury (Max et al., 2004; McKinlay, Grace, Horwood, Fergusson, & MacFarlane, 2009; Segalowitz & Lawson, 1995). Studies estimate the financial annual loss to our economy just from unemployment and underemployment to be close to $100 billion (Biederman & Faraone, 2006). In addition, individuals with ADHD are at higher risk for health impairments that may adversely affect longevity than controls, including higher rates of hypertension, obesity, diabetes, asthma, migraine, epilepsy, and dyslipidemias (Spencer et al., 2013). Thus, people with ADHD have an increased risk for premature death (Dalsgaard, Ostergaard, Leckman, Mortensen, & Pedersen, 2015).

At the same time, ADHD is a highly treatable disorder due to the well-documented efficacy and safety of stimulants, and these treatments can mitigate many of the ADHD-associated adverse outcomes. However, access to appropriate diagnosis of ADHD and follow-up treatment is not always available in many parts of the country due to limited access of expertise. This issue is particularly acute in rural and disadvantaged communities.

One highly promising approach to remedy this problem is through the use of telemedicine. This is because telemedicine can allow access to expertise remotely through a two-way video-conference through secure Internet access, thereby eliminating geographic barriers and the impediments of

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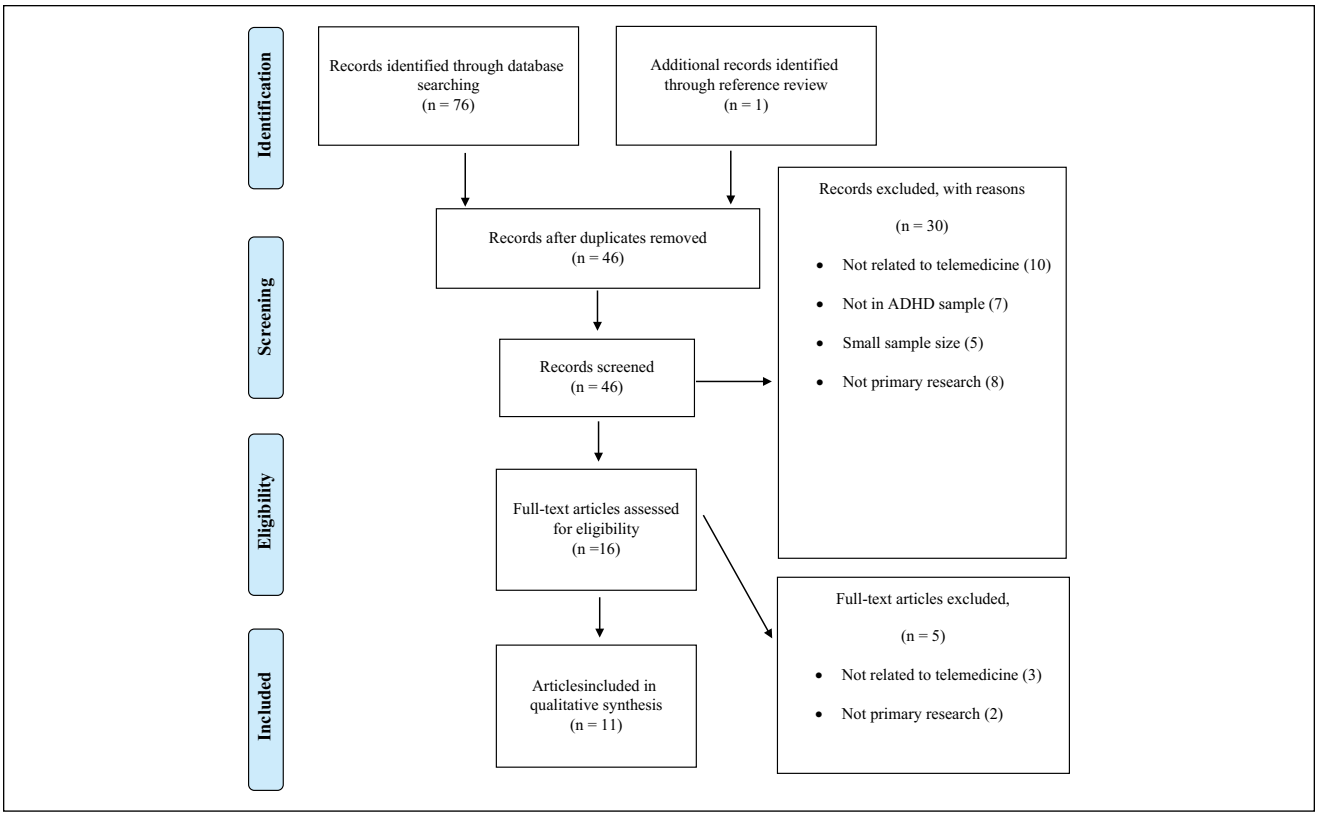

Figure 1. PRISMA Diagram.

limited local expertise for diagnosis and treatment of patients with ADHD of any age. Although telemedicine has been used successfully in several medical specialties, including pediatrics, neurology, cardiology, and psychiatry (Brignell, Wootton, & Gray, 2007; Weinstein et al., 2014) with favorable patient outcomes, satisfaction, in a cost-effective manner (Jaatinen, Aarnio, Remes, Hannukainen, & Koymari-Seilonen, 2002; Toledo, Triola, Ruppert, & Siminerio, 2012; Wakefield, Buresh, Flanagan, & Kienzle, 2004). Whether it can be used in the context of ADHD remains unclear. To this end, our main aim was to investigate what is known about the use of telemedicine in the context of ADHD. To do so, we conducted a systematic literature search of the extant literature on the subject.

Method

We systematically reviewed literature through PubMed, PsycINFO/OVID, and Medline utilizing the search ("telemedicine" or "telehealth" or "telepsychiatry") AND ("ADHD" or "attention deficit hyperactivity disorder" or "attention deficit-hyperactivity disorder" or "Attention deficit disorder"). References from relevant articles were reviewed. We included original human research in English. Our inclusion criteria included the following: the main focus of the article had to be on telemedicine in ADHD, had to have an adequate sample size of at least 20 participants, be published in a peer reviewed journal, and be written in the English Language. Excluded were reviews, letters, and conceptual articles.

Results

Our initial search identified 20 (PubMed), 28 (PsycINFO/OVID), and 28 (Medline) articles of which 31 were duplicates. One additional article was identified through reference review. From the 46 identified articles, only 11 met our priori inclusion and exclusion criteria. We excluded 13 articles that did not pertain to telemedicine, seven were not in an ADHD sample, five were in a small sample or case studies, and 10 were not primary research (Figure 1).

As shown in Table 1, all articles identified used telemedicine in pediatric samples with only one including adults as well. No study was identified that used telemedicine solely in adult samples. Of the articles identified, eight come from the same trial of telemedicine, the Children's ADHD Telemental Health Treatment Study (CATTS). Eight of the articles used telemedicine as an augmentation to standard care, one used telemedicine for consultation purposes, and one tested the feasibility of telemedicine for evaluation.

Table 1. Summary of Studies Included in Systematic Literature Review on Mind-Wandering and ADHD.

Year	Population (*N*)	Design	Main use of telemedicine	Main findings/conclusions
Children's ADHD Telemental Health Treatment Study (CATTS) studies				
Myers et al. (2013) Vander Stoep et al. (2013) Myers et al. (2015) McCarty et al. (2015) Rockhill et al. (2015) Tse et al. (2015) Rockhill et al. (2016) Vander Stoep et al. (2017)	233 Children with ADHD Children (5.5-12 years old) and their caregivers referred by 88 PCPs in 7 various rural communities	Children's ADHD Telemental Health Treatment Study (CATTS) Method Group A. Randomized to Telehealth *vs.* Group B. randomized to non-Telehealth	Augmentation of standard care	Telemedicine was associated with low attrition (3%). Children in the telemedicine group had greater symptomatic and functional improvement than children receiving standard treatment. Telemedicine is successful in reducing distress in caregivers of children with ADHD. High level of satisfaction with telemedicine In a subsample of 37 children, telemedicine performed as well as standard care in caregiver behavioral training. However, caregivers in the telemedicine group did not report improvement in their own distress
Other studies				
Neufeld et al. (2007) Yellowlees et al. (2008)	289 patients in rural setting 139 children, 129 adults (18-59), and 21 elderly patients (60^{+})	Telemedicine visits conducted by specialists with patients in rural areas followed by consultation to PCPs.	Consultation to patients and physicians. No direct services provided.	Significant improvements in mental health status based on the Short Form Health Survey (SF-12) at 3- to 6-month follow-up (based on subsample of 33 adult patients) CBCL subscales of affect and opposition were statistically improved at 3-month follow-up (Based on subsample of 58 children) Anecdotal reports suggested a high level of satisfaction and perceived benefit for these services among rural providers.
Nelson et al. (2012)	22 children with ADHD, average age 9.3 years	90-min telemedicine sessions with patient and evaluation team (child psychologist and developmental pediatrician) Main aim to implement AAP guidelines	Test of telemedicine as a diagnostic tool for implementing AAP Evaluation guidelines	Telemedicine had very high adherence to AAP guidelines using empirically supported scales, multiple informants, and evaluation of comorbidity.

Note. PCPs = primary care physicians; CBCL = Child Behavior Checklist; AAP = American Academy of Pediatrics.

The CATTS study was a randomized trial of treatment delivery in 223 children with ADHD referred by 88 primary care physicians (PCPs) in seven communities. The main goal of this study was to test the effectiveness of a Telehealth intervention to augment ongoing, in-person treatment of children with ADHD as well as to provide caregiver behavior training and to supervise behavioral therapy. Multiple articles (McCarty, Vander Stoep, Violette, & Myers, 2015; Myers, Vander Stoep, & Lobdell, 2013; Myers, Vander Stoep, Zhou, McCarty, & Katon, 2015; Rockhill, 2015; Rockhill, Tse, Fesinmeyer, Garcia, & Myers, 2016; Vander Stoep et al., 2017; Vander Stoep & Myers, 2013) were published using the same set of data, but reporting on various outcomes, including ADHD symptomatology in children and distress in their caregivers. This intervention randomized children to one of two groups. The first group received six two-component telemedicine sessions spaced 3 to 4 weeks apart consisting of algorithm-driven psychopharmacological treatment and in-person caregiver behavioral training. The second group received one telehealth consultation with the Primary Care Provider. Authors reported low attrition rates in telemedicine (3%) suggesting high efficacy and tolerability of the intervention. In addition, children in the telemedicine group had greater symptomatic and functional improvement than children receiving standard treatment. Telemedicine was also associated with lower levels of caregiver distress. The authors therefore concluded that telemedicine can be used for assisted diagnosis, medication management, and supervision of behavioral therapy. In a subsample of children from the CATTS trial ($n = 37$), telemedicine was used for pharmacotherapy and caregiver behavior training (Tse, McCarty, Stoep, & Myers, 2015). One group ($n = 12$) received caregiver behavior training through telemedicine, while the other group ($n = 25$) received caregiver behavior training in-person. No significant difference between the two groups was found in their main outcome measure of caregiver distress. This suggests telemedicine performed as well as standard care in the caregiver behavioral intervention.

Consultation was also provided using telemedicine in a study of 289 patients in a rural setting (Neufeld, Yellowlees, Hilty, Cobb, & Bourgeois, 2007; Yellowlees, Hilty, Marks, Neufeld, & Bourgeois, 2008). This sample consisted of 139 children, 129 adults (18-59 years), and 21 elderly patients (60+ years). This trial, conducted by The University of California Davis eMental Health Consultation Service, connected patients with specialists using telemedicine. Specifically, patients attended a "virtual visit" with a psychiatrist or psychologist, who then consulted with the patient's primary care provider. No systematic evaluation of satisfaction was completed; however, anecdotal reports suggest a high level of satisfaction and benefit for rural providers. In a convenience sample of 33 adult patients who completed a "virtual visit," significant improvements in mental health status based on self-report were found at 3- to 6-month follow-up (Neufeld et al., 2007). In a subsample of 58 children, the Child Behavior Checklist (CBCL), a symptom checklist completed by the parent, was collected at baseline and 3-month follow-up. Results showed modest improvements on some outcome measures, including statistical improvements on the CBCL subscales measuring affect and opposition at 3 months (Yellowlees et al., 2008).

One study (Nelson, Duncan, Peacock, & Bui, 2012) used telemedicine for evaluation. This study examined the role of telemedicine to achieve adherence to AAP guidelines for the assessment of children with ADHD ($n = 22$). Subjects and their parents participated in 90-min telemedicine sessions using video conferencing at school. Sessions were conducted with the patient and evaluation team, consisting of a child psychologist and developmental pediatrician. Parents were also invited to participate in sessions. The main aim of this study was to assess the feasibility of telemedicine as an evaluation tool for ADHD that adheres to the American Academy of Pediatrics (AAP) guidelines. Results showed high adherence to the AAP guidelines using criteria from the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association, 1994), empirically supported scales and interviews, multiple informants (teachers, parents, etc.), and evaluation of comorbidity. In addition, telemedicine proved to be a useful tool in connecting clinicians, patients, their family, and school personnel.

Discussion

Our literature review identified 11 articles from three trials of telemedicine in ADHD, with only one study including an adult sample. The available studies suggest that telemedicine is user friendly, valued by clinicians, caregivers, and educators, and appears to be well accepted as delivered from academic centers to rural or disadvantaged environments with less available expertise. Its use is also associated with improved outcomes of symptomatology and function. While promising, more work is needed to further asses the utility of telemedicine for all facets of health care delivery in both pediatric and adult ADHD.

Although a small number of articles were found, results from the literature suggest that telemedicine may be a viable method to provide assessment and evidence based pharmacologic treatment for children with ADHD. Specifically, children with ADHD and their caregivers who may not have access to treatment by specialists may use telemedicine to engage with expert clinicians who they would otherwise have no contact with in a rural setting. In addition to direct delivery of diagnostic and treatment services, telemedicine can also be used to provide expert consultation and education to clinicians in location close or distant with absence of expertise.

Telemedicine also proved a successful modality in connecting clinicians, patients, family, and school personnel. This platform allowed local primary care physicians to consult with specialists, specifically in the treatment of ADHD, providing them with practiced guidance in treatment strategies. Telemedicine, therefore, can be used to improve clinical practice in rural populations for patients, who otherwise may have been inadequately treated due to a lack of expertise in the diagnosing and treatment of ADHD in these areas.

All identified articles used telemedicine as either augmentation to standard care, consultation (patient to provider or provider to provider), and evaluation. Not one utilized telemedicine as an independent means for delivering direct clinical care to patients. This warrants further research on using telemedicine as a replacement for in-person clinical care. If successful, this finding could have significant impact on patients with ADHD in rural settings who may not have access to specialist treatment.

Lacking in the extant literature on telemedicine in ADHD are studies of assessment, diagnosis, or treatment of adults with ADHD. This issue is particularly important because of an even greater lack of expertise in the assessment and management of adult ADHD in the community than that available for pediatric ADHD. Future studies should test the reliability and fidelity of telemedicine to diagnose and treat patients with ADHD of all ages, including adults.

In summary, telemedicine has an enormous potential to expand the delivery of clinical services to patients and families with ADHD in a cost-effective manner. More work is needed to further evaluate its utility in the direct delivery of care to ADHD patients and to expand it use to adult populations.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Dr. Joseph Biederman is currently receiving research support from the following sources: AACAP, Feinstein Institute for Medical Research, Food & Drug Administration, Genentech, Headspace Inc., Lundbeck AS, Neurocentria Inc., NIDA, Pfizer Pharmaceuticals, Roche TCRC Inc., Shire Pharmaceuticals Inc., Sunovion Pharmaceuticals Inc., and NIH. Dr. Biederman has a financial interest in Avekshan LLC, a company that develops treatments for attention deficit hyperactivity disorder (ADHD). His interests were reviewed and are managed by Massachusetts General Hospital and Partners HealthCare in accordance with their conflict of interest policies. Dr. Biederman's program has received departmental royalties from a copyrighted rating scale used for ADHD diagnoses, paid by Bracket Global, Ingenix, Prophase, Shire, Sunovion, and Theravance; these royalties were paid to the Department of Psychiatry at MGH. In 2019, Dr. Biederman is a consultant for Akili, Jazz Pharma, and Shire. Through MGH corporate licensing, he has a U.S. Patent (#14/027,676) for a non-stimulant treatment for ADHD, and a patent pending (#61/233,686) on a method to prevent stimulant abuse. In 2018, Dr. Biederman was a consultant for Akili and Shire. In 2017, Dr. Biederman received research support from the Department of Defense and PamLab. He was a consultant for Aevi Genomics, Akili, Guidepoint, Ironshore, Medgenics, and Piper Jaffray. He was on the scientific advisory board for Alcobra and Shire. He received honoraria from the MGH Psychiatry Academy for tuition-funded CME courses. In 2016, Dr. Biederman received honoraria from the MGH Psychiatry Academy for tuition-funded CME courses, and from Alcobra and APSARD. He was on the scientific advisory board for Arbor Pharmaceuticals. He was a consultant for Akili and Medgenics. He received research support from Merck and SPRITES. Dr. Thomas Spencer received research support or was a consultant from the following sources: Alcobra, Avekshan, Ironshore, Lundbeck, Shire Laboratories Inc, Sunovion, the FDA, and the Department of Defense. Consultant fees are paid to the MGH Clinical Trials Network and not directly to Dr. Spencer. Dr. Thomas Spencer has been on an advisory board for Alcobra. Dr. Spencer received research support from Royalties and Licensing fees on copyrighted ADHD scales through MGH Corporate Sponsored Research and Licensing. Through MGH corporate licensing, Dr. Spencer has a U.S. Patent (#14/027,676) for a non-stimulant treatment for ADHD and a patent pending (#61/233,686) for a method to prevent stimulant abuse. Ms. Elizabeth Noyes has no relevant disclosures or declarations of interest.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by the Pediatric Psychopharmacology Research Council Fund.

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