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Telehealth and Autism Prior to and in the Age of COVID-19: A Systematic and Critical Review of the Last Decade

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Abstract
There has been growing interest in the use of telehealth; however, the COVID-19 pandemic and the subsequent isolation and restrictions placed on in-person services have fast-tracked implementation needs for these services. Individuals with autism spectrum disorder (ASD) have been particularly affected due to the often-intensive service needs required by this population. As a result, the aim of this review was to examine the evidence base, methodology, and outcomes of studies that have used telehealth for assessment and/or intervention with children and adolescents with ASD as well as their families over the last decade. Further, the goal is to highlight the advances in telehealth and its use with this special population. A systematic search of the literature was undertaken, with 55 studies meeting inclusion criteria and quality analysis. Specified details were extracted from each article, including participant characteristics, technology, measures, methodology/study design, and clinical and implementation outcomes. Services provided via telehealth included diagnostic assessments, preference assessments, early intervention, applied behavior analysis (ABA), functional assessment and functional communication training, and parent training. Findings, although still emerging, encouragingly suggested that services via telehealth were equivalent or better to services face-to-face. Results support the benefits to using telehealth with individuals with ASD. Future research should continue to explore the feasibility of both assessments and interventions via telehealth with those having ASD to make access to assessment services and interventions more feasible for families, while acknowledging the digital divide it could create.

Keywords Autism Spectrum Disorder · ASD · Autism · Telehealth · Assessment · Intervention

Introduction

"Telehealth" is an all-encompassing term for the use of various modes of technology to provide medical and mental health care services in place or in addition to in-person methods (American Psychological Association, 2013). Services can be implemented via synchronous or asynchronous modalities, such as telephone calls, video-teleconferencing, email electronic applications, or video and audio recordings (American Psychiatric Association, 2013). The use of telehealth as a tool for implementing intervention and assessment services has grown recently particularly with the impacts of COVID-19 on in-person access to services. As technology has improved, the implementation of services via telehealth has been found to be cost-effective and can be delivered across vast geographic regions which would otherwise prevent access to care (Baweja et al., 2021; Shulver et al., 2016). Additionally, the further integration of technology in clinical practice has become more widely accepted due to increased convenience, decreased stigma, improved patient outcomes, and reduced expenses (Luxton et al., 2016). As telehealth evolves, improves, and gains further acceptance, clinicians have also begun to explore the implementation of telehealth psychological and behavioral services to individuals with autism spectrum disorder (ASD).

Telehealth Applications for Autism Spectrum Disorder

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication and interactions and restricted, repetitive behaviors, interests, or activities (American Psychiatric Association, 2013).

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As ASD is a lifelong disorder with significant and cascading developmental implications, early identification and intervention have been found to be critical (Hyman et al., 2020). However, gaining access to intervention programs throughout the community is often a challenge for families who live in rural or remote areas, have limited or no transportation, are of lower socioeconomic status or experience other logistical difficulties (Sutherland et al., 2019). For example, children who are at or below the poverty line or live in rural areas are diagnosed with ASD much later than those children who are of high socioeconomic status or live in more urban areas (Antezana et al., 2017), which further delays their access to needed services. This disparity was likely even further impacted by the effects of the COVID-19 pandemic, where individuals who are below the poverty line are more at risk for experiencing health disparities and are advised to remain at home (Dahiya et al., 2020). Furthermore, many children with ASD had disruption to their services due to the COVID-19 pandemic, which was not only exacerbated by the state-wide mandatory shutdowns across the country but was also impacted by the decrease in staffing at these service providers (Eshraghi, 2020). Telehealth services, if effective and appropriate, may be able to address some of these concerns, as well as have the potential benefit of not disrupting a child with ASD's routine and daily schedule to the same degree with additional travel, time-lost, etc. It may also benefit the families as telehealth services have been found to be more cost-effective than in-person services (Camden & Silva, 2021). While the effects of telehealth for children with ASD should not be assumed to be equivalent to those seen with in-person services or those seen in neurotypical individuals using the medium for other concerns, it remains to be seen if a consistent body of literature has begun to accrue to suggest telehealth may or may not be a viable option in this population. Despite the increased need for access to mental health services, the literature regarding the use of telehealth for assessment and intervention services with children with behavioral needs, such as ASD, is limited.

The most recent systematic review of research focusing on ASD and the use of telehealth was conducted by Sutherland et al. (2019). Sutherland et al. (2019), sought to review articles to inform the speech-language pathology field, and found only 14 studies that met their inclusion criteria: the inclusion of at least one person with ASD, implementation of a telehealth system for the purpose of an intervention or assessment, the use of a design that allows for experimental control or comparison conditions, measurement of factors associated with telehealth implementation (e.g., child outcomes, feasibility, parent outcomes), and published in a peer-reviewed journal. There were 284 participants involved in the 14 studies with an age range of 19 months to adulthood. The services included in those studies consisted of diagnostic assessment services, early interventions, anxiety interventions, functional behavior assessment and communication training, web-based education and consultation, and language interventions. Their study sought to extend the findings in the previous review by Boisvert et al. (2010) where eight studies were included in their telehealth review and concluded that telehealth is a promising mode to treatment for individuals with ASD. Overall, the findings of the Sutherland et al. (2019) review supported the implementation of telehealth services, highlighting an improvement in fidelity, reduction of behavior problems, an increase in parent satisfaction, and an increase in program acceptability. The studies were a mixture of repeated measures designs, pre- and post-intervention studies, randomized controlled trials, mixed-methods, multiple-baseline designs, case studies, and observational data (Sutherland et al., 2019).

With advances in technology, the literature using telehealth has grown significantly. Since the last systematic review in 2018, a search using PsycINFO with the terms "telehealth OR telepractice" yielded 1,429 articles. Based on this sharp increase, and due to the imminent and ongoing impact of the COVID-19 pandemic since the last review, and the increasingly expansive improvements in telehealth platforms and technology, there is a need for a current update and review of the literature on the use of mental health services with the ASD population to understand the utility and efficacy of this service modality for the "new normal" (e.g., ongoing social distancing, the wearing of masks, recurring and ever-changing restrictions on in-person gatherings and activities, etc.). The aim of this review was to provide an overview of the literature regarding telehealth for children and adolescents with ASD over the last decade, with regards to the type, recipients, and outcomes of the services and provide a recent evidence base upon which professionals and researchers alike might base ongoing and future services and research.

Method

The *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)* was used to guide the systematic review process (see Fig. 1) based on its use in the previous review (Sutherland et al., 2019). A systematic search of the literature was conducted using the Medline, PsycINFO, ERIC, and CINAHL databases. These databases were selected based on the previous review by Boisvert et al. (2010) and Sutherland et al. (2019). Titles and abstracts were searched using key words to describe telehealth and ASD ("telehealth" OR "telemedicine" OR "telepractice" OR "telecare" AND "Autis*" allowing searches for Autism, Autistic, Autisms, etc.). Similar to the previous reviews, the search was limited to English and only articles from peer-reviewed journals were included. No eligible articles were found prior

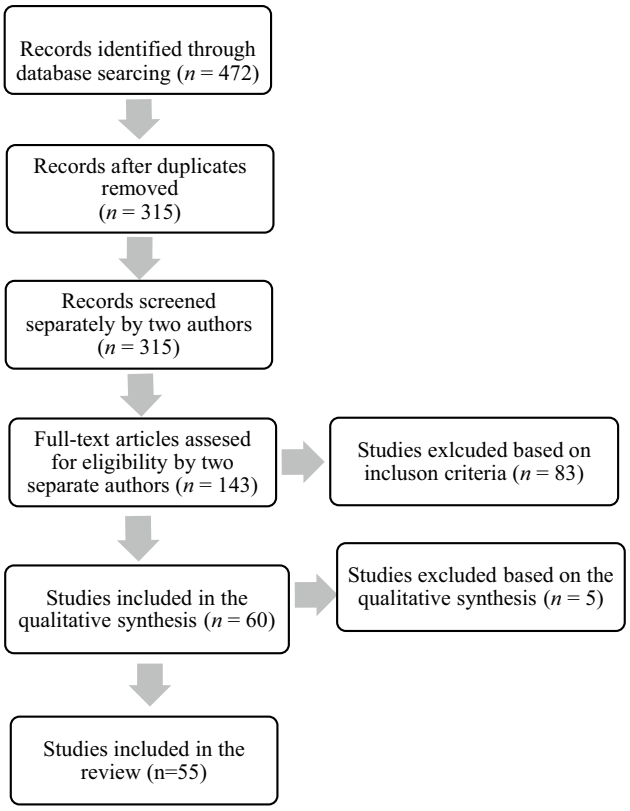

Fig. 1 PRISMA summary of paper screening process

to 2010 that were not included in the previous reviews (Boisvert et al., 2010; Sutherland et al., 2019). Based on the previous findings, this review included articles between December 2010 and March 2021 as a review of the last decade.

A total of 472 articles that included both the telehealth and autism search terms were found across the four databases. After duplicates were removed, a total of 315 remained. Titles and abstracts were screened separately by the first and second authors based on the predetermined inclusion criteria: (a) inclusion of one individual with autism or parent of a person with autism; (b) implementation of a telehealth system for the purpose of assessment or intervention; (c) the use of a design that allows for experimental control (e.g., intervention studies) or comparison condition (e.g., diagnostic studies); (d) measurement of factors associated with implementation (e.g., outcomes, feasibility, acceptability); and (e) published in a peer-review journal. Synchronous (e.g., real time consultation) and asynchronous (e.g., images, videos, applications) modalities were considered as telehealth services. Web-based materials used to train parent, teacher, or clinicians without any consultation were not included. General review articles and articles using software such as virtual reality or wearable sensors were excluded per previous reviews (Boisvert et al., 2010; Sutherland et al., 2019). After screening the 315 papers based on title and abstract, 143 articles remained. These articles were independently read in full by the first and second authors to determine eligibility. The two reviewers then discussed the articles to resolve any disagreements about inclusion of a study. Following the review, 60 papers remained that met all inclusion criteria.

A quality review of the articles that met the inclusion criteria was conducted using the Scientific Merit Rating Scales (SMRS; National Autism Center, 2015). The review included the process of rating the studies on five separate criteria for experimental rigor, including research design, measurement of dependent and independent variables, participant ascertainment, and generalization. The scientific merit score was obtained by combining the ratings of each criterion. Studies that met a score of 3, 4, or 5 indicated that scientific rigor had been utilized and firm conclusions can be drawn, while a score of 2 indicated initial evidence of intervention effects but more scientific rigor should be utilized to confirm these effects. Lastly, a score of 1 or 0 indicated that insufficient scientific rigor was applied to the studies. The studies were split between the second, third, and fourth authors to be rated based on the five criteria, while the first author independently rated all included studies. The ratings were then compared to the first author's ratings to ensure reliability. Articles were discussed if the absolute value of any of the individual variables and/or overall SMRS score was equal to one or greater; any discrepancies were discussed and resolved. After the ratings were completed, five studies were excluded from the review due to receiving a SMRS score of 1.9 or lower, which indicated a lack of scientific rigor. A total of 55 papers were included in the review as a result of these processes.

Results

All 55 papers reviewed were published between January 2010 and March 2021, across a range of disciplines. The first section of this review examines articles that emphasized the use of telehealth for either the assessment of ASD or other common assessments used to inform treatment of individuals with ASD (i.e., functional assessment, speech and language assessment, preference assessments). Details of the papers included in the assessment section of this review are summarized in Table 1. The next section outlines the different interventions utilized via telehealth for individuals with ASD. Details of the papers included in the intervention section of this review are summarized in Table 2. Within both the assessment and intervention sections, studies included in this review are organized by the telehealth participant in the following order: the individual with ASD him or herself, parents of individuals with ASD, and other interventionists/staff/teachers of individuals with ASD. The intervention

Table 1 Results of the systematic review for Assessment via Telehealth

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Sutherland et al. (2019)	13 children diagnosed with ASD (10 males, 3 females, 9–12 years of age)	Children	VC with laptop and webcam; application was developed by Coviu (formerly National Information Communications Technology Australia—NICTA)	Face to Face administrations of language assessments, followed by telehealth speech-language assessment	Method comparison design	Language assessment scores (core subtests of the CELF-4), behavior observation scores adapted from the CELF-P2, parent satisfaction questionnaire	No difference between conditions, all parents were comfortable with assessment
Reese et al. (2013)	21 parent–child dyads (3–5 years of age; 11 children with ASD and 10 with developmental delay)	Parents and their children	VC equipment including high-definition monitors and camera that clinicians could control the angles of from another room	Comprehensive Autism assessment either through VC or in-person: clinician administered ADI-R; the clinician coaches the parents to complete the ADOS presses with their child	Random assignment to either in-person or interactive VC assessment	ADOS module 1, ADI-R, satisfaction survey	No differences in diagnostic consistency between groups or inter-rater agreement on the ADOS items or ADI-R between groups, parents reported high satisfaction with VC group
Wacker et al. (2013)	20 parent–child dyads (age ranged from 29 to 80 months, all with ASD)	Parents	VC at teleconsultation centers using Windows-based PCs and webcams (no specific VC program reported)	Parents were trained over VC for 2, 1-h sessions on the principals of behavior analysis, 1 h session outlining procedure (e.g., preference assessment, FA), then coached through conducting the FA in four assessment conditions	Multi-element design	Children's behaviors, IOA, the procedural integrity, cost of treatment	Behavior analysts were effective in conducting FAs effectively and efficiently via telehealth, the remote FA successfully identified social functions, implementation via telehealth is cost-effective treatment strategy
Corona et al. (2021)	51 total children, 35 children were diagnosed with ASD (1–3 years of age), 10 developmental delays, and 6 typically developing	Parents and child	VC using wall mounted speakers and video platform (Cisco Systems)	Adaptation of the TELE-STAT (remote assessor provided prompts to parents) and utilization of TELE-ASD-PEDS (parent-led social tasks) to assess symptoms of ASD to inform diagnosis	Randomized assignment to either the TELE-STAT or TELE-ASD-PEDS groups, examined diagnostic accuracy and parent perception and satisfaction	TELE-STAT, TELE-ASD-PEDS, Parent questionnaire	Remote assessors accurately diagnosed 33 of the 35 children with ASD; Overall, diagnostic agreement was 86%. Parents (77%) reported they would prefer to play and observe during the remote assessment. Most feedback (25%) involved technology issues

Table 1 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Machalicek et al. (2009)	Three teacher–child dyads (male, 34 months, two males 5–7 years of age with ASD)	Teachers	VC using iChat from a remote site using a MacBook Isight camera, Isight video conference, and headsets	Phase 1: Realtime coaching of teachers administering paired-choice preference assessments, including where to begin trials and immediate corrective feedback Phase 2: did not have VC component	Teacher implementation comparisons, participant comparisons	Steps performed correctly by teacher, IOA, teacher fidelity, procedural integrity	Phase 1: teachers implement paired-choice preference assessment with 100% accuracy, satisfied with VC Phase 2: children preferred items selected in Phase1, indicating that VC maybe a successful strategy in providing feedback for preference assessments
Machalicek et al. (2010)	Six Teacher–Child dyads (with ASD; age from 4 to 10 years of age)	Teachers	VC using iChat from a remote site using a MacBook Isight camera, Isight video conference, and headsets	Baseline: teachers conducted FAs with instruction via VC but without feedback Intervention: teachers receive immediate feedback through VC Maintenance: FA without VC feedback	Multiple-baseline design across participants with embedded multi-element designs	FA, maintenance observations, IOA, treatment integrity questionnaire, social validity	High levels of treatment fidelity to FA procedures taught teacher's-maintained ability to successfully implement FA procedures up to 9 weeks post-initial training; socially acceptable
Higgins et al. (2017)	Three staff, three children with ASD (two males, 4–5 years of age, one female, 5 years of age), confederates	Direct-care staff	VC using Adobe Connect and webcams (sessions were recorded)	Training: multimedia presentation, descriptive feedback, and immediate feedback during scripted role-plays, each session consisted of 14 MSWO trails with a confederate, with instruction via VC	Nonconcurrent multiple-baseline design	Correct implementation of component MSWO skill, IOA, social validity questionnaire	Efficacy and social-validity showed telehealth-training was feasible and effective for all

Table 1 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Ausenhus and Higgins (2019)	Four trainees (19–23 years of age), one female, 4 years of age with ASD), confederates	Trainees	VC using VidyoDesktop, Dell Laptop, Surface Pro tablet	Confederates were given training on conducting brief MSWO preference assessments through remote, real-time feedback	Nonconcurrent multiple-baseline design	Percentage of MSWO skills implemented correctly, IOA, treatment integrity, social validity questionnaire	Increased procedural integrity after real-time feedback, High procedural integrity with child with ASD at follow-up, telehealth was acceptable, the training procedure was effective, and staff reported satisfaction with tech setup

ASD Autism Spectrum Disorder, *ADOS* Autism Diagnostic Schedule, *ADI-R* Autism Diagnostic Interview-Revised, *BASC-2* Behavior Assessment System for Children-Second edition, *CELF-4* Clinical Evaluation of Language Fundamentals-Fourth Edition, Australia and New Zealand, *CELF-P2* Clinical Evaluation of Language Fundamentals-Preschool, Second Edition, Australia and New Zealand, *FA* Functional Assessment, *IOA* Interobserver Agreement, *MSWO* Multiple Stimulus Without Replacement, *TELE-STAT* Screening Tool for Autism in Toddlers and Young Children, *VC* Video Conferencing

section also includes two studies that feature the telehealth participant as being a parent and a teacher together. Lastly, limitations and future directions for the use of telehealth with individuals with ASD are discussed.

Assessment

A total of eight studies implemented assessment procedures via telehealth for individuals with ASD. All of these studies used video conferencing (VC) to deliver the assessment procedures and utilized a variety of different VC systems (e.g., Cisco Systems, Isight via MacBooks, Adobe Connect, VidyoDesktop) (Ausenhus & Higgins, 2019; Corona et al., 2021; Higgins et al., 2017; Machalicek et al., 2009, 2010; Reese et al., 2013; Wacker et al., 2013). One study, used an application, Coviu, that was created for VC (Sutherland et al., 2019).

Telehealth Participant: Children with ASD

Only one study utilized VC to administer four subtests of a speech and language assessment (Clinical Evaluation of Language Fundamentals, 4th Edition) remotely by a speech-language pathologist to children with ASD; this telehealth procedure was compared to in-person administrations of the same four subtests. The assessment scores were reportedly high in agreement between in-person and telehealth implementation, but no differences between the procedures were found (Sutherland et al., 2019). Parents' satisfaction with the telehealth assessment was high; they also indicated that their children felt either "somewhat or definitely" comfortable with the procedures as well (Sutherland et al., 2019).

Telehealth Participant: Parent of Child with ASD

Two studies utilized the parents of individuals with ASD to implement diagnostic autism assessments. One study (Reese et al., 2013), randomly assigned participants to either the in-person administration group or VC administration group. Both groups were administered the *Autism Diagnostic Interview-Revised* (Rutter et al., 2003). Video conferencing was utilized to coach parents in implementing modified *Autism Diagnostic Observation Schedule (*Lord et al., 2002*)-Module 1* activities and presses with their children compared to an in-person autism assessment utilizing these same presses. No difference between diagnostic consistency was found between groups; inter-rater agreement was not significantly different on the ADI-R and only one significant difference for an item on the ADOS was found. Further, high parent satisfaction was reported for both conditions. Another study utilized telehealth assessment procedures to assess autism in young children (Corona et al., 2021). After randomized group assignment, remote assessors provided

Table 2 Results of the systematic review for Interventions via Telehealth

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Hepburn et al. (2016)	33 families with children with ASD (17 in the intervention, mean of 11.5 years of age and 16 in the waitlist control, mean of 12 years of age)	Children and their parents	Therapist used VC using OoVoo throughout the intervention sessions using webcams and headsets	10 session Telehealth Facing Your Fears intervention in a small-group format consisting of 4–6 parent youth dyads, individualized to fit the needs of each group	Repeated measure ANOVAs for pre- and post-intervention	SCARED, PSOC, participant monitoring form, parent and youth satisfaction ratings, treatment fidelity checklist	Results supported the feasibility and efficacy of a CBT intervention for anxiety in youth with ASD over telehealth; significant difference in scores on SCARED pre to post-intervention; therapist fidelity was strong, and all parents rated high levels of satisfaction
Ferguson et al. (2020)	Six children with ASD (males 3–7 years of age)	Children	VC using Zoom	5 days per week, probe and teaching sessions of discrete trial teaching (provided instructive or corrective feedback)	Nonconcurrent multiple-baseline design	Primary and secondary responses, primary observational responses and secondary observational responses, IOA	All participants learned primary and secondary responses, and five participants acquired primary and secondary observation responses, high levels of attending and engagement during teaching
McCrae et al. (2020)	17 children with ASD and insomnia (6–12 years of age)	Children and their parents	VC using Zoom	Eight (50 min) sessions of CBT-CI	Single arm study	Clinical interview, electronic sleep diary (SOL, TWT, TSTS), ABC, HRV, treatment satisfaction questionnaire, treatment credibility questionnaire	Improvement on challenging behaviors and SOL, TWT, and TSTS; Treatment integrity was high; treatment was rated 100% moderately to very helpful, 87.5% indicated CBT-CI was autism-friendly

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Cihon et al. (2021)	Three children with ASD (males, 4–5 years of age)	Children	VC using Zoom	One session per day (10 min), 2–5 days a week (depending on child); Interventionists administered Cool Versus Not Cool procedure (changing the conversation when someone was bored—7 steps)	Nonconcurrent multiple-baseline design	Probe sessions to document if participant engaged in a step; IOA; social validity questionnaire	All participants reached master criterion (all 7 steps) during intervention condition; 2 out of 3 participants continued to reach mastery during generalization condition; all 3 continued to engage in all steps correctly during maintenance (7-day follow-up); intervention was found to be acceptable
Baharav and Reiser (2010)	Two parent–child dyads (children 4.6–5.2 years of age)	Parents	VC using Skype on laptops	Speech and language intervention (6-week period): Control Period: 2 weekly, 50-min sessions in-person, Experimental Period: one in-person (50 min) followed by remote coaching via VC as needed (50 min)	Single-subject time series: A–B repeated measures design	Vineland-2, S, MacArthur-CDI, video analyses of therapy sessions, parent satisfaction questionnaire, and fidelity measures	Children made gain in some aspects of communication (Vineland-2 and MacArthur CDI scores) in both intervention models, and parents reported telehealth intervention was as valuable as in-person
Vismara et al. (2012)	Nine parent–child dyads (all children diagnosed with ASD and were 36 months or younger)	Parents	VC using webcam on laptops (no VC program specifically reported)	12-week,1-h/week ESDM parenting intervention with coaching and DVD learning module, Follow up: three-1-h sessions 2 weeks apart	Single-subject, multiple-baseline design with random assignment	Child social communication (e.g., language, imitation), ESDM Fidelity Scale, MBRS and CBRS, feasibility an acceptability questionnaire	High levels of treatment fidelity that were maintained, parents reported high satisfaction and ease of use, some child communication behaviors increased (e.g., language, use of language and gestures)

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Vismara et al. (2013)	Eight parent–child dyads (children with ASD and younger than 48 months of age)	Parents	VC on self-guided website using a laptop and webcam	12 weekly, 1.5-h parent coaching sessions to teach parent training strategies, access to P-ESDM learning modules, and 3, 1.5-h monthly follow-up sessions	Single-subject, multiple-baseline design with random assignment	Measure of parent satisfaction, P-ESDM Fidelity tool, MBRS, MacArthur-CDI, behavioral coding and parent reporting of child behaviors	Parent fidelity and total engagement increased from baseline through intervention, and maintained during follow-up, reported increased understanding and appreciation for helping their child learn skills at home
Wacker et al. (2013)	17 parent–child dyads (16 males, 1 female with ASD; ranged from 29 to 80 months in age)	Parents	VC at teleconsultation centers using Windows PCs and webcams	60-min sessions, received lived coaching from Behavior Analysts on FCT (baseline included FA sessions)	Nonconcurrent multiple-baseline design across children	Child problem behaviors based on FA (at baseline and intervention), IOA, acceptability and cost of service	Reduction in problem behaviors, Parents can be coached to administer FCT, parents rated treatment as acceptable, lower cost for telehealth than in-person
Suess et al. (2014)	Three children with ASD (males, 2–3 years of age)	Parents	VC using Skype and Debut software	Parents conducted all FA and FCT sessions while being coached by a behavior consultant	Multi-element design, with alternations between (A-coached) and (B-independent) trials	The children's and parent's behaviors were recorded and coded, IOA, parent fidelity, TARF-R	Parents' fidelity at implementing intervention increased, parents rated high levels of satisfaction, and the children's problem behaviors were reduced
Ingersoll and Berger (2015)	28 parents of children with ASD (age ranged from 27 to 73 months)	Parents	VC using Skype	Parents completed a self-directed or therapist-assisted version of ImPACT (6 months). The therapist-assisted group attended 24 total (2–30 min) remote coaching sessions per week	Children were matched on their expressive language using the Mullen Scales of Early Learning; then randomly assigned to the self-directed or therapist-assisted group	CEWFS, CES-D, ImPACT knowledge quiz, intervention fidelity, program engagement, program evaluation, TEI, BIRS	There were high rates of parent engagement, therapist-assisted group had greater engagement than the self-directed group, and the therapist-assisted group was more likely to finish program

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Wainer and Ingersoll (2015)	Five parent–child dyads (age ranged from 29 to 59 months)	Parents	Online VC using RIT website	Parent training either self-directed or taught through coaching sessions	Single-subject, multiple-baseline design	BIRS, program engagement, parent knowledge of RIT quiz, RIT fidelity form, child imitations, IOA	4 of 5 parents achieved overall fidelity of implementation, 4 of 5 children maintained higher than baseline spontaneous imitation, remote coaching was rated high
Ingersoll et al. (2016)	28 parents of children with ASD (age ranged from 27 to 73 months)	Parents	VC using Skype	Parents either completed a self-directed or therapist-assisted version of ImPACT (6 months). The therapist-assisted group attended 24 total (2–30 min) remote coaching sessions per week	Children were matched on their expressive language using the Mullen Scales of Early Learning; then randomly assigned to the self-directed or therapist-assisted group	Parent intervention fidelity, PSOC, FIQ, language targets during the parent–child interaction pre-, post-, and follow-up intervention. MacArthur-CDI, Vineland-2	Both groups increased parent fidelity to treatment, parent's rates of self-efficacy, and reduced parent stress, the therapist-assisted group made greater gains in parent fidelity, marginally greater gains in language targets during the parent–child interaction and was the only group to improve in social skills on the Vineland-2
Lindgren et al. (2016)	107 children with ASD or other DD (age 21–84 months) and their parents	Parents	Only Group 2 and 3 received remote coaching from a telehealth center, Group 2 used existing VC software, and Group 3 used VC on Skype	All three groups conducted FAs and FCT with their children. Group 1: treated in-home by trained consultants, Group 2: parents were coached on FAs and FCT via VC at a training clinic Group 3: coached via VC at home	FA: Mult-ielement single case design Random group assignment, Single-subject designs, comparisons between treatment delivery models (group differences)	FA sessions were coded, reduction of problem behaviors, treatment costs for each group,	There were no significant differences on reduction of behavior between groups, and parent-rated acceptability was high for all three groups, parents can successfully be taught to reduce their child's behavior problems through FA and FCT

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Machalicek et al. (2016)	Three parent–child dyads (two females, 8–16 years of age, one male, 9 years of age; all with ASD)	Parents	VC through IChat on laptop with webcam	Study 1: 60-min FBA interview, and 4 telehealth sessions for FA, provided feedback and coaching. Study 2: coached to implement brief multi-element treatment comparison, had video clips modeling strategies	Study 1: Brief multi-element treatment comparison. Study 2: Individual multi-element design, A-B non-experimental design	Data on the occurrence of challenging behaviors, IOA, procedural fidelity, social validity questionaries	Intervention strategies derived from FA decreased challenging behaviors, each parent chose to continue the strategies they liked implementing the best
Meadan et al. (2016)	Three mother–child dyads (children with ASD, 2–4 years of age)	Parents	VC through Skype on an iPad (recorded sessions)	Phase 1: 45-min training session, iPics coaches taught parents on 3 naturalistic teaching strategies (i.e., modeling, mand-model, time delay) and environmental arrangement. Phase 2: Ongoing coaching combined environmental arrangement and 3 naturalistic strategies. Phase 3: Maintenance	Multiple-baseline single case design	Parent quality and rate with which parents implemented the three strategies, children's social communication initiations and responses, IOA, social validity	General increase of rate and quality of strategy use, maintained above baseline, Parents reported high satisfaction with goals, procedures, and outcomes
Pickard et al. (2016)	28 parents of children with ASD (age ranged from 27 to 73 months)	Parents	VC using Skype	Self-directed: ImPACT online 12 sessions, Therapist-assisted: ImPACT online 12 sessions in addition to two 30-min remote coaching sessions per week	Children were matched on their expressive language using the Mullen Scales of Early Learning; then randomly assigned to the self-directed or therapist-assisted group	Sociodemographic questionnaire, ImPACT ratings, qualitative interviews (Analyzed by REAM)	Both groups found ImPACT to be favorable and easy to learn, positive perceptions about acceptability of program, Therapist-assisted group was 50% more likely to spontaneously report child made social communication gains

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Suess et al. (2016)	Five parent–child dyads (three males and two females with ASD, ranged from 2–7 years in age)	Parents	VC using Skype	Before FA, 1-h group remote meeting FA sessions: Parent conducted during 1-h session at autism center FCT sessions: with coaching during 3, 15-min remote visits over 3 consecutive weeks	FA: Multi-element design. FCT: Nonconcurrent multiple-baseline design across children	IOA, task completion, mands (either prompted or not prompted), frequency of problem behavior and other variables	Reduction in children's problematic behavior by average of 65.1%, suggest evidence supporting that parents can be coached to implement FA and FCT via telehealth
Simacek et al. (2017)	Three children (two females with ASD and one female with Rett syndrome; children between 3 and 4 years of age)	Parents	VC using Debut software with Logitech HD Pro Webcam C920 (sessions recorded)	FA sessions: 5 min with no more than 10 sessions (50 min), live coaching and feedback; FCT: coached with verbal feedback and instruction to use most to least prompting for AAC requests, up to 7 sessions were conducted per day, with either 3 trial blocks or lasting 5 min each	FAI, followed by SDA using a multi-element design. FA was then conducted, followed by FCT used an adapted multiple-probe design, in addition to ABAB design	Idiosyncratic responses for each child included frequency, AAC responses, IOA, TARF-R	AAC responses were strengthened when reinforcement was delivered for AAC response and denied for idiosyncratic responses in intervention phases, parents rated overall treatment as highly acceptable
Subramaniam et al. (2017)	Four parent–child dyads (children with ASD, ranged from 18 months to 12 years of age)	Parents	VC using Cisco WebEx program	In vivo initial visit and training with confederates, parent training/teaching DTI skills. VC sessions, feedback was immediate (twice a week), with fading of VC sessions	Nonconcurrent multiple-baseline design	Global parent treatment integrity, component parent treatment integrity, child mastery, trainer procedural fidelity, problem behavior, TARF	Parents were accurately able to implement DTI skills with VC, generalized skills and maintained accurate implementation over 26 weeks post-training, VC deemed as effective

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Bearss et al. (2018)	14 children with ASD (ranged from 3 to 7 years of age)	Parents	VC	6-month open trial of RUBI-PT program via telehealth (11 core sessions, 2 supplemental, 3 telephone boosters)	Open Trial	Subject categorizations, Feasibility measures (i.e., TFC, PTAS, parent satisfaction questionnaire, telehealth caregiver satisfaction survey, telehealth provider satisfaction survey, Efficacy measures (ABC, HSQ-ASD, PTP, CGI-I, Vineland-2)	High treatment fidelity, significant improvements on ABC, 78.6% of children were "much improved" on CGI-I, parent-reported greater confidence in handling behaviors, telehealth services deemed acceptable by parents
Benson et al. (2018)	Two children (one male with ASD, 5 years of age and one male with cerebral palsy, 8 years of age)	Parents	VC using Google Hangouts communication platform, Dell computer and Logitech camera	Coaches delivered remote instruction and support to parents for FA and FCT sessions	FA: Multi-element design. FCT: ABAB single case experimental design	SDA, IOA, reduction in children's self-injurious behavior, implementation fidelity	High levels of parent satisfaction with procedures and use of technology, high implementation fidelity across, reduction in child's problematic behaviors
Kuravackel et al. (2018)	33 children with ASD (age 3–12 years of age)	Parent	VC	Parents were assigned either the waitlist control group, face-to-face C-HOPE intervention or C-HOPE delivered by telehealth over an 18-month period	Iterative pretest–posttest control group design	M-CHAT, SCQ, ADOS-2, PSI, ECBI, BPS, Vineland-2, CSQ, GSRS, Parent fidelity questionnaire	Reduction in child problem behaviors, an increase in parent competency, and a decrease in parent stress, no differences in parent stress or competency by treatment modality, parents were highly satisfied with both face-to face and telehealth modalities
Schieltz et al. (2018)	Two children (2–6 years of age with ASD)	Parents	VC using Skype on Windows-based PC	Mothers provided FA and FCT while being coached from behavior consultants through telehealth sessions	FA: Multi-element design, FCT: nonconcurrent multiple-baseline design across participants	Behavioral definitions, IOA, (assessed using exact interval-by-interval comparisons), treatment fidelity	High treatment fidelity reported by parents, children's problem behaviors decreased

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Vismara et al. (2018)	Eight parent–child dyads (children were 18–48 months old and with ASD)	Parents	VC using Citrix program GoToMeeting	Intervention: 12 weekly, 1.5-h parent coaching sessions of P-ESDM topics, access to learning modules, Comparison: monthly 1.5-h coaching sessions, access to website without P-ESDM content	Randomized group assignment	P-ESDM fidelity tool, program website usage, program satisfaction ratings, social communication behaviors	Parents reported increased satisfaction in P-ESDM group than community group, children in P-ESDM group produced more imitation, increase in fidelity at follow up for P-ESDM group
Guðmundsdóttir et al. (2019)	Three parent–child dyads (3–4 years of age with ASD)	Parents	VC using Skype through Microsoft LifeCam Cinema	Training on naturalistic behavioral interventions (Sunny Starts Program, DANCE) given to parents (almost 2 h per session, 7–14 sessions depending)	Multiple-baseline design	Parents' behaviors, children's behaviors (social attending, requesting, number of words, unintelligent verbalizations), IOA	Teaching parents via brief in-person situation training, and on-going telehealth training increased their skills and had a positive effect on the child's skills, parents reported that social attending increased in children
Davis et al. (2020)	Two parent–child dyads (one male, 6 years of age, and one female, 15 years of age, with ASD)	Parents	VC through Whatsapp and video data collected through SendSafely	Token economy system implementation, 3-week baseline, training intervention phases (fixed interval 30 s), and faded intervention phase (fixed interval 60 s)	Nonconcurrent multiple-baseline design	Token economy procedural fidelity (e.g., frequency of token adherence, redirection, appropriate prompting through transitions to activity and break using tokens) based on observational data, IOA, social validity survey	Increase in implementation accuracy for both participants after baseline, both averaged over 84% accuracy through fading phase; decreased perception of disruption and confidence in using token economy system; parents reported convenience and ease of telehealth platform

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Fisher et al. (2020)	36 parent–child dyads (30 females, 6 males, 26–46 months, with ASD)	Parents	VC through VPN with Logitech webcam and Bluetooth headset	Intervention Group: Coached scripted role-plays with one parent of dyad and confederates to implement EIBI skills, Parent completed 9 E-learning modules Waitlist Control: second parent of dyad	RCT, pre-post test comparisons	BISWA and BISPA, social validity questionnaire, IOA	Percentage of opportunities for BISWA and BISPA increased pre-to post treatment in intervention group; intervention was rated as socially acceptable
Lindgren, (2020)	51 children (between 21 and 84 months with ASD)	Parents	VC using Skype	Competed FA with coaching before randomization, FCT Intervention Group: Parents conducted FCT with real-time coaching (60-min weekly session for at least 12 weeks). Delayed FCT Group: 12 weeks of treatment as usual	RCT FA: Multiple-element design FCT: nonconcurrent multiple-baseline across participants, plus reversal design	The percent of reduction of problem behavior in children, TARF-R	All children showed improved behavior in FCT group compared to two in Delayed group, improved in social communication and task completion in FCT group, and the parent implemented FCT using telehealth reduced children's problem behavior
Marino et al. (2020)	74 parents of 36 children with ASD, (average age: 69.6 months)	Parents	Web platform within Google-suite	Phase 1: Both groups 12, 2-h informative sessions Phase 2: 12 weeks of 2-h group behavioral therapy, 1-h per week one–one ABA for child Phase 3: 12 weeks Telehealth Group: 2-h per week tele-assisted one-on-one parent training and coaching Control Group: same intervention protocol without tele-assistance	RCT—group comparisons	HSQ-ASD, PSI/SF	Decrease on PSI/SF of tele-assisted group but not control group, increased ability of tele-assisted group to face stress

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Rooks-Ellis et al. (2020)	Ten parent–child dyads (six males, four females with ASD, mean age 29.3 months)	Parents	VC using Zoom	12-week interventionists trained and coached parents to implement P-ESDM	Concurrent multiple-baseline design across participants	P-ESDM Parent Fidelity Rating System; P-ESDM Coaching Fidelity Rating System; Autism Impact Measure; social validity questionnaire	Parent fidelity increased during generalization and maintenance phases; Positive change in autism symptoms; parents were satisfied, and majority found it effective
Suess et al. (2020)	Four parent–child dyads (males with ASD; ages 3–6 years)	Parents	VC using Skype	Behavioral consultant coached caregivers to complete FA, Extinction baseline, FCT (3 contexts) and FCT in treatment context (1 h weekly)	Four Phases: (a) FA, (b) Extinction baseline in treatment context, (c) FCT in three alternative contexts, (d) FCT in treatment context	Individualized Target Mands and Target Tasks were recorded and coded, IOA	Problem behavior reduced an average of 97.8% following initial alternative contexts FCT; mitigated resurgence of problem behaviors; generalized appropriate behaviors across participants/ significant reductions in resurgence were found
Gerow et al., (2021a, b)	Seven parent–child dyads (six males, one female, with ASD, 3–11 years of age)	Parents	VC using VSee	Therapist coached parent during preference assessment; Provided written and verbal instructions, prompting, and feedback (during all phases: Brief FA and FCT sessions)	Brief FA: 4 or 5 randomized conditions; treatment evaluation was based on reversal design	Response per minute of target challenge behavior; TARF-R	Reduction in challenging behavior during FCT; Assessment strategy was found to be feasible and acceptable
Gerow et al., (2021a, b)	Four parent–child dyads (males with ASD, 5–9 years of age)	Parents	VC using VSee	Goal development (daily living skills) therapist provided instructions, prompting, and feedback for all phases (preference assessment, teaching trials, intervention)	Concurrent multiple-baseline design	Percentage of completed steps of task analysis	Accurate implementation led to increase in daily living skills across participants

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Hao et al. (2021)	30 parent–child dyads (matched on gender ratio Female: Male, 3:12, range of 23–86 months of age with ASD)	Parents	VC using Zoom	In-person and Telehealth group; Two group sessions and 6 weekly 1 h individual sessions—feedback was provided on implementation accuracy of SKILLS	Group differences	Initiations, responses, and NDW per minute, MLU; Reliability for dependent variables	No significant differences between intervention groups; significant gains based on NDW and MLU; parents' increase fidelity of implementation of intervention
O'Brien et al. (2021)	One parent and child (3 years of age) with ASD	Parents	Vidyo teleconferencing software	10 min of 60 min session was used for "check in," 40 min used for FA or FCT sessions were conducted, 10 min feedback was provided to parent	Single-subject design	Data collected on target problem behaviors, independent requests for preferred items, Reliability data, IOA, TARF-R	FA indicated behaviors maintained by escape and access functions, FCT lead to reduction in problem behavior, by 7th session, 100% independent requesting; 100% independent requesting at 6-month follow-up; highly acceptable
Pierson et al. (2021)	Four children, three with ASD (5–7 years of age), one with Down Syndrome (6 years of age)	Parents	WebEx, Google Drive	Anticipatory set (preview elements of storybooks); Training consisted of didactic teaching of storybook DR intervention (following PEER); Coaching was synchronous 1 time per week, feedback provided	Multiple-probe-across-participants design	Parent implementation of modified DR intervention; Child answers to comprehension questions; IOA; social validity questionnaire	No changes in child responses were found for majority of participants; Parent-reported some difficulty with child behavior and intervention procedures
Sivaraman et al. (2021)	Six total dyads four parent–child dyads (three males, one female 6–8 years of age) and two therapist-child dyads (6–7 years of age), all with ASD	Parents	Video-calling platform on laptop (no specific VC program was reported)	Live coaching caregivers to teach face mask wearing; taught through graduated exposure, behavior shaping, and contingent reinforcement	Nonconcurrent multiple-baseline design	Duration of seconds wearing mask; Scored completed steps of hierarchy; TARF-R, IOA	All children tolerated wearing a mask for 10 min (target duration); Parents found the training to be useful and practical

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Yi and Dixon (2021)	13 parent–child dyads (11 males, 2 females with ASD, average age: 8 years)	Parents	VS using software (i.e., Zoom, Skye, GoToMeeting)	ACT group: 60-day telehealth ABA parent training curriculum included onboarding with brief ACT session, 5 self-paced lessons, 5 individual consultations with follow-up coaching. Control Group: same program with modifications of onboarding and progress monitoring (no ACT session)	RCT—group comparisons	Percentage of online lessons parents completed, average scores during knowledge checks; social validity questionnaires; IOA	Parents in ACT group finished more lessons; no differences in scores on knowledge checks; program was rated favorably by parents
Gibson et al. (2010)	One 4-year-old male with ASD and two preschool staff	Preschool staff	VC using Skype on desktops. Verbal feedback was transmitted via microphone system in the staff's ear	Initial face-to-face FA, video chat consultation with teachers on how to do FCT, and immediate feedback given to teachers on their administration of the FCT during class using microphone system	ABAB design to evaluate the effectiveness of FCT intervention on reducing the child's behavior (12 sessions)	IOA, BIRS-R, Elopement (defined by consultants)	Reduction in elopement behavior from baseline to post-intervention, consultation procedures were found to be acceptable by teachers
Neely et al. (2016)	Three interventionists and three children (all with ASD, 4–8 years of age)	Interventionist	VC using Vsee on iPad or MacBook (recorded sessions at clinic)	Training package to teach novice interventionists incidental teaching for children (feedback on videos)	Concurrent multiple baseline across participants	Interventionist behavior: Frequency of communication opportunity, Child behavior: number of child's verbal mands, duration of training, IOA, treatment integrity, TEI-SF	All interventionists achieved high fidelity for 4 consecutive sessions, increased number of communication opportunities following training, two of the three interventionists were able to maintain high fidelity long term, each child increased their mands above levels at baseline

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Barkaia et al. (2017)	Three therapists, three children (three males, two 4 years of age, one 6 years of age)	Therapist	VC using Skype and telephone audio connection using Viber	Baseline: coach to implement intervention for language development, coached watched 15 min and provided feedback Coaching: 15-min coaching session to the therapist	Concurrent multiple-baseline design	Therapist behaviors: Correct command sequences, positive consequences, Child behaviors: mands and echoics, social validity scale	Coaching helped increase treatment efficacy, therapists increased in levels of higher order comments and decreased in levels of direct commands, all children's verbalization increased in responding from baseline, and children demonstrated increased echoic
Neely et al. (2018)	Two first-tier coaches six s-tier interventionists, paired with one child with ASD (3–7 years of age)	Coaches, interventionist	VC using Vsee on iPad (recorded sessions at clinic)	After target phase was set via VC, coaches conducted 5-min sessions with child, completed 1-h online module, set target phase via VC with interventionist, met target phase, and then taught interventionist via VC on target steps	Multiple-baseline design for remote incidental teaching, multi-probe design to evaluate the effects of coaches teaching interventionists to implement incidental teaching	Interventionist dependent variables (incidental teaching, communication opportunities), frequency of child requests, IOA, treatment integrity, TEI-SF, researcher-developed questionnaire	Incidental teaching and performance criteria were met with high fidelity, child participants increased their requests above baseline, communication opportunities were variable, high acceptability of intervention
D'Agostino et al., (2020)	Six preschool practitioners and 6 children (children between 3 and 4 years of age, only one child with ASD)	Preschool practitioners	VC using Zoom	Telehealth training of NDBI procedures with coaching sessions involving delayed feedback and video self-evaluation	Single case multiple probes across participants design	Practitioner behavior: frequency of target skill opportunity: Child behavior: target communication behavior, IOA, treatment fidelity, TSP questionnaire, TEIYD scale, IRP-15, researcher-developed questionnaire	A functional relationship between training and practitioner behavior, and between training and the frequency of child target communication behavior, increase in child communication opportunities related to increase in child behavior, high acceptably of training

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Schlosser et al. (2020)	Seven children with ASD (five males, 6–8 years of age)	Interdisciplinary School Team	VC (no specific program reported)	Biweekly VC sessions to train and coach on VIS intervention procedures	Mixed-methods approach	Goal Attainment Scaling; CARS2-QPC, Communication Matrix, Adapted TEI-SF, Self-efficacy scale	Improved across 22 goals, more progress towards expressive than receptive goals; significant communication matrix scores pre vs. post-intervention; rated a highly acceptable intervention; self-efficacy improved over time
Singh et al. (2021)	Three adolescents with ASD (13, 17, and 19 years of age)	Therapists	VC using Zoom; WhatsApp	Real-time training in mindfulness and SoF vs. implementation of BSP intervention	Multiple-baseline design	Operational definition of self-injury (each instance counted as one event), AARP, Social validity questionnaire for participants adapted from SoF program	No significant differences in reduction of SIB between baseline and BSP; Significant reduction in SIB for SoF intervention, more social validity for SoF than BSP by parents and adolescents
Ruble et al. (2013)	49 special education teachers and child dyads (children with ASD, 3–9 years of age)	Teachers and parents	VC using Adobe Connect Pro and a laptop webcam	COMPASS intervention: 3-h parent-teacher consultation and 1.5-h coaching sessions between clinician and teachers every 5 weeks for 20 weeks. Group 1: Placebo Control. Group 2: COMPASS followed by face-to-face coaching sessions. Group 3: COMPASS followed by web-based coaching sessions	RCT	OWLS, DAS, and Vineland-2 for original group equivalency, consultant adherence to COMPASS consultation protocol, consultant fidelity, teacher fidelity, PET-GAS	The study successfully found that parent consultation improves individualized outcomes, and the COMPASS and web-based coaching was found to be efficacious, although there were no significant group differences

Table 2 (continued)

Article	Participant characteristics	Telehealth participant	Technology	Service	Design/method	Measures	Reported outcomes
Guðmundsóttir et al. (2017)	Two parent–child dyads (5-and 4-year-old with ASD)	Special Education Teacher and Parent	VC using Skype through Microsoft LifeCam Cinema	Training services on naturalistic behavioral interventions (Sunny Starts Program, DANCE) given to parents (1 h per session)	Multiple-baseline experimental design	IOA, Parents' behaviors (teaching episodes), children's behaviors (social attending, requesting)	Increase in children's social attending skills, teaching parents via brief in-person situation training and on-going telehealth training increased their skills

AARP Abbreviated Acceptability Rating Profile, *ABA* Applied Behavior Analysis, *ABC* Aberrant Behavior Checklist, *ACT* Acceptance and Commitment Therapy, *ADOS* Autism Diagnostic Schedule, *ADOS-2* Autism Diagnostic Schedule-Second Edition, *APCP* Assessment of Preschool Children's Participation, *ASD* Autism Spectrum Disorder, *ASRS* Autism Spectrum Rating Scale, *BIRS* Behavior Intervention Rating Scale, *BIRS-R* Behavior Intervention Rating Scale-Revised, *BISWA* Behavioral Implementation of Skills for Work Activities, *BISPA* Behavioral Implementation of Skills for Play Activities, *BPS* Being a Parent Scale, *BSP* Behavior Support Plan, *CARS2-QPC* Childhood Autism Rating Scale 2-Questionnaire for Parents or Caregivers, *CBRS* Child Behavior Rating Scale, *CBT* Cognitive Behavioral Therapy, *CBT-CI* Cognitive Behavioral Therapy for Childhood Insomnia, *MacArthur-CDI* MacArthur Communicative Developmental Inventory, *CES-D* Center for Epidemiologic Studies Depression Scale, *CEWFS* Computer-Email-Web Fluency Scale, *CGI-I* Clinical Global Impression-Improvement Scale, *C-HOPE* COMPASS for Hope, *COMPASS* Collaborative Model for Promoting Competence and Success, *COPM-2* Canadian Occupational Performance Measure-Second Edition, *CSQ* Consultation Satisfaction Questionnaire, *DAS* Differential Ability Scale, *DANCE* Decide, Arrange, Now, Count and Contemplate, Enjoy, *DD* Developmental Disorders, *DR* Dialogic Reading, *DTI* Discrete Trial Intervention, *ECBI* Eyberg Child Behavior Inventory, *EIBI* Early Intensive Behavioral Intervention, *ESDM* Early Start Denver Model, *FA* Functional Assessment, *FAI* Functional Assessment Interview, *FBA* Functional Behavior Assessment, *FCT* Functional Communication Training, *FIQ* Family Impact Questionnaire, *FRED-R* Family Routines Exploration and Description-Revision, *GAS* Goal Attainment Scaling, *GSRS* Group Session Rating Scale, *HRV* Heart Rate Variability, *HSQ-ASD* Home Situation Questionnaire-ASD, *IEP* Individualized Education Program, *ImPACT* a telehealth-based parent-mediated intervention for young children with ASD, *IOA* Interobserver Agreement, *iPics* Internet-Based, Parent-Implemented Communication Strategies, *IRP-15* Intervention Rating Profile-15, *MBRS* Maternal Behavior Rating Scale, *M-CHAT* Modified Checklist for Autism in Toddlers, *MLU* Mean length of utterance, *MSEL* Mullen Scales of Early Learning, *NDBI* Naturalistic Developmental Behavioral Intervention, *NDW* Number of Different Words, *OWLS* Oral and Written Language Scales, *PEER* Prompt, Evaluate, Expand, and Repeat, *P-ESDM* Parent Coaching in the Early Start Denver Model, *PET-GAS* Psychometrically Equivalence Tested Goal Attainment Scaling, *PSI* Psychological Screening Inventory, *PSI/SF* Parental Stress Index/Short Form, *PSOC* Parenting Sense of Competence Scale, *PTAS* Parent Treatment Adherence Scale, *PTP* Parent Target Problems, *RCT* Randomized Controlled Trial, *REAM* Rapid Evaluation and Assessment Methodology, *RIT* Reciprocal Imitation Training, *SCARED* Screen for Anxiety and Related Emotional Disorder in Children, *SCQ* Social Communication Questionnaire, *SDA* Structured Descriptive Assessment, *SIB* Self-injurious Behavior, *SKILLS* Skills and Knowledge of Intervention for Language Learning Success, *SoF* Soles of the Feet, *SRS* Social Responsiveness Scale, *SOL* Time From Initial Lights Out Until Sleep Onset, *SP-2* Sensory Profile-Second Edition, *SRS-2* Social Responsiveness Scale-Second Edition, *TARF* Treatment Acceptability Rating Form, *TARF-R* Treatment Acceptability Rating Form-Revised, *TEI* Treatment Evaluation Inventory, *TEI-SF* Treatment Evaluation Inventory-Short Form, *TEIYD* Teacher Efficacy for the Inclusion of Young children with Disabilities Scale, *ToMI* Theory of Mind Inventory, *TSP* Target Skill Prioritization, *TWT* Time Awake From Lights Out Until Out of Bed, *TST* Time Awake From Lights Out Until Out of Bed Minus Time in Bed, *VC* Video Conferencing, *VIS* Visual Immersion System

prompts to parents using an adaptation of the *Screening Tool for Autism in Toddlers and Young Children* (Stone et al., 2000) via VC or used the TELE-ASD-PEDS to guide parents to lead specific social tasks with their children (Corona et al., 2021). Both of these telehealth administrations were used to establish diagnostic accuracy; across the sample, diagnostic accuracy was 86–77% of parents reported that they would prefer both to play and observe the child during the remote assessment instead of just playing with the child or just observing (Corona et al., 2021). Based on these two studies, it does appear that well-established diagnostic measures of ASD (i.e., *ADOS* and *ADI-R*), as well as other measures of ASD symptomology, can be used via telehealth successfully as accurate alternatives for identifying children with ASD rather than solely relying on in-person assessments (Corona et al., 2021; Reese et al., 2013).

Lastly, one study used a telehealth platform to educate, train, and coach a parent at a teleconsultation center to implement a functional analysis assessment (four conditions) with their children with ASD successfully (Wacker et al., 2013). Remote real-time coaching was effective in having parents administer the functional analysis and was successful with identifying the social function of the behaviors consistently (Wacker et al., 2013). Results were comparable to previous functional analysis studies where theses assessments were conducted in-home with parents but the telehealth administration was a more cost-effective strategy (Wacker et al., 2013).

Telehealth Participant: Interventionists/Staff/Teachers of Children/Adolescents with ASD

Four studies focused on implementing an assessment via telehealth with interventionists, staff, and/or teachers who work with individuals with ASD. Three studies utilized either teachers, direct-care staff, or clinical staff for the purposes of either implementing preference assessments with children with ASD (Ausenhus & Higgins, 2019; Higgins et al., 2017; Machalicek et al., 2009), while one study used teachers to conduct functional analyses for challenging behavior in children with ASD (Machalicek et al., 2010).

A preference assessment is a structured method utilized to identify highly preferred items that can be used as reinforcers when teaching new skills (Ausenhus & Higgins, 2019). Two studies utilized trained confederates to assist in the training of the staff to deliver the preference assessment to minimize the actual participant with ASD's exposure to an assessment of low treatment integrity (Ausenhus & Higgins, 2019; Higgins et al., 2017). One study utilized delayed video feedback and real time feedback during roleplays with the confederate (Higgins et al., 2017), while the other provided remote, real-time feedback during the preference assessment with the participant with ASD (Ausenhus & Higgins, 2019). These studies found that training of staff to deliver preference assessments can be effectively done via telehealth and all trained staff indicated they would recommend this training procedure to others in the future. Further, procedural integrity was high across studies. The third study utilized VC to supervise teachers conducting paired-choice preference assessments with immediate remote feedback following each trial during the assessments (Machalicek et al., 2009). The teachers completed these preference assessments with 100% accuracy following feedback; when preference assessment results (the items that were selected as preferred) were further tested with the same children with ASD, the children did prefer the items selected during the preference assessment (Machalicek et al., 2009). Teachers and staff indicated satisfaction with the telehealth supervision protocol (Ausenhus & Higgins, 2019; Higgins et al., 2017; Machalicek et al., 2009). Lastly, functional analyses were conducted with teachers of children with ASD using immediate feedback via VC and the supervision that was provided aided teachers in continuing to implement FAs effectively nine weeks after the initial feedback, but during the maintenance phase, the implementation for each teacher varied (Machalicek et al., 2010). This indicates that remote functional analyses conducted by teachers may be an acceptable tool, but more follow-up sessions may be needed after the initial sequences of training to ensure accurate implementation.

Based upon this review, there are a limited number of studies that examine the efficacy of the assessment of ASD or the use of other types of assessments with children and adolescents with ASD via telehealth. Of the articles that examined social validity, the use of technology and equipment was acceptable and the technical difficulties experienced, if any, were reportedly manageable (Ausenhus & Higgins, 2019; Higgins et al., 2017; Machalicek et al., 2009, 2010). Primarily, all of the assessment studies included in this review demonstrate the feasibility of using telehealth to accurately assess not only for diagnostic purposes, but to also conduct other forms of assessments with children with ASD.

Treatment

Forty-seven studies in this review provided a variety of intervention services via telehealth to individuals with ASD. Of the 47 studies, four studies targeted the child with ASD directly, 34 had the parent receiving the telehealth intervention and then the parent administered it with their child with ASD, seven utilized other individuals (i.e., teachers, therapists, interventionists), and two studies used both a parent and teacher. Similar to the assessment section, VC was the telehealth method utilized the most across studies.

Telehealth Participant: Children and Adolescents with ASD

Four studies focused on implementing an intervention via telehealth directly with individuals with ASD. The VC platform was either OoVoo (Hepburn et al., 2016) or Zoom Video conferencing (Cihon et al., 2021; Ferguson et al., 2020; McCrae et al., 2020). Two studies utilized telehealth to administer cognitive behavioral therapy directing to children with ASD (Hepburn et al., 2016; McCrae et al., 2020). The first study delivered a cognitive behavioral intervention (modified version of Face Your Fears: Group Therapy for Managing Anxiety in Children with High Functioning Autism) via VC for 10 sessions to small groups of child-parent dyads to address co-occurring anxiety symptoms in ASD (Hepburn et al., 2016; Reaven et al., 2011). The telehealth group had significantly lower parent-reported youth anxiety symptoms than the waitlist control group following the completion of the study. Parents and youth indicated strong satisfaction with the telehealth delivery method, although technical glitches (e.g., lost connections) were commonly reported (Hepburn et al., 2016). The second study conducted cognitive behavior therapy for childhood insomnia for eight, 50 min sessions with children with ASD and insomnia (McCrae et al., 2020). Children with ASD saw improvements in challenging behaviors and sleep related measures (e.g., time awake from lights out until out of bed) and reported the intervention to be moderately to very helpful (McCrae et al., 2020). Treatment integrity for both studies was high (Hepburn et al., 2016; McCrae et al., 2020).

An additional study employed discrete trial teaching with dyads of children with ASD, five days per week, with both real-time instructive feedback or corrective feedback (Ferguson et al., 2020). High levels of attending and engagement were found during teaching and all participants acquired both primary responses (defined as when participant vocally stated the name of the stimulus when the stimulus was presented) and secondary responses (defined as when the participant vocally responded to a question about the stimulus when the stimulus was presented) (Ferguson et al., 2020). Lastly, a social skills intervention (the Cool Versus Not Cool intervention) was implemented via telehealth with three children with ASD; this intervention targeted the social skill of changing the conversation by recognizing when someone was bored (Cihon et al., 2021). The social skills intervention had seven steps to achieve mastery and all three participants mastered all of the steps by the end of the intervention program, whereas only two continued to reach mastery during generalization phase (Cihon et al., 2021). All four of these studies are indicative of progress in implementing interventions directly to individuals with ASD via telehealth platforms.

Telehealth Participant: Parents of Children and Adolescents with ASD

Thirty-four studies in this review featured the parents of individuals with ASD as the primary receiver of the telehealth intervention programs, which then they delivered to their children with ASD. All of the studies used VC as the main form of communication to deliver the interventions, but the software used varied (e.g., Skype, Zoom, Cisco WebEx, GoToMeeting, Google Hangouts, Whatsapp, Vsee, and Vidyo). For clarity and discussion purposes, the 34 studies are divided by intervention type below.

Behavior Management/Parenting Training Eleven studies featured telehealth delivered parent management/parent training interventions and all utilized VC through different telehealth platforms. Three studies evaluated the effectiveness of ImPACT, a telehealth-based parent-mediated intervention for children with ASD, implemented via self-directed and therapist-assisted delivery models (Ingersoll & Berger, 2015; Ingersoll et al., 2016; Pickard et al., 2016). These studies all found that parents were engaged in both conditions but therapist assistance increased engagement and acceptability of the program; initial findings also support an increase in social communication skills (Pickard et al., 2016) and improved language targets (Ingersoll et al., 2016) regardless of condition, but only the therapist-assisted group increased in social skills (Ingersoll et al., 2016). Similarly, four studies explored the feasibility and acceptability of parent implemented interventions based on the Early Start Denver Model (ESDM) and the effect on different child behaviors (e.g., communication, imitation) (Rooks-Ellis et al., 2020; Vismara et al., 2012, 2013, 2018). Across all four studies, parent fidelity in implementation increased through intervention and maintained through follow-up. Autism symptoms, as measured by the Autism Spectrum Rating Scale, decreased (Rooks-Ellis et al., 2020) and child language and use of both language gestures increased (Vismara et al., 2012). Overall, the use of the ESDM was an effective intervention delivered via telehealth. Additionally, the use of a telehealth hybrid of reciprocal imitation training (RIT) similarly found high parent acceptability and effectiveness in increasing their child's spontaneous imitation skills (Wainer & Ingersoll, 2015). Two other specific parent-mediated intervention programs were investigated. The Research Unit on Behavior Interventions—Parent Training (RUBI-PT) program was administered via telehealth over the course of 16 weeks, followed by three booster sessions, to address a variety of problem behaviors (Bearss et al., 2018). All caregivers indicated more confidence in handling problem behaviors and all families who completed the telehealth satisfaction questionnaire indicated that they would

recommended the telehealth program to other parents (Bearss et al., 2018). The Sunny Starts Program, a parent training program, used naturalistic teaching strategies to increase specific child behaviors (i.e., social attending and requesting skills) (Guðmundsdóttir, 2019). After an initial in-person training, all communication and sessions were conducted via telehealth (Guðmundsdóttir et al., 2019). Social attending increased and skills were maintained at last 1 month after follow-up and generalization varied across the three parent–child dyads (Guðmundsdóttir et al., 2019). Lastly, Davis et al. (2020) utilized telehealth to teach parents to implement a token economy system (30-second fixed intervals) with children with ASD. Parents were able to implement the reinforcement system with over 84% accuracy through the faded intervention phase and parents reported that the telehealth platform was convenient and easy to use (Davis et al., 2020).

Functional Communication Training An additional twelve studies utilized telehealth via VC to deliver functional communication training (FCT) after functional analyses that were also delivered via telehealth (Benson et al., 2018; Gerow et al., 2021a, b; Lindgren, 2016, 2020; Machalicek et al., 2016; O'Brien et al., 2021; Schieltz et al., 2018; Simacek et al., 2017; Suess et al., 2014, 2016, 2020; Wacker et al., 2013). Studies varied on the design and method used to evaluate the implementation of the FCT (e.g., randomized control trial, single-subject design) but the coaching of parents via VC during functional analysis and FCT sessions was utilized across studies. After the implementation of FCT with remote coaching and training via telehealth, child problem behaviors were reduced in 11 studies (Benson et al., 2018; Gerow et al., 2021a, b; Lindgren et al., 2016, 2020; Machalicek et al., 2016; O'Brien et al., 2021; Schieltz et al., 2018; Suess et al., 2014, 2016, 2020; Wacker et al., 2013). One particular study focused on reducing the resurgence of problem behaviors once they were reduced significantly and demonstrated that remote coaching of FCT can accomplish this both effectively and more rapidly than previous research (Suess et al., 2020). Further, parents were able to conduct a functional analysis and the intervention strategies derived from this reduced the child's problem behaviors (Machalicek et al., 2016; Suess et al., 2016). The use of FCT with coaching via telehealth was also used to increase the number of augmentative and alternative communication requests in children with ASD; the use of differential reinforcement enhanced the augmentative and alternative communication responses (Simacek et al., 2017). High level of satisfaction with telehealth implementation and interventions were found to be acceptable across studies (Benson et al., 2018; Gerow et al., 2021a, b; Schieltz et al., 2018; Suess et al., 2014; Wacker et al., 2013).Overall, it appears that parents are able to learn and implement both functional analysis and FCT with children with ASD successfully via telehealth.

Social Communication Interventions Three studies specifically used parents to implement social communication intervention programs in children with ASD (Baharav & Reiser, 2010; Hao et al., 2021; Meadan et al., 2016). The study by Meadan et al., 2016, adapted the Parent-Implemented Communication Strategies (PiCS) program, which is an in-person treatment, to become an internet-based program (i-PiCS) that was taught remotely with coaching sessions conducted via a telehealth platform. They investigated whether a parent's application of the naturalistic teaching strategies that were taught and coached via VC would increase their child with autism's expressive communication skills. Parents learned to successfully implement the strategies only when they were coached via VC and saw increases in child's social communication skills (Meadan et al., 2016). Similarly, another study examined group differences between an in-person and telehealth implementation of the Skills and Knowledge of Intervention for Language Learning Success (SKILLS) project with parents and children with ASD (Hao et al., 2021). There were six, 1-h sessions across 6 weeks, where parents would be coached and provided feedback on skills implementation with their children. Hao et al. (2021) found increases in child's number of different words and mean length utterance but did not find significant group differences between outcomes, indicating that the telehealth implementation can be effective. Lastly, the traditional in-person model (2 weekly sessions) was compared to a hybrid model (one in-person followed by one remote session via telehealth with coaching) in the effectiveness of delivering a speech and language intervention; children made communication gains in both (Baharav & Reiser, 2010). Parents also reported high satisfaction with the intervention (Baharav & Reiser, 2010). All three studies concluded that parents were satisfied with the social communication intervention they received via telehealth and all three studies demonstrated gains in social communication skills when the intervention was delivered via telehealth; therefore, there is support for the use of telehealth in the implementation of social communication interventions with children with ASD.

Applied Behavior Analysis (ABA) Four studies examined the possibility of using ABA across telehealth platforms (Fisher et al., 2020; Marino et al., 2020; Subramaniam et al., 2017; Yi & Dixon, 2021) One study utilized VC to aid parents via telehealth to deliver discrete-trial instruction (DTI), an intervention based upon applied behavior analysis (ABA), with their children with ASD (Subramaniam et al., 2017). Parents first received necessary in-person behavioral skills training on how to implement the DTI procedures and then trainers

conducted VC sessions with the parents and provided immediate feedback after each session; parents continued to have high treatment integrity with remote supervision months following the initial training (Subramaniam et al., 2017). While this study demonstrated that DTI can be implemented with feedback to parents via telehealth, there are limitations that need to be further explored (e.g., adherence to scheduled meetings, use of in session coaching in addition to end of session feedback) to determine if DTI can successfully implement over time via telehealth. Marino and colleagues (2020) examined the effect of an in-person versus telehealth assisted behavioral intervention for children with ASD. Participants were randomized for group assignment and the study was conducted through three phases. During Phase 1, all groups received twelve, 2-h informative sessions on ABA and characteristics of ASD. During Phase 2 all parents received 2-h weekly group behavioral therapy and all children received 1 h per week of individualized ABA therapy for 12 weeks. Lastly, during Phase 3, for 12 weeks, parents in the telehealth group received 2-h per week one-on-one behavioral training and coaching while the control group received 2-h per week in-person treatment (Marino et al., 2020) Results demonstrated a decrease in parent-reported stress related to child's challenging behaviors and improvements in their perception on how to manage these behaviors was seen in the telehealth group only (Marino et al., 2020). Another study examined the efficacy of parent implementation of early intensive behavioral intervention skills via telehealth using parent–child dyads, where one parent received the intervention and other parent was in the control group (Fisher et al., 2020). Similarly, to Marino et al., 2020, Fisher et al. (2020) found increases in correct implementation of skills for both work and play activities in the intervention group only. Lastly, Yi and Dixon (2021) investigated the differences between a 60-day ABA intervention with and without an Acceptance and Commitment Therapy (ACT) session during onboarding. After the onboarding meeting, parents completed five self-paced online lessons each followed by a VC consultation session with follow-up coaching based on the behavior management plan created for each family. Parents in the ACT group completed more lessons and progressed further in treatment compared to the control group but did not significantly differ on the knowledge they gained throughout the study (Yi & Dixon, 2021). All four studies reported that the parents indicated positive aspects of the telehealth intervention; some parents reported the telehealth intervention to be reasonable (Subramaniam et al., 2017), while the other studies who directly assessed social validity indicated high satisfaction with the delivery of the intervention through telehealth (Fisher et al., 2020; Marino et al., 2020; Yi & Dixon, 2021).

Other Intervention Programs Four other studies utilized telehealth to deliver other parent-mediated intervention programs (Gerow, et al., 2021a, b; Kuravackel et al., 2018; Pierson et al., 2021; Sivaraman et al., 2021). The Collaborative Model of Promoting Competence and Success (COMPASS) for Hope was delivered via VC; this program led to a reduction of problem behaviors for the children with ASD as well as a decrease in parent-reported stress and an increase in parent-reported competency (Kuravackel et al., 2018). Similarly, another study focusing on daily living skills examined parent coaching (prompting and feedback from therapist) for skill implementation based on individualized goals delivered via telehealth and found the intervention increased daily living skills in children with ASD; more specifically, increases in the amount of completed steps occurred for 10 out of the 12 individualized skills addressed by the intervention (across participants) (Gerow, et al., 2021a, b). However, one study conducted by Pierson et al. (2021) did not find results supporting the use of their intervention in increasing specific child outcomes. A modified dialogic reading intervention was implemented via telehealth with parent training and coaching components, requiring the parents to provide prompts after the child provided his or her response to comprehension questions (Pierson et al., 2021). Very limited changes were found in the behavior of the children receiving the intervention; therefore, the child outcomes were not indicative of the intervention being helpful. Parents reported the intervention to be socially valid and the complex nature of this multi-element intervention may account for the lack of increases in children's comprehension (Pierson et al., 2021). Lastly, the study conducted by Sivaraman et al. (2021), which may be one of the most applicable studies for the current time period, examined the efficacy of a telehealth implemented mask wearing training for children with ASD. Live coaching via VC was used to guide parents through graduated exposures with their child with ASD putting on and wearing a mask; other intervention components included behavior shaping techniques and contingent positive reinforcement (Sivaraman et al., 2021). By the end of the intervention, all children with ASD were able to wear a mask for 10-min (the target duration) and parents reported the intervention to be useful (Sivaraman et al., 2021). This study demonstrated that with guidance from a professional via telehealth, other treatment providers as well as parents can learn how to successfully teach a child with ASD to wear a mask.

Telehealth Participant: Interventionists/Staff/Teachers of Children and Adolescents with ASD

Seven studies implemented telehealth interventions with either interventionists, staff, and/or teachers who work with

individuals with ASD using a variety of VC platforms such as Skype, Zoom, Whatsapp, and VSee (Barkaia et al., 2017; D'Agostino et al., 2020; Gibson et al., 2010; Neely et al., 2016, 2018; Schlosser et al., 2020; Singh et al., 2021).

Behavior Interventions Four studies utilized behavioral interventions (D'Agostino et al., 2020; Neely et al., 2016, 2018; Singh et al., 2021). An incidental teaching training package taught remotely via VC to coaches and then interventionists, led to increased communication skills in the children with ASD and high fidelity in implementation (Neely et al., 2016, 2018). Naturalistic Developmental Behavior Intervention procedures, which incorporated self-paced online modules, intervention planning, and video self-evaluation, were taught to preschool practitioners and then sessions via VC which involved delayed performance feedback (D'Agostino et al., 2020); practitioners achieved intervention fidelity and children with ASD increased in communication behaviors which both generalized and maintained at follow-up. Lastly, Singh et al. (2021) implemented both a behavioral program (behavioral support plan) and mindfulness-based program (Soles of the Feet) via telehealth to reduce the number of self-injurious behaviors (SIB) three children with ASD were engaging in. Results yielded a reduction in SIB when the children received the Soles of the Feet intervention but not when they only received the behavior support plan (Singh et al., 2021). Acceptability was high for each intervention across all four studies (D'Agostino et al., 2020; Neely et al., 2016, 2018; Singh et al., 2021).

Functional Communication Training Teachers were also utilized to implement FCT via videoconferencing with a behavioral consultant (e.g., with modeling, roleplays, and feedback) to reduce the elopement of a child with ASD (Gibson et al., 2010). High fidelity in implementation as well as high satisfaction with the implementation procedures yields additional evidence that providers can be trained to implement FCT via telehealth (Gibson et al., 2010).

Social Communication Interventions Two studies focused on utilizing teachers to aid in increasing social communication skills for children with ASD through the use of telehealth (Barkaia et al., 2017; Schlosser et al., 2020). Schlosser et al. (2020) investigated whether a coaching-based intervention, the Visual Immersion System™ (VIS™), can be implemented successfully via telehealth. The school's interdisciplinary team received a workshop on VIS™ followed by biweekly VC sessions as well as in-between session communications via email or phone. Based on their primary outcome variable (goal attainment scaling) all participants improved individually based on their specified goals (overall made more progress on expressive language than receptive language goals) (Schlosser et al., 2020). Additionally, coaching via VC and telephone audio (via Viber) with a therapist was used to increase social attending and communication skills for a child with ASD (Barkaia et al., 2017). Both studies yielded high treatment acceptability and children benefited from increases in targets skills, which further supports the use of telehealth as a means to deliver social communication based interventions with children with ASD (Barkaia et al., 2017; Schlosser et al., 2020).

Telehealth Participant: Parent AND Teacher of Children with ASD

Two studies utilized both parents and teachers, together, to implement interventions for children with ASD. Specifically, one study utilized both a parent and special education teacher to increase social communication behaviors (e.g., requesting, attending) in children with ASD; after in-person baseline assessments and initial training of the Sunny Starts Program, described earlier, communication and intervention sessions were conducted via telehealth (Guðmundsdóttir et al., 2017). Target child behaviors increased during intervention and follow-up phases (Guðmundsdóttir et al., 2017). A second study used parent-teacher consultations through the use of the Collaborative Model of Promoting Competence and Success (COMPASS) to examine the effects of web-based coaching compared to in-person coaching and a control condition (Ruble et al., 2013). There were no differences of overall change across goal domains for either the web-based or in-person group, which demonstrates that coaching via telehealth is effective (Ruble et al., 2013).

Overall, the use of telehealth, specifically videoconferencing and coaching, has been found to be a feasible and satisfactory means to deliver a variety to interventions to children and adolescents with ASD. Of the intervention articles included in this review, three studies were directly and/or indirectly impacted by the COVID-19 pandemic in some way (e.g., data collection, social validity questionnaire results) and provide even more support for the use of telehealth as a means to deliver treatment effectively to children with ASD (Cihon et al., 2021; Gerow, et al., 2021a, b; Yi & Dixon, 2021). Additionally, as indicated earlier, one study focused on an intervention for mask wearing, which is still currently and vitally important (Sivaraman et al., 2021). Parents and teachers were the direct recipient of the telehealth coaching and guidance in 43 out of 47 studies included in the intervention section; this demonstrates that parents and teachers continue to be necessary facilitators of interventions for children with ASD. Lastly, five studies directly compared telehealth interventions to in-person interventions (Baharav & Reiser, 2010; Kuravackel et al., 2018; Lindgren et al., 2016; Marino et al., 2020; Ruble et al., 2013). Results of four studies yielded no differences between intervention groups in the measured variables (e.g., reduction in problem

behavior, increase in communication skills) indicating that telehealth may be just as beneficial a treatment medium as in-person services (Baharav & Reiser, 2010; Kuravackel et al., 2018; Lindgren et al., 2016; Ruble et al., 2013). The study conducted by Marino and colleagues found that parent stress decreased in the telehealth group (had VC coaching) but not the control group, which further supports the use of telehealth as a means to deliver intervention to children with ASD.

Discussion

The present systematic review sought to explore the literature on telehealth services for individuals with ASD that has been published in the last decade. The 55 telehealth articles examined the types of services and the clinical and implementation outcomes. A range of services were provided via telehealth modalities for assessment (i.e., diagnostic assessments, preference assessments, functional assessments, and speech and language assessments) and treatment (i.e., behavior management, functional communication training, applied behavioral, social communication interventions, and other targeted interventions). The majority of studies (3 assessment and 34 treatment) focused on the parent as the direct recipient of the telehealth intervention. Furthermore, the outcomes from the majority of the studies suggested that the use of telehealth services is possibly equivalent to in-person services or at least superior to control groups. This finding is in line with the previous reviews conducted by Boisvert et al. (2010) and Sutherland et al. (2019).

Despite the last systematic review being relatively recent, there has been a large increase in the number of telehealth research articles produced since publication. The previous systematic review found only 14 articles with eligible studies and an addition 41 studies have emerged that met eligibility. This sharp increase indicates both a shift in the acceptability and implementation of telehealth modalities for individuals diagnosed with ASD as well as a direct response to the consequences of the COVID-19 pandemic. We were able to extend the findings from the previous review in terms of delivery methods and types of services. Since the last review in 2018, the types of intervention and assessment services has grown, which ultimately has increased the need to review and evaluate the literature. Research examining the use of telehealth allows for intervention and assessment services to be provided in equivalence or in conjunction with in-person services.

The findings here are relevant to the implementation of mental health services for individuals with ASD. The majority of the studies included in the review focused on the implementation of intervention services for children and parents, such as communication skills, parent training, cognitive behavioral therapy for anxiety, and ABA. These evidence-based treatments have been the gold standards for in-person interventions. The increase in literature examining the services via telehealth allows for clinicians to target individuals who may not have access to in-person services, such as those suffering from a lack of service providers, or those from lower socioeconomic status or underrepresented racial and ethnic minorities (Pickard et al., 2019). Additionally, with the risk associated with the COVID-19 pandemic, the ability to apply evidence-based treatment services to a telehealth modality is even more essential. Studies that have focused on the implementation of telehealth have continued to find promising results in changes in outcomes for children with ASD as well as the social validity of telehealth (e.g., feasibility, acceptability, satisfaction).

It is important to also consider the access to technology, internet, and/or equipment used across telehealth studies. All of the studies in this review commented on the different telehealth platforms and equipment utilized by both the individual providing the coaching and the participant receiving the telehealth intervention. Twenty-one out of the 55 studies, indicated that they would be able to provide the equipment necessary for the families to participate in their studies (Baharav & Reiser, 2010; D'Agostino et al., 2020; Fisher et al., 2020; Gerow et al., 2021a, b; Hepburn et al., 2016; Ingersoll et al., 2016; Ingersoll & Berger, 2015; Lindgren et al., 2016; Machalicek et al., 2016; McCrae et al., 2020; Meadan et al., 2016; O'Brien et al., 2021; Pickard et al., 2016; Schieltz et al., 2018; Simacek et al., 2017; Subramaniam et al., 2017; Suess et al., 2014, 2020; Vismara et al., 2012, 2013). This may have allowed for more families to participate who may not have had access to the technology required. There were ten additional studies that used telehealth centers, clinics, or schools that already had the equipment necessary for participation (Ausenhus & Higgins, 2019; Corona et al., 2021; Higgins et al., 2017; Machalicek et al., 2009, 2010; Neely et al., 2016, 2018; Suess et al., 2016; Sutherland et al., 2019; Wacker et al., 2013). However, the 24 remaining studies (43%) either indicated that participants utilized their own technology and equipment, or the study required (as inclusion criterion) access to technology (e.g., desktop computer, laptop, webcam) and internet. This may have limited the number of families who were able to participate in these particular studies; it is advantageous to be able to help provide the necessary technology to be all-inclusive in who can participate.

Furthermore, only two studies which focused on the diagnostic assessment of children with ASD via telehealth used participants with a current ASD diagnosis (an inclusion criterion of this review). The initial literature search yielded more than 8 studies exploring the diagnostic assessment of ASD, but upon further examination, these studies primarily used children who were "at risk" for ASD or researchers

used standardized assessment procedures during the course of the study as corroborating evidence for diagnostic accuracy since the participants were not initially enrolled with a current ASD diagnosis (Juárez et al., 2018; Smith et al., 2017). Interestingly, only one used standardized ASD assessments (i.e., ADOS, ADI-R; Lord et al., 2002) to determine their efficacy in accurately assessing ASD over telehealth (Reese et al., 2013) and one used other measures (e.g., TELE-ASD-PEDS) to accurately diagnosis via telehealth (Corona et al., 2021). More studies need to be conducted examining the efficacy of utilizing standardized ASD assessment measures (e.g., ADOS-2), which are widely used to diagnosis ASD in-person, with participants with established diagnoses to accurately inform their accuracy and use via the telehealth medium. Despite this, the diagnostic studies included in the systematic review provide insight on the ability to remotely deliver important services. Individuals living in rural areas or who are below the poverty line are diagnosed with ASD at much slower rates and at later ages (Antezana et al., 2017). The ability to provide evidence-based services to diagnose ASD via telehealth modalities can potentially reduce the service disparity experienced among this population. Further replication and more studies that examine the use of standardized measures of ASD would further solidify the use of telehealth to accurately diagnosis ASD.

A variety of interventions (e.g., ABA, FCT, social communication) were found to be successfully delivered through videoconferencing platforms and lead to specific child-related outcomes such as reductions in problem behaviors or increases in social communication skills. The majority of intervention studies utilized free, cost-effective telehealth platforms (e.g., Zoom, Skype) while only one used a specific videoconferencing software at regional clinics and a teleconsultation center (Wacker et al., 2013). The results yielded from this review provides evidence that telehealth can be a medium to deliver pertinent services to children with ASD.

Limitations and Future Directions

While the current review and state of the literature is encouraging of the use of telehealth in those with ASD, there understandably remain a number of limitations. First, the review does not include unpublished work, which may further benefit the scope of telehealth for individuals with ASD. Although there were two authors reviewing the articles for criteria to ensure reliability, there may be appropriate articles that were missed in the process due to the inclusion criteria that was set. Additionally, due to the COVID-19 pandemic, there has been a recent increase in the use of telehealth services for both intervention and assessment services for individuals with ASD. However, the current review only dates to March 2021 to provide insight on the scope of established telehealth services being implemented prior to the pandemic.

Additional research would be beneficial to explore variations and success rates among providers utilizing technology for services with individuals with ASD during the COVID-19 pandemic, as many of the articles published within the last year did not mention the impact of COVID-19 on their study. Only three studies, indicated how they were effected by the COVID-19 pandemic and only one study described the adjustments they made (Yi & Dixon, 2021).

Additionally, research focusing on providing intervention and assessment services to individuals with ASD and other comorbid disorders is also lacking, there was only one study focusing on comorbid anxiety in children with ASD (Hepburn et al., 2016). Without further exploring the utility of telehealth services in comorbid disorders, these services would not be applicable to many individuals with ASD. Future research should explore the use of telehealth intervention and assessment services with individuals with comorbid disorders. Even though the studies reviewed were largely amenable to implementation via telehealth, it remains to be seen if the full range of ASD presentations can be adequately accommodated and adapted to this modality. Depending on the severity of an individual's presentation, it may also be necessary to consider the safety of individuals on the other end of the platform (e.g., safely addressing challenging behaviors like aggression and self-injury without the safety of trained personnel to handle extinction bursts, etc.). Here, good telehealth practices are important as adequate safety plans and emergency procedures should be created and reviewed in advance. Licensure laws and state regulations also require consideration. It is imperative that practitioners stay current with guidelines involving practicing over great distances and possibly even state/national boundaries. As well, an informed risk vs. benefit calculation must be conducted by both the patient and the practitioner going forward given the frequency with which we see data breaches, 3rd party sharing of information by tech companies, and accidental (and sometimes unfortunately malicious) video "bombing" of uninvited participants joining/disrupting sessions. Finally, while more studies have explored participant satisfaction, cost, and acceptability since the previous review, these factors should continue to be explored to ensure the feasibility of telehealth for the families and individuals with ASD. Along these lines, telehealth interventions should move beyond merely mirroring in-person services (e.g., offering typical manualized CBT for anxiety as practiced in-person). Researchers should investigate specialized techniques and procedures which may yet need to be developed (as opposed to just adaptations of existing treatments) and alterations may be

desirable to maximize treatment effects specifically via a telehealth platform. As well, every effort should be made to be sure results obtained via telehealth generalize to other "real-world" situations beyond electronic screens.

Conclusion

Telehealth services for individuals with ASD has begun to emerge as a useful tool for assessment and intervention services relevant to mental health services. With advances in technology and the recent need for telehealth as a result of the COVID-19 pandemic, the literature examining the uses and feasibility of telehealth has greatly increased. The current review suggests there are many uses for telehealth in terms of providing assessment, intervention, and training that benefit individuals or families of individuals with ASD. Modifications to treatment and assessment for individuals with ASD has been found to be successful for in-person services, which may also be beneficial for services provided via technology. Modifications that may be beneficial include using more concrete skills, visual tactics, child-specific interests, and parental involvement (Moree & Davis, 2010). Further research is needed, however, to determine the success of these modifications via telehealth, as well as any additional uses of telehealth with individuals with ASD.

Declarations

Conflict of interest The authors have no conflict of interest to declare.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standard. Informed consent was obtained from all individual participants included in the study.

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