Examining implementation of the Extension for Community Healthcare Outcomes (ECHO) model to train clinicians on best-practice care for autism

Kaela Amorim
Integrated Program in Neuroscience, McGill University, Montreal
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Abstract (English)

Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder that's diagnosis and treatment is often complicated by its heterogeneous presentation, along with commonly co-occurring conditions. Current training opportunities in ASD for healthcare providers are often inadequate at preparing them to work with this population. This inadequacy likely contributes to barriers to healthcare for individuals with ASD such as insufficient knowledge and competence of healthcare providers regarding the topic of ASD. The Extension for Community Healthcare Outcomes (ECHO) model was developed to provide healthcare providers with additional training. This model has been used to provide training on ASD to healthcare providers (ECHO-Autism), and has been shown to lead to increases in knowledge and self-efficacy in participants. The objective of this thesis was to explore a novel implementation of ECHO-Autism, using Moore's CME Evaluation Framework. This framework highlights important outcome measures to be assessed (such as Participation, Satisfaction, Learning, Competence, and Performance).

Methods: This ECHO-Autism program consisted of seven sessions on the topic of medical and neurodevelopmental conditions in ASD and took place over a four-month period. Twenty-two healthcare providers from various professions participated in this study. Surveys were administered before the beginning of the ECHO program to capture participants' baseline knowledge and perceived self-efficacy scores. After completion of the program, participants completed surveys assessing satisfaction, knowledge, perceived self-efficacy, and changes to practice behaviour.

Results: Participants reported high satisfaction with the program after its completion. Additionally, significant increases to scores on the knowledge and perceived self-efficacy surveys were found from pre- to post-ECHO. However, there was no longer a significant increase in scores on the Knowledge Survey when controlling for years of experience working with individuals with ASD.

Discussion: Based on the outcomes examined in this study, ECHO-Autism was shown to be a successful training program. Additionally, the results highlight that this training model has the

potential to reduce common barriers to best-practice care for individuals with ASD, such as inadequate training for healthcare providers, along with a reported lack of provider knowledge and competence. Further research should be done to compare ECHO-Autism to more established training methods, and to examine the other outcomes associated with Moore's CME Evaluation Framework.

Abstract (French)

Contexte : Les troubles du spectre autistique (TSA) sont des troubles du développement neurologique qui sont souvent compliqués par leur présentation hétérogène, ainsi que par des affections souvent concomitantes. Les possibilités actuelles de formation sur les TSA pour les prestataires de soins de santé ne sont pas suffisantes, ce qui contribue probablement au manque de connaissances et de compétences des prestataires de soins de santé en ce qui concerne les TSA. Le modèle ECHO (Extension for Community Healthcare Outcomes) a été développé pour offrir aux prestataires de soins de santé une formation complémentaire. Ce modèle a été utilisé pour fournir une formation sur les TSA (ECHO-Autism), et c'était démontré qu'il permettait d'augmenter les connaissances et les compétences, ce qui est généralement mesuré à l'aide de mesures de l'auto-efficacité perçue. L'objectif de cette thèse est d'explorer une nouvelle mise en œuvre de l'ECHO-Autisme en utilisant le cadre d'évaluation de la FMC de Moore, qui fournit d'importantes mesures de résultats à évaluer (telles que la participation, la satisfaction, l'apprentissage, la compétence et la performance).

Méthodes : Un programme ECHO-Autisme comprenant sept séances sur les conditions médicales et neurodéveloppementales des TSA a été mis en œuvre sur une période de quatre mois. Vingt-deux professionnels de la santé de diverses professions ont participé à cette étude. Des questionnaires ont été administrés avant le début du programme ECHO afin de recueillir les connaissances de base et les scores d'auto-efficacité perçue. À l'issue du programme, les participants ont répondu à des enquêtes évaluant la satisfaction, les connaissances, l'auto-efficacité perçue et les changements de comportement dans la pratique.

Résultats : Les participants se sont déclarés très satisfaits du programme. En outre, des augmentations significatives des scores des enquêtes sur les connaissances et l'auto-efficacité perçue ont été constatées entre les moments de pré-évaluation et de post-évaluation. Des tests post-hoc ont montré qu'il y avait toujours une augmentation significative des scores de l'enquête sur l'auto-efficacité perçue lorsque l'on contrôlait le nombre d'années d'expérience de travail avec les TSA ; cependant, il n'y avait plus d'augmentation significative des scores de l'enquête sur les connaissances.

Discussion : Cette thèse a exploré la mise en œuvre d'un nouveau programme ECHO-Autism en utilisant les résultats liés au cadre d'évaluation de la FMC de Moore. Il a été constaté qu'à travers les résultats examinés, ECHO-Autism s'est avéré être un programme de formation réussi. En outre, les résultats sont susceptibles d'aider à réduire les obstacles identifiés aux meilleures pratiques de soins pour les personnes atteintes de TSA, tels que la formation inadéquate des prestataires de soins de santé, ainsi que le manque signalé de connaissances et de compétences des prestataires. D'autres recherches devraient être menées pour comparer ECHO-Autism à des méthodes de formation plus établies et pour examiner les autres résultats associés au cadre d'évaluation de la FMC de Moore.

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Contribution of Authors

Kaela Amorim was the author of this thesis. She contributed to the conceptualization, data collection, data analysis, interpretation of results, and writing. Dr. Myriam Beauchamp contributed to conceptualization and editing. Dr. Mayada Elsabbagh and Dr. Julie Scorah supervised each aspect of the project.

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List of Abbreviations

ASD = Autism Spectrum Disorder

ECHO = Extension for Community Healthcare Outcomes

NDD = Neurodevelopmental Disorder

Statement of Problem

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental disorder, characterized by restricted, repetitive behaviours and social-communication challenges (American Psychiatric Association, 2013). Core features associated with ASD include difficulties with social-emotional reciprocity, forming and understanding relationships, challenges with changes in routines and sensitivity to sensory stimuli (American Psychiatric Association, 2013). The median prevalence of ASD worldwide is estimated to be approximately 1/100 (Zeidan, 2022), with co-occurring conditions also commonly present in these individuals. The prevalence of co-occurring psychiatric disorders (i.e. attention-deficit/hyperactivity disorder, sleep disorders, mood disorders, etc.) is reported to be 54.8-94% (Hossain et al., 2020), indicating that the majority of individuals with ASD also present with at least one co-occurring psychiatric disorder. Moreover, individuals with ASD have high rates of co-occurring non-psychiatric disorders such as epilepsy (22%), infections (23%), and hearing impairments [19%; (Vohra, 2017)]. The presence of co-occurring disorders can make diagnosing and treating ASD more difficult as it can lead to increased variability of ASD symptoms and may negatively affect developmental trajectories (El Achkar & Spence, 2015; Hus & Segal, 2021).

Due to the complexity associated with diagnosing and treating ASD, providing best practice care requires professional training specific to this population. The Extension for Community Healthcare Outcomes (ECHO) model serves as a promising method to provide clinicians with further training and to increase knowledge and competence (Arora et al., 2007; Zhou et al., 2016). This model offers virtual training consisting of didactic and case-based learning, along with connecting professionals to each other Arora et al., 2007). While the ECHO model has been applied to several health conditions, it has only more recently been used to provide training relating to autism (Mazurek et al., 2017).

Using Moore's Continuing Medical Education (CME) Evaluation Framework, which measures outcomes such as changes to provider knowledge and competence (Moore et al., 2009), this project will add to the growing body of literature on ECHO-Autism. This project will aim to explore outcomes associated with participation in a novel ECHO-Autism program, with

program content created by our ECHO-Autism team, using Moore's CME Evaluation Framework to determine which outcomes to assess.

Background

There are several factors that make the diagnosis of ASD challenging, one of which being that it is based on observable behaviour (Lord et al., 2018). Therefore, the clinical judgement of individual healthcare providers must be relied on to diagnose ASD (Hus & Segal, 2021). Making these judgements can be difficult as symptoms of ASD overlap with symptoms of other common disorders such as Attention Deficit and Hyperactivity Disorder (ADHD) and developmental language disorder (Hus & Segal, 2021). However, as there are currently no reliable biomarkers for ASD, we must continue to rely on observable behaviour for diagnosis (Lord et al., 2018).

Furthermore, because ASD is a heterogeneous disorder, optimal treatments should be tailored to individual needs (Klinger et al., 2021). However, there is little evidence regarding which treatments are ideal for which individuals with ASD. Small sample sizes in intervention studies and limited variation of ASD presentation in study participants contribute to restricting the generalizability of this research (Klinger et al., 2021; Lord et al., 2020). The treatment of ASD can also be further complicated by co-occurring neurodevelopmental and psychiatric conditions [speech and/or language disorders, Attention-Deficit/Hyperactivity Disorder (ADHD), sleep disorders, genetic disorders, etc.], as well as medical conditions (gastrointestinal disorders, sleep problems, seizures, etc.). The complexities caused by co-occurring disorders can then contribute to barriers to healthcare for this population, such as inadequate clinician knowledge (Atun-Einy & Ben-Sasson, 2018; Morris et al., 2019).

Co-occurring conditions can have significant impacts on overall health, quality of life, and healthcare access (Bauman, 2010). Clinical presentations may also differ when a co-occurring condition is present with ASD (El Achkar & Spence, 2015; Forman et al., 2022; Hus & Segal, 2021). Therefore, it is important that these individuals have access to healthcare professionals with the specific knowledge and skills necessary to provide effective treatment. For example, epilepsy is a disorder that frequently co-occurs with autism. It is estimated that

epilepsy is present in 23% of individuals with ASD compared to just 4.8% of the general population (Vohra et al., 2017). When epilepsy co-occurs with ASD, it leads to increased risk of cognitive and behavioural deficits thus requiring more specialized care, which some healthcare professionals may not be able to provide (El Achkar & Spence, 2015). The presence of seizures has been shown to negatively affect developmental trajectories of individuals with ASD, leading to more difficulties with improving skills in categories such as receptive language, expressive language, sensory awareness, and health across time when compared to individuals with ASD and no seizures (Forman et al., 2022). Additionally, anti-epileptic drug treatments can potentially worsen symptoms in areas that individuals with ASD often struggle with, such as communication, behaviour, attention, mood, and sleep (Frye et al., 2013). The difficulties associated with providing healthcare to individuals with ASD, especially when a co-occurring disorder is present, can lead to barriers to accessing healthcare for this population.

Identifying and treating co-occurring conditions can be complicated by challenges with communication skills which are a symptom of ASD, and can be further complicated among the subgroup of individuals with ASD who have sensory sensitivities (Bauman, 2010). Difficulties with communication may make obtaining a detailed medical history challenging, while sensory sensitivities may prevent individuals from completing a thorough physical exam (Bauman, 2010). For example, gastrointestinal (GI) disorders are a co-occurring medical condition commonly seen in individuals with ASD (Madra et al., 2020). Yet, GI disorders are very difficult to identify in individuals with ASD as they often do not present with typical indicators of GI distress (Madra, 2020). Neurotypical patients with GI distress will usually verbalize their complaints and identify the source of their discomfort to their physician, whereas communication difficulties and atypical sensory perception make this difficult for some individuals with ASD (Bauman, 2010; Hus & Segal, 2021; Madra et al., 2020). Additionally, individuals with ASD may find it challenging to complete the testing necessary to diagnose certain conditions (i.e. MRI's, blood draws, etc.) for various reasons, including sensory sensitivities (Davit et al., 2011; Stogiannos et al., 2022). Appropriate interventions are required for these individuals, but, due to potential challenges obtaining diagnoses, they can be difficult to access.

A lack of professional competence among healthcare professionals caring for individuals with ASD is often a barrier to healthcare for this population (Malik-Soni et al., 2022; Sing & Bunyak, 2018). Recent scoping reviews on healthcare providers' experiences with ASD found inadequate knowledge regarding best practice care for these patients to be a recurring theme (Beauchamp et al., 2022; Morris et al., 2019). Healthcare providers often report that they lack specialized knowledge in ASD and experience difficulties providing comprehensive care due to the complexity and heterogeneity of clinical presentations among individuals on the spectrum, although many report a desire for increased knowledge relating to ASD (Beauchamp et al., 2022; Malik-Soni et al., 2022; Mazurek et al., 2020a; Morris et al., 2019). Although higher years of experience is associated with stronger ASD knowledge, even professionals who are experienced working with individuals with ASD have demonstrated gaps in their knowledge of the disorder (Atun-Einy & Ben-Sasson, 2018). One specific topic that experienced professionals have been shown to require further knowledge on is early ASD markers (Atun-Einy & Ben-Sasson, 2018). Inadequate knowledge on this topic is particularly concerning as it can lead to delays in diagnosis, and thus delays in receiving treatment. The need for physicians to improve their knowledge to provide better quality care is also reported by individuals with ASD and their families/caregivers (Malik-Soni et al., 2022).

In order for healthcare providers to improve their knowledge and competence relating to ASD, high quality training opportunities are required. As the number of individuals with ASD increases, the number of clinicians with sufficient training and expertise to care for these individuals has not growing at the same rate (Canadian Academy of Health Sciences, 2022). The need for more information and training regarding ASD often reported by healthcare professionals, underscores that many current training and continuing education programs are not sufficient and may negatively impact physicians ability to care for this population (Ghaderi & Watson, 2019; Morris et al., 2019; Penner, et al. 2017). Moreover, even when healthcare providers do partake in traditional training opportunities (e.g., attending conferences, workshops, etc.), these opportunities are sometimes found to be "too general" and do not always represent clinical cases (Ghaderi & Watson, 2019). Gardner and colleagues (2016) found that the majority of nursing faculty members do not feel prepared to teach their students how

to care for individuals with ASD and almost half do not dedicate any class instruction time to teaching about ASD. This is not surprising as many of these faculty members reported not having strong ASD knowledge, feeling uncomfortable providing care to individuals with ASD, or receiving no ASD training themselves (Gardner et al., 2016). An increase in educational opportunities and professional development for clinicians, along with bringing together diverse clinicians to create professional networks, is necessary to improve healthcare for individuals with ASD (Canadian Academy of Health Sciences, 2022). Given to reported issues related to training in healthcare professionals working in ASD, a new method of providing more specific and relevant ASD-related training is warranted.

The Extension for Community Healthcare Outcomes (ECHO) model is a potential solution to the aforementioned challenges to caring for individuals with ASD caused by inadequate training opportunities. It is a telemedicine and distance-learning based program that aims to increase training opportunities for healthcare providers and to build professional networks (Arora et al., 2007). The ECHO model was initially developed to improve patient care by increasing the competence of primary care providers (PCPs; including primary-care physicians, nurse practitioners, physician assistants, and pharmacists) in underserved areas by providing them with additional training towards the management of complex conditions (Arora, et al., 2007). Project ECHO offers virtual training to healthcare providers in an effort to remove barriers from participation that may be associated with other methods of training [i.e. cost, geographical proximity, etc.; (Arora et al., 2016)]. Participation only requires the internet or telephone service, thus clinicians from any location may participate thereby increasing the quality of care for patients across geographic regions (Arora et al. , 2007).

Project ECHO was originally founded to improve care for patients with hepatitis C in New Mexico. Arora and colleagues developed this program as New Mexico has limited healthcare resources, especially in prisons and rural locations, where 32 of 33 counties were described as being medically underserved (Arora et al., 2007). The goal of the project was originally to train PCPs to provide specialized care to those in prisons or underserved areas where specialists are inaccessible (Arora et al., 2007). In 2005 alone, two-years after the first

ECHO clinic took place, over 1500 patients were able to receive hepatitis C care from ECHO participants (Arora et al., 2007).

The ECHO model has now been used for a variety of conditions in over 10 countries (Arora et al., 2016; Zhou et al., 2016). ECHO uses case-based educational experiences to train clinicians. Sessions consist of co-management of cases with specialists, group case-management, and brief didactic presentations on topics pertaining to the condition of interest (Arora, et al., 2007). Since its development, the ECHO model has been shown to increase professional knowledge and improve patients' access to healthcare (Zhou et al., 2016).

In 2016, the ECHO model was piloted for ASD (Mazurek et al., 2017). As ASD is a complex condition in which scientific evidence is rapidly changing, the flexibility of the ECHO model makes it is a suitable approach to provide continued training on the topic (Mazurek et al., 2017). Additionally, the ECHO model connects healthcare providers to experts across many disciplines working in the field of autism. Thus, participants are able to easily access the latest evidence and recommendations directly from the experts. Research on the ECHO-Autism program has focused largely on outcomes such as changes to participant self-efficacy [i.e., an individual's perception of their skills; (Bandura, 1982)], clinical knowledge, and practice behaviour [healthcare providers behaviours in clinical settings; (Sengupta et al., 2022)].

To help determine which outcomes are important to assess and how to assess them when evaluating ECHO programs, Moore's Continuing Medical Education (CME) Evaluation framework [Table 1; (Moore et al., 2009)] can been used. This framework was developed by Moore and colleagues (2009) as a conceptual model to assist with planning and assessment of CME activities (Moore et al., 2009). Multiple published papers on ECHO have selected their outcomes based on Moore's CME evaluation framework (Panda et al., 2022; Zhou et al., 2016).

Table 1. Moore's CME Evaluation Framework adapted from Zhou and colleagues (Zhou, 2016)

CME Framework	Level	Description
Participation	1	The number of healthcare providers who participated in a CME program
Satisfaction	2	The degree to which the expectations of the participants about the setting and delivery of a CME program were met

Learning	3	The degree to which participants could demonstrate that they have gained the knowledge that the CME program intended for them to have gained (includes both declarative and procedural knowledge)
Competence	4	The degree to which participants could show in an educational setting that they have learned the skills the program intended for them to learn (includes perceived self-efficacy/self-confidence)
Performance	5	The degree to which participants could show that they are able to translate what they learned at the CME activity into practice
Patient Health	6	The degree to which the health status of patients improved due to changes in the practice behaviour of participants
Community Health	7	The degree to which the health status of a community of patients changed due to changes in the practice behaviour of participants

Since the first ECHO-Autism study was published by Mazurek and colleagues in 2017, the amount of research on this program has been growing. Moore's CME Evaluation Framework can be used to summarize the results of ECHO-Autism studies, as previously done for ECHO studies on other topics (Table 2; Panda et al., 2022; Zhou et al., 2016). Many ECHO-Autism studies have examined outcomes associated with the first five levels of Moore's CME Evaluation Framework.

Table 2. Summary of results from previous ECHO-Autism studies in relation to Moore's CME Evaluation Framework

CME framework	Level	Results
Participation	1	Studies have reported high attendance (Mazurek et al., 2020; Nowell et al., 2020; Sengupta et al., 2022)
Satisfaction	2	High levels of satisfaction with the program (Mazurek et al., 2017; Mazurek et al., 2020b; Dreiling et al, 2022; Sengupta et al., 2022)
Learning	3	Increases in participant knowledge has been reported in some ECHO-Autism studies (Mazurek et al., 2020a, Nowell et al., 2020, Dreiling et al., 2022; Sengupta et al., 2022), but not others (Mazurek et al., 2020b)
Competence	4	Across studies, participants demonstrate increases to self-efficacy after participation in ECHO-Autism (Mazurek et al., 2017; Mazurek et al., 2020b; Mazurek et al., 2020a; 39, Nowell et al., 2020; Gianchetto et al., 2019; Dreiling et al., 2022; Sengupta et al., 2022)
Performance	5	Changes to practice behaviour has been reported in numerous ECHO-Autism studies (Mazurek et al., 2017; Mazurek et al., 2020b; Mazurek et al., 2019; Bellesheim et al., 2020; Sengupta et al., 2022) One study reported that participants did not demonstrate statistically significant improvements to evaluated practice behaviours (Mazurek et al., 2020a)

Patient Health	6	N/A
Community Health	7	N/A

Level 1 Participation. Participation refers to the number of participants in a CME program (Moore et al., 2009), measured from attendance records (Moore et al., 2009). In ECHO-Autism studies that report this, levels of attendance were found to be high with participants attending the majority of sessions (Mazurek et al., 2020b; Nowell et al., 2020; Sengupta et al., 2022).

Level 2 Satisfaction. Satisfaction data is typically based on a questionnaire after completion of the CME program (Moore et al., 2009). ECHO-Autism programs often use a survey developed by Mazurek and colleagues (2017) with ten questions rated on a 5 point-Likert scale: "strongly agree" indicating high satisfaction and "strongly disagree" indicating low satisfaction (Dreiling et al., 2022; M. O. Mazurek et al., 2017; Mazurek et al., 2020c; Sengupta et al., 2022). High satisfaction with the program has been consistently reported (Dreiling et al., 2022; Mazurek et al., 2017; Mazurek et al., 2020c; Sengupta et al., 2022).

Level 3 Learning. The third level is described as the participants' ability to demonstrate that they have gained the knowledge that the CME program intended for them to have gained at its completion; this category can be further divided into procedural knowledge (e.g., participants know how to do what the program planned for them to know what to do) and declarative knowledge [e.g., participants know what the program planned for them to know; (Moore et al., 2009)]. The majority of ECHO-Autism studies evaluating knowledge developed their own knowledge survey tailored to the topics covered by their specific ECHO program (Dreiling et al., 2022; Mazurek et al., 2020b; Mazurek et al., 2020c), while others used knowledge surveys developed by Mazurek and colleagues for previous ECHO-Autism programs (Nowell et al., 2020; Sengupta et al., 2022). Most ECHO-Autism studies report significant increases in participant knowledge as a result of participation (Dreiling et al., 2022; Mazurek et al., 2020b; Nowell, 2020; Sengupta, 2022). However, Mazurek and colleagues (2020c) reported a slight increase that was not statistically significant (Mazurek et al., 2020c).

Level 4 Competence. Competence is described as participants' abilities to demonstrate in an educational setting that they have learned the skills the program intended for them to

learn (Moore et al., 2009). This level also includes self-efficacy. Changes to Competence have been measured by the majority of ECHO-Autism studies by way of a self-report self-efficacy survey (Primary Care Autism Self-Efficacy survey) developed by Mazurek and colleagues [2017; (Mazurek, et al., 2019; Nowell et al., 2020)], or an adapted version (Dreiling et al., 2022; Mazurek et al., 2020b; Mazurek et al., 2020c; Sengupta et al., 2022). Giachetto and colleagues developed their own self-efficacy survey using the same format (Giachetto et al., 2019). Across all studies, participants demonstrate significant increases to score on self-efficacy surveys after participation in ECHO-Autism regardless of the questionnaire used to measure it (Dreiling et al., 2022; Giachetto et al., 2019; Mazurek et al., 2019; Mazurek et al., 2020b; Mazurek et al., 2020c; Nowell et al., 2020; Sengupta et al., 2022).

Level 5 Performance. Level 5 refers to participants' abilities to show that they are able to translate what they learned at the CME activity into practice (Moore et al., 2009). Level 5 can be measured objectively though observation of performance in a clinical setting or subjectively through participants' self-report of their clinical performance (Moore et al., 2009). ECHO-Autism studies have measured changes to "practice behaviour" using a variety of methods. Two studies used self-report surveys asking participants whether they made changes to their practice behaviour due to participation in ECHO-Autism and found significant improvements (Mazurek et al., 2020c; Sengupta et al., 2022). Three studies collected data on practice behaviour from participants reporting on the their use of screening tools, all of which found a significant increase in use from pre- to post-ECHO (Bellesheim et al., 2020; Mazurek et al., 2017; Mazurek et al., 2019). In contrast to these findings, one large scale multi-site study by Mazurek and colleagues (2020b) reported that participants did not demonstrate statistically significant improvements in practice behaviours (Mazurek et al., 2020b).

Level 6 Patient Health. Patient Health refers to changes in patient health due to participants' changes in practice behaviour (Moore et al., 2009). Patient charts or administrative databases (objective) or patient self-report regarding health status (subjective) are methods of measuring this level (Moore et al., 2009). Previous ECHO-Autism studies have not reported on changes to Patient Health.

Level 7 Community Health. This last level assesses whether the health status of a community changes due to changes in participants' practice behaviour (Moore et al., 2009). Sources of data for level seven include epidemiological reports (objective) and community self-report [subjective; (Moore et al., 2009)]. Changes to Community Health have not been reported by any ECHO-Autism studies.

As ECHO-Autism programs become more common, additional research on outcomes associated with their implementation becomes necessary. Furthermore, there is conflicting information about whether participation in ECHO-Autism leads to significant increases in knowledge for participants or changes to practice behaviour, which warrants further investigation.

Aims and Hypotheses

The aim of this thesis was to conduct exploratory analyses evaluating the implementation of a new ECHO-Autism program in Quebec on the topic of co-occurring medical and neurodevelopmental conditions with ASD, as measured by Moore's CME Evaluation Framework. Specifically, we assessed levels one through five of the framework (Participation, Satisfaction, Learning, Competence, Performance).

Based on the ECHO-Autism literature, it was hypothesized that there would be significant increases in scores on the knowledge and self-efficacy surveys from pre- to post-ECHO. Additionally, we expected to find high attendance and satisfaction with the program, along with reported changes to practice behaviour.

Methods

Participants and Setting

Participants to the ECHO-Autism program were recruited through general advertising [e.g., networks, and professional associations, Neuro Website, social media (Facebook, LinkedIn, Twitter), and mailing list] connected with our clinical team led by Dr. Julie Scorah. Sessions were also advertised to key clinician contacts at other hospitals in the Montreal area (McGill University Health Centre, Douglas Mental Health University Institute, CHU Sainte-

Justine, and Jewish General Hospital). Participants were mainly recruited in Quebec. However, as this was a virtual training opportunity, participants were not excluded if they were based outside of Quebec.

Participants were included in the ECHO-Autism program if they worked or were training in a relevant clinical field (e.g., psychology, medicine, nursing, etc.) with a focus on patients with neurodevelopmental disorders and/or autism. Examples of roles that were excluded include researchers, parents, and teachers. We aimed to have 35-40 participants for the ECHO-Autism program. This number was considered to be optimal as it would facilitate discussion during sessions and provide unique perspectives but was also few enough to ensure that everyone would have the opportunity to participate within the allotted session time. A total of 63 individuals applied to take part in the ECHO-Autism program and 38 were accepted. The 25 individuals who were excluded were not healthcare providers or healthcare providers in training, thus did not meet our inclusion criteria.

All participants accepted into the ECHO-Autism program were then invited to participate in the study (although they did not have to participate in the study to attend the program). Based on previous ECHO-Autism studies, the target number of participants enrolled in the study portion was a minimum of 20. The median number of participants for previous ECHO-Autism studies published at the time of study development was 18 but we aimed to include additional participants to account for possible attrition. We exceeded our goal and enrolled 22 participants into the current study. Due to clinical considerations associated with the intervention, pragmatic methods were used to determine sample size. However, post-hoc power testing was also done. Based on the Knowledge Survey scores of the sixteen participants who completed both pre- and post-ECHO assessments and an alpha value of .05, it was found that the power of our analyses is 0.98.

Participants completed a registration form indicating, among other things, their profession, their clinical experience, location of practice and type of clientele. Study participants' years of experience working with patients with ASD ranged from 0.5 to 22 (*M*=7.16, SD=6.14). The majority of participants who enrolled were from Quebec (72.7%, N=16), while other participants were from Ontario (13.6%, N=3), Alberta (9.1%, N=2), and outside of

Canada (4.5%, N=1). Psychologists made up the largest portion of participants (45.5%), followed by pediatricians (18.2%), speech-language pathologists (9.1%), psychoeducators (9.1%), nurses (4.5%), psychiatrists (4.5%), occupational therapists (4.5%), and psychology students/trainees (4.5%). When asked how much of their caseload is comprised of individuals with ASD or other NDDs, participants reported most or all (27.3%), the majority (31.8%), about half (18.2%), or the minority (18.2%). The majority of participants work with children with ASD (68.2%), while many also work with adolescents (59.1%) and/or adults (31.8%). Further information regarding consented participants can be found in Table 3.

Of the 22 participants who initially consented to participate, six were lost to attrition and did not complete the post-ECHO assessments. There were no apparent trends among the participants lost to attrition as their characteristics were similar to that of all consented participants. Table 3 outlines further characteristics of these six participants who were lost to attrition.

Table 3. Demographic Information for all consented participants and participants lost to attrition

	All Participants		Participants Lost to Attrition	
	M (SD)	Range	M (SD)	Range
Years Working with Individuals with ASD	7.16 (6.14)	0.5-22	6.2(3.35)	1-10
	Number (N)	Percent	Number (N)	Percent
Location of Practice:				
Quebec	16	72.7%	3	50%
Ontario	3	13.6%	2	33.3%
Alberta	2	9.1%	1	16.7%
Outside Canada	1	4.5%		
Language of Services Provided:				
English	8	36.4%	1	16.7%
French	3	13.6%	1	16.7%
English and French	5	22.7%	3	50%
Profession:				
Psychologist	10	45.5%	3	50%
Pediatrician	4	18.2%	1	16.7%
Nurse	1	4.5%	0	0%
Occupational Therapist	1	4.5%	1	16.7%
Speech-Language Pathologist	2	9.1%	1	16.7%

Psychoeducator	2	9.1%	0	0%
Psychology Student/Trainee	1	4.5%	0	0%
Psychiatrist	1	4.5%	0	0%
Primary Workplace (check all that apply):				
Private Practice	6	27.3%	1	16.7%
CLSC	4	18.2%	1	16.7%
Family Medicine Group	2	9.1%	1	16.7%
Hospital	4	18.2%	2	33.3%
Research Centre	3	13.6%	0	0%
Non-Profit Organization	1	4.5%	1	16.7%
School/School Board	2	9.1%	0	0%
Student/Trainee	1	4.5%	0	0%
Government Funded Mental Health Agency	1	4.5%	1	16.7%
How Much of Caseload Comprised of Individuals with ASD or Other NDDs:				
Most or All	6	27.3%	1	16.7%
The Majority	7	31.8%	2	33.3%
About Half	4	18.2%	2	33.3%
The Minority	4	18.2%	1	16.7%
Age Groups of Individuals with ASD Treated (check all that apply):				
Children	15	68.2%	5	83.3%
Adolescents	13	59.1%	4	66.7%
Adults	7	31.8%	0	0%
Previously Attended ECHO Session?				
Yes	7	31.8%	3	50%
No	15	68.2%	3	50%

Intervention

The ECHO program is described as brief didactic presentations by expert specialists complemented by discussions and questions based on participant provided cases (Arora et al., 2016). The length and frequency of ECHO sessions may vary and should be decided based upon clinical needs (Arora et al., 2016).

The current ECHO-Autism program consisted of seven, 90-minute sessions over a period of four months between August and November 2022 and was organized as an accredited CME program. The theme of this ECHO-Autism program was co-occurring medical and neurodevelopmental conditions in ASD. Sessions were facilitated by Dr. Julie Scorah who received facilitator training from the ECHO-Autism superhub located in Missouri, USA. This

location is considered a 'superhub' as it was the location of the first ECHO-Autism study and has been the site of many others since, along with publishing numerous studies on the program (Mazurek et al., 2017). Dr. Scorah is a neuropsychologist who specializes in the diagnosis and treatment of ASD and who has practiced for many years at several tertiary care centres. In addition to Dr. Scorah, a hub team consisting of other clinical professionals delivered didactic lectures, helped oversee the sessions and gave recommendations on cases presented by the participants. The hub team for this ECHO-Autism program consisted of a neuropsychologist, a geneticist, a speech-language pathologist, a developmental pediatrician, a neurologist, a parent advocate, and a social worker. Session topics were as follows: genetic disorders, language disorders, ADHD, epilepsy, sleep, and parent perspective on co-occurring diagnoses. A neurologist specializing in sleep disorders in ASD was a guest speaker. She participated in only the one session in which she gave the didactic presentation. The format of each session, which adhered to the ECHO model, can be found in Table 4.

Table 4. Session format

Activity	Brief Description
Introductions	At the beginning of each session, all attendees introduced themselves.
Didactic Presentation	A hub team member presented a didactic lecture in their area of specialization.
Questions Regarding Didactic	Following the didactic presentation, participants had the opportunity to ask questions on the presentation topic.
Case Presentation	For each session, a participant volunteered to present either a current patient case for which they wanted advice, or a closed case which they found interesting (although in this case there were asked not to share their conclusions). Cases were de-identified, therefore patient confidentiality was maintained throughout.
Questions for Case Presenter	Participants and the hub team had the opportunity to ask clarifying questions regarding the case.
Recommendations for Case from Hub Team	Members of the hub team provided recommendations on the case, as required. Hub team suggestions were recorded.

Recommendations for Case from Other Participants	Following the hub team members' recommendations, other participants were able to provide their own suggestions.
Session Summary	A short summary of the session was provided by the facilitator. During this time, they also asked the participants for volunteers to present a case at the next session.

After each session, relevant documents (didactic PowerPoints, case recommendations) were posted in a OneDrive folder that the participants were able to access. Moreover, at the end of each session, we asked for a participant to volunteer to present a case at the next session. The participant who volunteered was responsible for completing a case presentation form one week before the session at which they were presenting. If there were no volunteers to present a case by the end of the session, an email was sent out asking for volunteers following the completion of the session. Within two weeks of presenting a case, case presenters would be emailed a *Case Recommendations* document which listed all the recommendations the hub team had for them.

Two weeks before each session, an agenda was sent to participants which also included the Zoom link for the session. Additionally, a reminder email was sent to participants and hub team members on the day of the session.

Measures

All participants first completed a demographics form as part of their application to the program. Additional data from study participants was collected in accordance with Moore's CME Evaluation Framework (Moore et al., 2009). Measures were chosen to assess each level of the framework deemed feasible to evaluate. We measured levels one through five of the framework (see Table 1) because it was practical to measure these levels using surveys given to ECHO-Autism participants. Measuring changes to levels six and seven (e.g., Patient and Community Health) was beyond the scope of this project due to requiring other sources of data that we did not have access to for this project (i.e. patient charts, epidemiological reports, patient report, etc.). Table 5 contains a complete list of all measures collected for both the

study and the present intervention (ECHO-Autism), along with further details regarding each measure.

Demographics Form: Before being accepted to participate in this program, participants were asked to complete a demographics form. Information captured by the demographics form included profession, years of experience working with individuals with ASD, how much of the participants' caseload is made up of individuals with ASD, and place of work.

Attendance Form: Completed by administrative staff after each session to indicate who was in attendance.

ECHO-Autism Satisfaction Survey: Satisfaction was assessed after completion of the program using a survey developed for a previous ECHO-Autism study [Appendix I; (Mazurek et al., 2017)]. This survey consisted of 10 multiple choice questions; answer choices ranged from 'Strongly Agree' to 'Strongly Disagree' and were rated on a 1-5 point Likert scale. Two open-ended questions asking participants for their thoughts on the program and suggestions for improvements were also included.

Knowledge Survey: We assessed Learning through the implementation of a Knowledge Survey (Appendix II). As the didactic lecture content was developed specifically for this ECHO-Autism program, the Knowledge Survey was developed by the hub team to include questions tailored to the content that was presented during the sessions. This survey included 20 questions, seventeen multiple choice and three true or false. There were four questions per topic (genetics, language, attention-deficit/hyperactivity disorder, epilepsy, sleep). Due to the nature of the 'Parent Perspective' topic, it was not included in this survey. Participants completed the Knowledge Survey both pre- and post-ECHO.

Primary Care Autism Self-Efficacy (PCASE) Survey: The PCASE survey, developed by Mazurek and colleagues (2017) to evaluate changes to participant perceived self-efficacy following

participation in ECHO-Autism, was used in this study. It was adapted to better fit the participants and topics in the current program while still maintaining the original structure (Mazurek et al., 2017). This survey included 27 questions that fall into four sections: Identification and Evaluation (6 questions), Managing Comorbidities (7 questions), Referral and Resources (8 questions), and Additional (6 questions that do not fall into the other categories). This survey used a 1-6 point Likert scale ranging from "No confidence" to "Highly confident/expert," with a total possible score of 162.

We used a retrospective pre/post design. Participants completed this survey once at baseline. Then, after the final ECHO-Autism session, participants took a slightly altered version of this survey (Appendix IV). The altered version contained the exact same questions as were asked pre-ECHO; the only difference was that participants now had to provide two responses per question. One response assessed how they would rate their self-efficacy after participation. The other response assessed how they now felt their self-efficacy was before the program began. We used this approach as prior studies have found that when traditional pre/post designs are used, participants commonly overestimate their initial abilities which can lead to program effects being underestimated (Drennan & Hyde, 2008; Geldhof et al., 2018; Thomas et al., 2019). The implementation of retrospective pre/post designs has been shown to more accurately capture pre-intervention ability, the effects of the program/intervention to be better determined (Drennan & Hyde, 2008; Thomas et al., 2019).

Post-Case Presentation Survey: This survey assessed changes to practice behaviour following participation in ECHO-Autism [Appendix V; (Kanigsberg & Penner, 2019)]. Specifically, we examined whether case presenters implemented the recommendations provided to them following the sessions, in the *Case Recommendations* document. Both quantitative and qualitative information were collected. First, for each participant, the survey listed all the recommendations given by the hub team. Participants were asked to indicate whether (yes or no) each recommendation had been implemented. If they answered 'no' they were then asked to indicate why they did not implement the recommendation, from a list of possible reasons. Question two asked participants to rate whether the recommendations met their needs on a

scale of 1 (strongly disagree) to 5 (strongly agree). Last, participants were asked to answer two open-ended questions examining: 1) whether the recommendations changed the participants course of action regarding the presented case and 2) whether the recommendations provided during other clinicians' case presentations led to changes in their practice behaviour. It should be noted that this survey was only completed by the six clinicians who were part of the study and who also presented a clinical case. Qualitative data was not used for analyses as it was outside the scope of this master's thesis. Additionally, as question two was similar to the satisfaction survey, we did not analyze data from this question. Thus, only data from question one was analyzed and reported in this study.

Session Evaluation Form: Participants completed a session evaluation form after each session. This form was necessary to receive CME credits from participation.

Table 5. Details Regarding Measures

Evaluation Activities	Type of method	Approximate time	Baseline Evaluation	During the program	Post-ECHO
Consent Form	Online survey	10 min	X		
Demographics	Online survey	5 min	X		
ECHO-Autism Satisfaction Survey	Online Survey	10 min			X
Attendance	Online Survey	5 min		X	
Session Evaluation Form	Online Survey	10 min		X	
Case Registration	Online Survey	25 min		X	
Knowledge Survey	Online Survey	15 min	X		X

Perceived Self-Efficacy Survey	Online Survey	15 min	X		X
Post-Case Presentation Survey	Online Survey	15 min			X

Data Analysis

First, to examine Satisfaction, descriptive statistics (mean and standard deviation) were calculated. To examine changes in knowledge pre- to post-ECHO, we used a paired-samples t-test. Shapiro-Wilk tests were used to assess normality. For the Knowledge Survey, pre-ECHO knowledge scores did not violate normality, but post-ECHO knowledge scores did. Thus, both a parametric (paired samples t-test) and non-parametric test (Wilcoxon Signed Rank) were used.

Next, to examine changes in perceived self-efficacy from pre-ECHO to post-ECHO, we again used a paired-samples design. A paired-samples design (paired-samples t-test) was used to compare survey results rating pre-ECHO perceived self-efficacy to post-ECHO perceived self-efficacy. We also conducted a retrospective pre-post analysis on perceived self-efficacy, comparing pre-ECHO score to retrospective pre-ECHO score using a paired-samples t-test. First, normality was tested using a Shapiro Wilk test. None of the variables violated normality, thus paired samples t-tests were used.

Since prior research has shown that even healthcare providers who are experienced working with individuals with ASD demonstrate gaps in ASD knowledge and competence (Atun-Einy & Ben-Sasson, 2018), we tested the same hypotheses above, controlling for years of experience working with individuals with ASD using repeated measures ANCOVAs (one for knowledge and one for perceived self-efficacy). Data from participants who completed both the post-ECHO surveys and provided their years of experience working with individuals with ASD on the registration form were included (N=11).

Last, to determine whether participation in the program affected Performance, we conducted exploratory analyses using data collected by the post-case presentation survey. Specifically, we planned to analyze question one of the post-case presentation survey: "*Please indicate whether or not you implemented each recommendation from your (date) case presentation*." We report the percentage of recommendations implemented for each

participant. For each recommendation not implemented, we also report the reason they gave for not implementing it. Sample size for this investigation was six due to there being only six study participants who also presented a case.

Results

Overall, attendance was high across sessions (Table 6). Attendance of those who completed the post-ECHO assessments was higher than overall attendance of consented participants (Table 6). The average number of sessions attended by all consented participants was 5 (SD=2.3) and the range was 0-6 sessions. The average number of sessions attended by participants who completed post-ECHO assessments was 6 (SD=1.1), and ranged from 4-7 sessions. Number of sessions attended was not significantly related to knowledge gained or participants' years of experience working with ASD. Additionally, the average rating across questions on the satisfaction survey was 1.6 (SD=.43), which falls between "strongly agree" and "agree." The average rating indicates a high level of satisfaction with the program.

Table 6. Participant Attendance for Each Session

	All Consented Participants (N=22)		Participants That Completed Post-ECHO Assessments (N=16)	
Session Number	Number of Participants Who Attended	% Participants Who Attended	Number of Participants Who Attended	% Participants Who Attended
1	16	72.7%	14	87.5%
2	18	81.8%	15	93.8%
3	18	81.8%	16	100%
4	15	68.2%	14	87.5%
5	15	68.2%	14	87.5%
6	13	59.1%	11	68.8%
7	14	63.6%	13	81.3%

Table 7. Mean, standard deviation, and range for Knowledge Survey and Perceived Self-Efficacy Survey at each timepoint

Measure	Mean (SD)	Range
Knowledge Survey		
Pre-ECHO	12 (2.1)	9-17
Post-ECHO	14.9 (2.2)	10-17
Perceived Self-Efficacy Survey		
Pre-ECHO	88.4 (26.3)	40-135
Post-ECHO	106.3 (25.5)	60-150
Retrospective Pre-ECHO	85.4 (32.1)	33-140

Total knowledge score increased significantly from pre-ECHO (*M*=12.7, SD=2.1) to post-ECHO (*M*=14.9, SD=2.2), t(15)= -5.508, p<.001 (Table 7). There was no statistically significant interaction between years of experience working with individuals with ASD and Knowledge Survey scores, F(1,9)=.314, p=.589, η^2 =.034. There was no longer a significant change to score on the Knowledge Survey between the pre-and post-ECHO timepoints when controlling for the years of experience working with individuals with ASD, *F*(1,9)=4.978, p=.053, η^2=.356.

Perceived self-efficacy score significantly increased between pre-ECHO (*M*=86.3, SD=29.1) and post-ECHO (*M*=106.3, SD=25.5), t(15) = -4.412, p<.001 (Table 7). There was no significant difference between mean pre-ECHO perceived self-efficacy score (*M*=86.3, SD=29.1) and mean retrospective pre-ECHO perceived self-efficacy score (*M*=85.5, SD=32.1), t(15)=.226, p=.824. Mean retrospective pre-ECHO perceived self-efficacy score (*M*=85.5, SD=32.1) was significantly lower than mean post-ECHO perceived self-efficacy score (*M*=106.3, SD=25.5), t(15)= -5.148, p<.001. There was no statistically significant interaction between years of experience working with individuals with ASD and pre- and post-ECHO perceived self-efficacy survey scores, F(1,9)=.270, p=.616, η^2 =.029. When controlling for the covariate, years of experience working with individuals with ASD, perceived-self efficacy score still increased significantly from pre- to post-ECHO, *F*(1, 9)=7.031, p=.026, η^2=.439.

After viewing the results of the Post-Case Presentation survey, we determined that the measure did not work as intended by Kanigsberg and Penner (2019). This survey asked case-

presenters what changes they made to their clinical practice as a result of their participation. However, not all case-presenters presented a current case. Additionally, we were unable to do quantitative analyses due to the small sample size. Thus, we analyzed this measure as a case series (Appendix VI). Additionally, for a breakdown of category (i.e. medical investigations/interventions, speech-language pathology assessment or intervention, psychological assessment or intervention, occupational therapy assessment or intervention, refer to other services, school accommodations/adaptations, family or individual support/resources, or case presenter professional development) for each recommendation given to each case presenter who completed the Post-Case Presentation Survey, see Appendix VII.

Discussion

The goal of this thesis was to evaluate implementation of a new ECHO-Autism program using measures previously used in other settings as well as novel measures that we developed. Participation, Satisfaction, Learning, Competence, and Performance were examined. It was discovered that ECHO-Autism led to significant increases in ASD knowledge and perceived self-efficacy from pre- to post-ECHO. Further analyses then showed that when controlling for years of experience working with individuals with ASD, the increase of perceived self-efficacy score remained significant, while increase to knowledge score did not. These beneficial changes resulting from participation in ECHO-Autism highlight the programs utility in providing healthcare providers with knowledge, competence, and skills that they can use to improve the care they provide to individuals with ASD.

Results of the present study are in-line with those of previous studies (Dreiling et al., 2022; Mazurek et al., 2020b; Nowell et al., 2020; Sengupta et al., 2022) and suggest that ECHO-Autism is an effective method for improving healthcare provider ASD-related knowledge. Only one ECHO-Autism study did not find significant increases to knowledge as a result of participation (Mazurek et al., 2020c). However, the differing result can potentially be explained by various reasons. First, knowledge surveys differed between studies and there is no way to determine their relative difficulty levels. Additionally, didactic presentation content typically

differs between programs, and directly affects the knowledge survey content and participant learning. Last, participants' years of experience vary between studies, with Mazurek and colleagues (2020) having a higher average years of experience compared to all studies that found significant increases in knowledge.

Contrary to our hypothesis, controlling for years of experience working with individuals with ASD was found to affect changes to knowledge scores. This is an important finding as we were the first ECHO-Autism study to explore this question. A previous ECHO-Autism study has examined the effect of experience on knowledge changes; however, they used whether participants had prior ASD training (yes/no) as their measure of experience. Sengupta and colleagues (2022) found that participants demonstrated significant increases in scores on a knowledge survey from pre- to post-ECHO, regardless of experience (Sengupta et al., 2022), which differs from our finding. One potential reason for this is that while our study had a wide range of healthcare professionals, 90% of their sample was made up of pediatricians. Another potential reason is that Sengupta and colleagues (2022) had a much larger sample size, and as our result was approaching significance, it is possible that with a larger sample size we may have had a similar result. Lastly, a different metric of experience was used. Therefore, it can be suggested that while prior ASD training does not affect whether participants demonstrate significant increases in knowledge after participation in ECHO-Autism, years of experience working with individuals with ASD does.

The effect of years of experience on changes to knowledge scores varies within non-ECHO literature (Ameh et al., 2016; Hjorth-Johansen et al., 2019). Hjorth-Johansen and colleagues (2019) found that years of experience did not affect changes to knowledge in an e-learning training program, while Ameh and colleagues (2016) found the opposite in an in-person training program. There are some potential reasons for the differing results. Hjorth-Johansen and colleagues (2019) had participants with a very low average years of experience (less than one year), whereas Ameh and colleagues (2016) and the present study, had higher average years of experience. Additionally, Ameh and colleagues (2016) and the current study had samples made up of a range of healthcare professionals and very few students. Hjorth-Johansen and colleague's (2019) participants were all nurses, most of whom were also

students. Thus, it is proposed that participant characteristics determine whether changes to knowledge scores after participation in a training program are affected by their years of experience. Having more experience working with individuals with ASD and no longer being a student may lead to changes to ASD knowledge being more variable between individuals.

We found a significant increase in self-efficacy as a result of participation in ECHO-Autism, which is consistent with all ECHO-Autism literature (Dreiling et al., 2022; Giachetto et al., 2019; Mazurek et al., 2017; Mazurek et al., 2020b; Mazurek et al., 2020c; Sengupta, 2022). These results highlight that this program reliably improves self-efficacy of healthcare providers and potentially contributes to reducing the barrier to healthcare for individuals with ASD caused by insufficient healthcare provider competence. Additionally, in support of our hypothesis, controlling for years of experience working with individuals with ASD did not affect whether we found a significant increase in perceived self-efficacy from pre- to post-ECHO. One prior ECHO study split participants into a high and low experience groups for the analysis of self-efficacy (Zhao et al., 2022). They found significant increases in self-efficacy scores for both groups after participating in their ECHO program (Zhao et al., 2022). Sengupta and colleagues (2022) examined whether having prior ASD training affected changes to self-efficacy from pre- to post-ECHO and found that both those who had previous ASD training and those who did not reported significant increases to self-efficacy (Sengupta et al., 2022). These results, in addition to the results of our study, suggest that healthcare providers can increase their perceived self-efficacy through participation in ECHO, regardless of their experience level.

Interestingly, we did not find a significant difference between pre- and retrospective pre-ECHO perceived self-efficacy scores. This result was unexpected as there is evidence supporting the utility of retrospective pre/post designs, and showing that they are more accurate at estimating baseline ability in non-ECHO studies (Drennan & Hyde, 2008; Yank et al., 2013). However not totally surprising since results from an ECHO study by White and colleagues (2019) were also similar to ours. A potential reason for the discrepancy in results between ECHO studies and non-ECHO studies is that while participants in the other training programs were nursing graduate students (Drennan & Hyde, 2008) or medical residents (Yank et al., 2013), the majority of participants in the ECHO studies were not students or trainees (White et

al., 2019). Whether participants are still in the process of attending school or considered to still be in-training may affect changes between pre- and retrospective pre-ECHO self-efficacy scores. Thus, the ECHO findings highlight that participants who are no longer in school or considered to be in training may be able to more accurately capture their pre-ECHO self-efficacy.

Although the data evaluating the Performance level was preliminary, it is still interesting to consider. It appears that case-presenters do try to implement suggestions given to them by the hub team. The hub team of this ECHO-Autism program gave each participant many suggestions for their case. Providing a large number of suggestions per case seemed to be effective as it allowed participants to successfully implement multiple recommendations, even if a few were not feasible (i.e. due to availability of resources).

Limitations and Future Directions

There were limitations to this study that should be mentioned. First, the measures being used across ECHO-Autism studies present a problem. For example, we found that the Post-Case Presentation Survey did not provide the intended information. Not only does this measure greatly limit the number of participants eligible to complete it, but this survey also relies on participants presenting current cases which was not a requirement for the ECHO-Autism program. Additionally, the PCASE survey must be adapted to the specific content discussed in different ECHO-Autism programs but there are no guidelines on doing so. The PCASE survey is also self-report which is an issue as perceived self-efficacy working with individuals with ASD may not reflect actual competence working with this population. Moreover, there are issues with measuring performance in ECHO-Autism studies. Many studies use self-report measures for investigating changes to practice behaviour. Using self-report for measuring this outcome can be inaccurate as there is no way to determine whether participants actually made the changes they reported. This problem is exacerbated by a lack of standardized measures for practice change, thus making it difficult to compare results across studies. To solve this limitation, key performance outcomes for ECHO-Autism programs of various topics should be identified. For example, ECHO-Autism programs on the topic of diagnosis could focus on

assessment skills (i.e. using ADOS-2). This could then be measured objectively by having an expert diagnostician rate participants' use of the tools.

For the analyses with covariates, we were reduced to a sample size of eleven as not all participants completed the 'Years of Experience' section of the Demographics Form. A smaller sample size may present a limitation as it reduces power. This is especially important to highlight as changes to knowledge score from pre- to post-ECHO, while controlling for years of experience, was approaching significance. Thus, it is possible that we may have had a significant finding if we had a larger sample size for this calculation.

Another limitation is that all participants voluntarily signed up to participate in ECHO-Autism to receive additional training and to partake in the study. Thus, this was a self-selected participant population who likely value additional training as they sought it out, demonstrating their motivation to improve. This specific subpopulation who chose to participate in this training opportunity may not be reflective of the population of healthcare providers as a whole.

Additionally, there are currently no studies examining outcomes relating to levels six (Patient Health) or seven (Community Health) of the CME framework. It is unknown if these provider level changes associated with ECHO-Autism actually improve the care received by individuals with ASD. In the future, it will be vital to investigate whether or not the implementation of ECHO-Autism affects these levels to fully evaluate the impact the of the program.

Conclusion

The results of this study support the use of ECHO-Autism to provide healthcare providers with further training on ASD. It was demonstrated that participation in the program can lead to improvements in outcomes associated with Moore's CME Evaluation Framework. These beneficial changes have the potential to contribute to reducing common barriers to healthcare faced by individuals with ASD through empowering healthcare providers. Participants of all experience levels were shown to benefit from ECHO-Autism. Increasing high-quality ASD training opportunities for healthcare providers is necessary to keep up with the growing population of individuals with ASD and ensure that they can receive best-practice care.

Thus, it is important that novel training methods, such as ECHO-Autism, continue to be evaluated. More research is needed on the effect of years of experience and the utility of retrospective pre/post designs with respect to ECHO-Autism.

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Appendices

Appendix I: Satisfaction Survey

Satisfaction Survey

Please complete the survey below.

Thank you!

SATISFACTION SURVEY Version 2

Version Date 11/18/2015

[initial_intake_arm_1][echo_reg_fname], please complete this questionnaire.

This questionnaire assesses your confidence in your satisfaction with the ECHO Autism clinic.

The time needed to complete this questionnaire is 5-10 minutes.

Please rate the extent to which you agree with the following:	Strongly Agree	Agree	Neutral or No Opinion	Disagree	Strongly Disagree
1. Participation in ECHO Autism improved my ability to care for children with autism in my practice	○	○	○	○	○
2. I learned best-practice care in autism through participation in ECHO Autism	○	○	○	○	○
3. I was able to connect with peers and colleagues through participation in ECHO Autism	○	○	○	○	○
4. ECHO Autism specialists provided guidance in managing children with autism	○	○	○	○	○
5. I respected the professional advice received from ECHO Autism experts	○	○	○	○	○
6. The didactic presentations enhanced my knowledge about autism	○	○	○	○	○
7. Discussions with other participants enhanced my knowledge about autism	○	○	○	○	○
8. Case-based learning increased my knowledge about autism	○	○	○	○	○
9. I have been satisfied with the technology associated with the ECHO Autism clinic	○	○	○	○	○

10. The technology for the ECHO Autism clinic functioned smoothly	○	○	○	○	○

Score _____

11. Please share your thoughts about the ECHO Autism clinic:

12. Please share any suggestions for improvement for the ECHO Autism clinic:

Appendix II: Knowledge Survey

Autism Knowledge Survey

Autism Knowledge Survey Version: 2022

[initial_intake_arm_1][echo_reg_fname], please complete this questionnaire.

This questionnaire assesses your knowledge on a variety of topics on autism and co-occurring conditions. Please answer each as best you can.

The time needed to complete this questionnaire is 10-30 minutes

1. Which of the following are indications for referral of a child with ASD to a geneticist for evaluation?

◯ a. Family history of intellectual disability
◯ b. Dysmorphic features
◯ c. Congenital anomalies
◯ d. All of above

Score _____

2. A 2-year-old girl with a diagnosis of ASD has a history of language regression. She had 6 words at 18 months, and stopped saying all of them by her 2nd birthday. She had developed a pincer grasp by 10 months but now can't pick up small objects. She breathes rapidly when excited or nervous. She has started grinding her teeth during the day. She is walking but cannot yet climb stairs or run. What genetic condition is important to consider?

◯ a. Williams syndrome
◯ b. Angelman syndrome
◯ c. Rett syndrome
◯ d. Down syndrome

Score _____

3. Which of the following are true of language development in children on the autism spectrum (check all that apply)?

☐ a. All children on the autism spectrum have a language disorder
☐ b. Social communication is affected in some but not all children on the autism spectrum
☐ c. There is a great deal of variability in the language abilities of children on the autism spectrum
☐ d. Speaking abilities are commensurate with language abilities.

Score _____

4. Language includes the following areas (check all that apply)

☐ a. Morphology
☐ b. Oral-motor skills
☐ c. Syntax
☐ d. Pragmatics

Score _____

5. Children with autism who have challenges with learning one language should not be exposed to a second language. True or false.

◯ a. True
◯ b. False

Score

_____

6. If a child on the autism spectrum presents challenges with language, they should be referred to which specialist?

◯ a. A speech-language pathologist who has training and experience working with this population
◯ b. A teacher who has training and experience working with this population
◯ c. Early interventionists who have training and experience working with this population
◯ d. Any of the above

Score

_____

7. What is the estimated prevalence of ADHD in the autistic population?

◯ a. 20-30%
◯ b. 30-50%
◯ c. 50-70%
◯ d. 70-90%

Score

_____

8. What is the first-line medication for ADHD in the autistic population?

◯ a. Intuniv (guanfacine)
◯ b. Strattera (atomoxetine)
◯ c. Psychostimulants
◯ d. ADHD medications are contraindicated in ASD

Score

_____

9. What medical comorbidities need to be ruled-out when diagnosing ADHD?

◯ a. Sleep apnea
◯ b. Hyperthyroidism
◯ c. Anemia
◯ d. All of the above

Score

_____

10. In which situations can a combination of psychostimulants + non-stimulants (intuniv or Strattera) be considered when treating ADHD?

◯ a. Weight loss due to appetite suppression
◯ b. Comorbid anxiety
◯ c. Comorbid tic disorder
◯ d. All of the above

Score

_____

11. What is the main advantage of chromosomal microarray over traditional karyotype?

◯ a. It can detect much smaller deletions and duplications
◯ b. It can detect consanguinity
◯ c. It can detect balanced chromosome rearrangements
◯ d. It is cheaper

Score

_____

12. What is the main advantage of exome sequencing?

◯ a. Rapid turnaround time
◯ b. Able to assess all genes in one blood test
◯ c. Can diagnose all known genetic disorders
◯ d. Eliminates need for newborn screening at birth

Score

_____

13. Every person with Autism should have an EEG to screen for epilepsy at the time of diagnosis

◯ a. False
◯ b. True

Score

_____

14. Which of the following episodes are suggestive of seizures?

◯ a. Episodes only occur in a specific context, in this case when attending speech therapy
◯ b. The episodes are stereotyped, and their duration can vary between 3 minutes and 20 minutes
◯ c. The episodes are interrupted with vigorous touching or stimulation
◯ d. The person is extremely tired and less responsive after the episode, constituting a post-ictal period

Score

_____

15. EEG abnormalities can be found in up to what percentage of people with autism?

◯ a. 10%
◯ b. 30%
◯ c. 40%
◯ d. 60%

Score

_____

16. Epilepsy is most common in people with autism and intellectual delay

◯ a. True
◯ b. False

Score

_____

17. For a child or adult with autism and insomnia, which of the following sleep treatments should be initiated first?

◯ a. Melatonin
◯ b. Clonidine
◯ c. Trazodone
◯ d. Behavioral sleep education

Score _____

18. What is the prevalence of parent-reported sleep problems among children with ASD?

◯ a. 5-20%
◯ b. 21-50%
◯ c. 51-80%
◯ d. 81-100%

Score _____

19. Standard/regular-release melatonin is most useful for addressing which of the following:

◯ a. Difficulty falling asleep
◯ b. Difficulty staying asleep
◯ c. Early morning awakenings
◯ d. Sleep walking
◯ e. All of the above

Score _____

20. A parent reports their 3 y/o child with ASD is not sleeping well. Which of the following would be appropriate steps for treatment (check all that apply):

☐ a. Consult with pediatrician
☐ b. Gather information about routines and home/sleep environment with intention of addressing sleep hygiene
☐ c. Recommend a weighted blanket
☐ d. Share the ATN/AIR-P Sleep Strategies guide with caregivers

Score _____

Total Score _____

Appendix III: Self-Efficacy Baseline Survey

Self-Efficacy Survey - Baseline

Self-Efficacy Survey - Baseline Version: 2016

[initial_intake_arm_1][echo_reg_fname], please complete this questionnaire about yourself.

This questionnaire assesses your confidence in your ability to effectively do specific activities.

The time needed to complete this questionnaire is 15-30 minutes.

Please rate how CONFIDENT you are in your ABILITY to EFFECTIVELY do the following:

Identification and Evaluation

How CONFIDENT are you in your ABILITY to EFFECTIVELY:

	No confidence	Very little confidence	Slight confidence	Confident	Very confident	Highly confident/expert
1. Use assessment tools for evaluating a child's development	○	○	○	○	○	○
2. Identify red flags for autism and comorbid conditions in toddlers	○	○	○	○	○	○
3. Identify red flags for autism and comorbid conditions in preschool children	○	○	○	○	○	○
4. Identify red flags for autism and comorbid conditions in school-aged children	○	○	○	○	○	○
5. Identify red flags for autism and comorbid conditions in adolescents	○	○	○	○	○	○
6. Discuss your concerns about autism and comorbid conditions with parents	○	○	○	○	○	○

Score: Identification and Family _____

Managing Comorbidities

How CONFIDENT are you in your ABILITY to EFFECTIVELY:

	No confidence	Very little confidence	Slight confidence	Confident	Very confident	Highly confident/expert

7. Assess sleep problems in autistic individuals	○	○	○	○	○	○
8. Screen for seizures in autistic individuals	○	○	○	○	○	○
9. Determine when to make a neurology referral for autistic individuals and suspected seizures	○	○	○	○	○	○
10. Assess for ADHD in autistic individuals	○	○	○	○	○	○
11. Discuss treatment options for ADHD with parents of autistic individuals	○	○	○	○	○	○
12. Screen for features of genetic conditions in autistic individuals	○	○	○	○	○	○
13. Screen for language problems in autistic individuals	○	○	○	○	○	○

Score: Managing comorbirdiies _____

Referral and Resources

How CONFIDENT are you in your ABILITY to EFFECTIVELY:

	No confidence	Very little confidence	Slight confidence	Confident	Very confident	Highly confident/expert
14. Refer an individual to intervention services	○	○	○	○	○	○
15. Refer an individual for investigations for sleep problems or recommend to the individual's doctor to refer the individual for sleep problems	○	○	○	○	○	○
16. Refer an individual for investigations for seizures/epilepsy or recommend to the individual's doctor to refer the individual for seizures/epilepsy	○	○	○	○	○	○
17. Refer an individual for investigations for genetic testing or recommend to the individual's doctor to refer the individual for genetic testing	○	○	○	○	○	○

18. Refer an individual for investigations for language testing or recommend to the individual's doctor to refer the individual for language testing	○	○	○	○	○	○
19. Refer an individual for investigations for ADHD or recommend to the individual's doctor to refer the individual for ADHD	○	○	○	○	○	○
20. Help families access therapy resources for autistic individuals	○	○	○	○	○	○
21. Identify family support resources for families of autistic individuals	○	○	○	○	○	○

Score: Referral and Resources

_____

Additional

How CONFIDENT are you in your ABILITY to EFFECTIVELY:

	No confidence	Very little confidence	Slight confidence	Confident	Very confident	Highly confident/expert
22. Provide appropriate anticipatory guidance to families raising children with autism	○	○	○	○	○	○
23. Partner with parents around therapeutic decisions for children with autism	○	○	○	○	○	○
24. Partner with parents to facilitate decision making about their child	○	○	○	○	○	○
25. Establish a parent professional partnership	○	○	○	○	○	○
26. Provide a medical home for autistic individuals	○	○	○	○	○	○
27. Serve as a local consultant within your clinic or community for autism questions	○	○	○	○	○	○

Score: Additional

_____

Total Score

_____

Appendix IV: Self-Efficacy Post-Program Survey

Self-Efficacy Survey - Post

Version: 2016

This questionnaire assesses your confidence in your ability to effectively do specific tasks. For each question, you will be asked to rate your CONFIDENCE level BEFORE PARTICIPATING in the ECHO-Autism program (column on the left) AND your CONFIDENCE level AFTER PARTICIPATING in the ECHO-Autism program (column on the right).

The time needed to complete this questionnaire is 20-30 minutes.

Identification and Evaluation

How CONFIDENT were you BEFORE PARTICIPATING in your ABILITY to EFFECTIVELY:		**How CONFIDENT were you AFTER PARTICIPATING in your ABILITY to EFFECTIVELY:**
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**1. Use assessment tools for evaluating a child's development**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**2. Identify red flags for autism and comorbid conditions in toddlers**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**3. Identify red flags for autism and comorbid conditions in preschool children**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**4. Identify red flags for autism and comorbid conditions in school-aged children**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**5. Identify red flags for autism and comorbid conditions in adolescents**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset

○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**6. Discuss your concerns about autism and comorbid conditions with parents**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset

Managing Comorbidities

How CONFIDENT were you BEFORE PARTICIPATING in your ABILITY to EFFECTIVELY:		**How CONFIDENT were you AFTER PARTICIPATING in your ABILITY to EFFECTIVELY:**
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**7. Assess sleep problems in autistic individuals**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**8. Screen for seizures in autistic individuals**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**9. Determine when to make a neurology referral for autistic individuals and suspected seizures**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**10. Assess for ADHD in autistic individuals**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**11. Discuss treatment options for ADHD with parents of autistic individuals**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset

○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**12. Screen for features of genetic conditions in autistic individuals**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**13. Screen for language problems in autistic individuals**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset

Identification and Evaluation

How CONFIDENT were you <u>BEFORE PARTICIPATING</u> in your ABILITY to EFFECTIVELY:		**How CONFIDENT were you <u>AFTER PARTICIPATING</u> in your ABILITY to EFFECTIVELY:**
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**14. Refer an individual to intervention services**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**15. Refer an individual for investigations for sleep problems or recommend to the individual's doctor to refer the individual for sleep problems**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**16. Refer an individual for investigations for seizures/epilepsy or recommend to the individual's doctor to refer the individual for seizures/epilepsy**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**17. Refer an individual for investigations for genetic testing or recommend to the individual's doctor to refer the individual for genetic testing**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset

○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**18. Refer an individual for investigations for language testing or recommend to the individual's doctor to refer the individual for language testing**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**19. Refer an individual for investigations for ADHD or recommend to the individual's doctor to refer the individual for ADHD**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**20. Help families access therapy resources for autistic individuals**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**21. Identify family support resources for families of autistic individuals**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset

Additional

How CONFIDENT were you <u>BEFORE PARTICIPATING</u> in your ABILITY to EFFECTIVELY:		**How CONFIDENT were you <u>AFTER PARTICIPATING</u> in your ABILITY to EFFECTIVELY:**
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**22. Provide appropriate anticipatory guidance to families raising children with autism**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**23. Partner with parents around therapeutic decisions for children with autism**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset

○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**24. Partner with parents to facilitate decision making about their child**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**25. Establish a parent professional partnership**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**26. Provide a medical home for autistic individuals**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset
○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset	**27. Serve as a local consultant within your clinic or community for autism questions**	○ No confidence ○ Very little confidence ○ Slight confidence ○ Confident ○ Very confident ○ Highly confident/expert reset

Appendix V: Post-Case Presentation Survey

POST-CASE PRESENTATION SURVEY

1. **Please indicate whether or not you implemented each recommendation from your _____(date) case presentation:**

Recommendation	Yes, I implemented this recommend-ation	No, I did not implement this recommend-ation	If NO, please indicate all that apply:
e.g. Provide a formal diagnosis for child			☐ I did not think family was ready ☐ I did not have the time ☐ Family declined the recommendation ☐ I did not agree with this recommendation ☐ This recommendation was outside my scope of practice ☐ This recommendation is not available in my area ☐ Other: (*please describe*) _____ _____
e.g. Encourage parents to bring diagnostic letter and reports from the SLP to the school.			☐ I did not think family was ready ☐ I did not have the time ☐ Family declined the recommendation ☐ I did not agree with this recommendation ☐ This recommendation was outside my scope of practice ☐ This recommendation is not available in my area ☐ Other: (*please describe*) _____
e.g. Order a microarray			☐ I did not think family was ready ☐ I did not have the time ☐ Family declined the recommendation ☐ I did not agree with this recommendation ☐ This recommendation was outside my scope of practice ☐ This recommendation is not available in my area ☐ Other: (*please describe*) _____ _____
e.g. Refer to a neurologist			☐ I did not think family was ready ☐ I did not have the time ☐ Family declined the recommendation ☐ I did not agree with this recommendation ☐ This recommendation was outside my scope of practice ☐ This recommendation is not available in my area ☐ Other: (*please describe*) _____ _____

2. **The recommendations provided through the ECHO Autism clinic met my needs:**

   1 - Strongly disagree; 2 - Disagree; 3 - Neutral/no opinion; 4 - Agree; 5 - Strongly agree

3. **Did the recommendations from ECHO Autism make you pursue a different action than you would have otherwise? If yes, please explain.**

4. **Did the recommendations from other cases that were presented during ECHO Autism influence your actions? If yes, please explain.**

Appendix VI: Results Post-Case Presentation Survey

Question 1:

Participant Number	Total Number of Recommendations	Number of Recommendations Implemented	Number of Recommendations Not Implemented	Percentage of Recommendations Implemented	Reason(s) Given for Not Implementing Recommendations
34	7	6	1	86%	Parents implemented recommendation before I was able to suggest it
46	8	8	0	100%	N/A
51	11	8	3	73%	1. School had already tried recommendation 2. Parents not aware of info relevant to this recommendation and were already too overwhelmed 3. Parents could not afford
52	13	0	13	0%	No longer caring for patients and retired from active pediatric practice
58	9	0	9	0%	Tried to meet with parents but they are no longer available
60	10	9	1	90%	Provider unaware of programs consistent with recommendation

Question 2:

	The recommendations provided through the ECHO Autism clinic met my needs:				
Participant Number	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
34		X			
46		X			
51	X				
52	X				
60	X				

Question 3:
Participant 46: "Yes, I had not considered certain recommendations before they were recommended to me, and I implemented them (e.g. using a full ADOS-2 assessment for diagnosis instead of theory of mind/empathy questionnaires)"

Participant 51: "I was rejecting the school as partner and had thought of them as adversary (as that was the parent's position). Your reframing helped the family pursue more collaborative actions"

Participant 60: "Recommending speech path (I might not have [without] encouragement [because] VCI [average]. Also adaptive functioning recommendation a good motivator as I might not have due to feeling that mother had already completed many measures including ADI, and might have felt overwhelmed"

Question 4:
Participant 51: "I cannot recall any concrete examples at the moment, but I did take notes which I return to from time to time and these influence my actions"

Participant 52: "Looking for underlying genetic causes. Realizing that autism is a lot of work for caregivers"

Participant 60: "Somewhat. There was overlap in recommendations, one case didn't apply to my cases so much, and I missed a few sessions"

Appendix VII: Case-Presentation Recommendation Category Breakdown

Breakdown of category of all recommendations each case presenter who completed the Post-Case Presentation Survey received

Participant Number	Medical Investigations/ Intervention	Speech and Language Pathology Assessment or Intervention	Psychological Assessment or Intervention	Occupational Therapy Assessment or Intervention	Refer to Other Services	School Accommodations /Adaptations	Family or Individual Support/ Resources	Case Presenter Professional Development
34	0	1	0	0	0	1	4	1
46	0	2	1	0	0	0	2	3
51	1	1	1	0	3	3	2	0
52	5	3	0	1	1	0	2	1
58	1	0	4	0	1	0	2	1
60	1	1	1	1	0	0	3	3