INTERAGENCY AUTISM COORDINATING COMMITTEE

2019

SUMMARY OF ADVANCES

in Autism Spectrum Disorder Research

IACC
INTERAGENCY AUTISM COORDINATING COMMITTEE

OFFICE OF AUTISM RESEARCH COORDINATION
NATIONAL INSTITUTES OF HEALTH

INTERAGENCY AUTISM COORDINATING COMMITTEE

2019
SUMMARY OF ADVANCES

In Autism Spectrum Disorder Research

IACC
INTERAGENCY AUTISM COORDINATING COMMITTEE

OFFICE OF AUTISM RESEARCH COORDINATION
NATIONAL INSTITUTES OF HEALTH

COVER DESIGN

NIH Medical Arts Branch

COPYRIGHT INFORMATION

SUGGESTED CITATION

Interagency Autism Coordinating Committee (IACC). *2019 IACC Summary of Advances in Autism Spectrum Disorder Research*. May 2020. Retrieved from the U.S. Department of Health and Human Services Interagency Autism Coordinating Committee website: *https://iacc.hhs.gov/publications/summary-of-advances/2019/*.

ABOUT THE IACC

The Interagency Autism Coordinating Committee (IACC) is a Federal advisory committee charged with coordinating Federal activities concerning autism spectrum disorder (ASD) and providing advice to the Secretary of Health and Human Services (HHS) on issues related to autism. The Committee was established by Congress under the *Children's Health Act of 2000*, reconstituted under the *Combating Autism Act (CAA) of 2006*, and renewed most recently under the *Autism Collaboration, Accountability, Research, Education, and Support (CARES) Act of 2019*.

Membership of the Committee includes a wide array of Federal agencies involved in ASD research and services, as well as public stakeholders, including self-advocates, family members of children and adults with ASD, advocates, service providers, and researchers, who represent a variety of perspectives from within the autism community. The IACC membership is composed to ensure that the Committee is equipped to address the wide range of issues and challenges faced by individuals and families affected by autism.

Under the CAA and subsequent reauthorizations, the IACC is required to (1) develop and annually update a strategic plan for ASD research, (2) develop and annually update a summary of advances in ASD research, and (3) monitor Federal activities related to ASD.

Through these and other activities, the IACC provides guidance to HHS and partners with other Federal departments, Federal agencies, research and advocacy organizations, and the broader autism community to accelerate research and enhance services with the goal of profoundly improving the lives of people with ASD and their families.

***

For more information about the IACC, see *http://www.iacc.hhs.gov*.

TABLE OF CONTENTS

INTRODUCTION

THE 2019 IACC SUMMARY OF ADVANCES IN AUTISM SPECTRUM DISORDER RESEARCH

Each year, the IACC releases a list of scientific advances that represent significant progress in the field. The *2019 IACC Summary of Advances* provides short, plain language summaries of the top research breakthroughs selected by the IACC from a pool of research articles nominated by the members. The 20 studies selected for 2019 have provided new insight into disparities in ASD diagnoses, predictors of language development in preschoolers with ASD, and the impact of various environmental factors on ASD risk. The advances also include studies of behavioral interventions for children with ASD, strategies to train therapists in publicly funded mental health services, supports for transition-age youth and young adults, and ASD prevalence estimates in 4-year-old children.

Articles in the *IACC Summary of Advances* are grouped according to the topics represented by the seven questions of the *IACC Strategic Plan for ASD*. Citations for the articles selected for the *2019 IACC Summary of Advances*, as well as a complete listing of those nominated, are included at the end of the document.

ARTICLES SELECTED FOR THE 2019 SUMMARY OF ADVANCES

QUESTION 1: HOW CAN I RECOGNIZE THE SIGNS OF ASD, AND WHY IS EARLY DETECTION SO IMPORTANT?

- Accuracy of Autism Screening in a Large Pediatric Network
- Evaluation of the Diagnostic Stability of the Early Autism Spectrum Disorder Phenotype in the General Population Starting at 12 Months
- Disparities in Documented Diagnoses of Autism Spectrum Disorder Based on Demographic, Individual, and Service Factors

QUESTION 2: WHAT IS THE BIOLOGY UNDERLYING ASD?

- Predictors of Longer-Term Development of Expressive Language in Two Independent Longitudinal Cohorts of Language-Delayed Preschoolers with Autism Spectrum Disorder

QUESTION 3: WHAT CAUSES ASD, AND CAN DISABLING ASPECTS OF ASD BE PREVENTED OR PREEMPTED?

- Association of Genetic and Environmental Factors with Autism in a 5-Country Cohort
- Identification of Common Genetic Risk Variants for Autism Spectrum Disorder
- Measles, Mumps, Rubella Vaccination and Autism: A Nationwide Cohort Study
- Air Pollution, Neighborhood Deprivation, and Autism Spectrum Disorder in the Study to Explore Early Development
- Association of Maternal Prenatal Vitamin Use with Risk for Autism Spectrum Disorder Recurrence in Young Siblings

QUESTION 4: WHICH TREATMENTS AND INTERVENTIONS WILL HELP?

- Effectiveness of Community-Based Early Intervention for Children with Autism Spectrum Disorder: A Meta-Analysis
- A Multisite Randomized Controlled Two-Phase Trial of the Early Start Denver Model Compared to Treatment as Usual
- Effect of Wearable Digital Intervention for Improving Socialization in Children with Autism Spectrum Disorder: A Randomized Clinical Trial

QUESTION 5: WHAT KINDS OF SERVICES AND SUPPORTS ARE NEEDED TO MAXIMIZE QUALITY OF LIFE FOR PEOPLE ON THE AUTISM SPECTRUM?

- Effectiveness of Training Therapists to Deliver an Individualized Mental Health Intervention for Children with ASD in Publicly Funded Mental Health Services: A Cluster Randomized Clinical Trial

- The Effect of Medicaid Waivers on Ameliorating Racial/Ethnic Disparities Among Children with Autism

QUESTION 6: HOW CAN WE MEET THE NEEDS OF PEOPLE WITH ASD AS THEY PROGRESS INTO AND THROUGH ADULTHOOD?

- A 20-Year Study of Suicide Death in a Statewide Autism Population
- Loss in Services Precedes High School Exit for Teens with Autism Spectrum Disorder: A Longitudinal Study
- Use of Vocational Rehabilitation Supports for Postsecondary Education Among Transition-Age Youth on the Autism Spectrum
- Competitive Employment for Transition-Aged Youth with Significant Impact from Autism: A Multi-Site Randomized Clinical Trial

QUESTION 7: HOW DO WE CONTINUE TO BUILD, EXPAND, AND ENHANCE THE INFRASTRUCTURE SYSTEM TO MEET THE NEEDS OF THE ASD COMMUNITY?

- Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 4 Years—Early Autism and Developmental Disabilities Monitoring Network, Seven Sites, United States, 2010, 2012, and 2014
- Selection Bias on Intellectual Ability in Autism Research: A Cross-Sectional Review and Meta-Analysis

QUESTION 1

HOW CAN I RECOGNIZE THE SIGNS OF ASD, AND WHY IS EARLY DETECTION SO IMPORTANT?

Accuracy of Autism Screening in a Large Pediatric Network

Guthrie W, Wallis K, Bennett A, Brooks E, Dudley J, Gerdes M, Pandey J, Levy SE, Schultz RT, Miller JS. *Pediatrics.* 2019 Oct;144(4). pii: e20183963. [*PMID: 31562252*]

Most children with autism spectrum disorder (ASD) show symptoms by 2 years of age, but many are not diagnosed until age 4 or older. Because earlier diagnosis of ASD is associated with positive outcomes, the American Academy of Pediatrics recommends universal screening for ASD. Conducted by primary care providers, universal screening would evaluate all children between ages 18 and 24 months for signs of ASD to promote earlier detection of the disorder and to ensure that all children, especially those from underrepresented groups (including rural and lower-income children), receive adequate supports and services. However, the US Preventive Services Task Force concluded that there is currently insufficient evidence to recommend universal screening. Existing data typically underrepresent children of color and children from low-income families. Additionally, there is limited data about the long-term outcomes of children who screen negative for ASD and subsequently do not return for follow-up.

In this study, researchers examined the accuracy of universal screening in a real-world setting by using a screening tool and long-term follow-up among a diverse population of toddlers in a large pediatric primary care health network. A total of 23,634 children were screened in the study and 50.4% were screened more than once. The researchers used the Modified Checklist for Autism in Toddlers with Follow-Up (M-CHAT/F), the most widely used screening tool for this age group. Primary care providers administered the M-CHAT/F to all children aged 16 to 26 months who received a well-child check-up from a Children's Hospital of Pennsylvania primary care provider. All children in the study received follow-up screening at or after age 4. The researchers used the children's electronic health records to confirm an ASD diagnosis, considering a child to have ASD if the diagnosis appeared more than once in the health record or if the diagnosis was provided by a specialist.

The researchers screened 91% of children who had eligible visits. Of these children, 9.5% screened positive for ASD on the first administration of the M-CHAT/F. After a second screening, the final number of children who screened positive for ASD dropped to 6.2%. The researchers determined that the M-CHAT/F is less accurate in detecting ASD in this

"real-world" cohort than previously assumed. The M-CHAT/F positively identified only 38.8% of children who were later diagnosed with ASD (similar to what has been reported in other studies), and children who did screen positive for ASD only had a 14.6% probability of actually having the disorder.

There were differences in the sensitivity (percentage of true positives among those who screened positive) of the M-CHAT/F across sex, age, race, and income. The M-CHAT/F was less sensitive for girls than for boys. The M-CHAT/F was more sensitive for older toddlers than for younger toddlers at the initial screening, and combining results from repeated follow-up screenings yielded greater sensitivity than the first screening or any single follow-up screening. Children of color and children from lower income households were more likely to screen positive for ASD than white children or children from higher income families. However, the researchers found that the M-CHAT/F more accurately diagnosed white children with ASD than children of other racial or ethnic groups. Children from urban areas, low-income families, or families who used Medicaid were also less likely to receive an accurate diagnosis. These children were less likely to receive repeated screenings.

Despite demographic disparities, children who screened positive received an ASD diagnosis on average 7 months earlier than children who initially screened negative but did have ASD (as determined at a later date). This finding indicates that, in many cases, accurate early screening can accelerate a child's diagnosis and potentially lead to earlier intervention. The researchers concluded that universal screening in primary care is possible when administered electronically and fully integrated with electronic health records. Although new tools are needed in addition to the M-CHAT/F to detect a greater proportion of children with ASD and reduce racial and socioeconomic disparities in the screening process, universal screening remains a promising method for early ASD detection among young children.

Evaluation of the Diagnostic Stability of the Early Autism Spectrum Disorder Phenotype in the General Population Starting at 12 Months

Pierce K, Gazestani VH, Bacon E, Barnes CC, Cha D, Nalabolu S, Lopez L, Moore A, Pence-Stophaeros S, Courchesne E. *JAMA Pediatr*. 2019 Jun 1;173(6):578-587. [*PMID: 31034004*]

Although most children with ASD are diagnosed between the ages of 3 and 4 years, many children show ASD-related symptoms as early as 12 months of age. Because toddlerhood (12 to 36 months) is a stage of rapid brain development, late diagnosis often represents a missed opportunity for early intervention during this important developmental period.

Despite the potential benefits associated with early detection, the US Preventive Services Task Force believes there is currently insufficient evidence to recommend universal screening for ASD. Some opponents of universal screening for 18-month-old children have expressed concerns about diagnostic stability, the likelihood that an initial ASD diagnosis is confirmed at subsequent evaluations. Previous studies that have addressed diagnostic stability have only used small groups of 18-month-old children who were not representative of the general population, and no such studies have included a control group of children without ASD.

The goal of this study was therefore to determine diagnostic stability of ASD among children 12 to 36 months old who were randomly selected from the general population. The researchers also aimed to evaluate the diagnostic stability of ASD compared to other diagnostic categories (e.g., language or developmental delay) among children of this age group.

A California-based early detection screening program, Get SET Early, referred 2,241 toddlers to the study for ASD evaluation. To establish a control group for comparison, clinics participating in Get SET Early also referred typically developing (TD) toddlers. The study included 1,269 toddlers who received at least two evaluations from licensed psychologists every 12 months until 3 years of age. At each evaluation, the children received a designation of ASD, ASD features (showing signs, but not enough to meet DSM diagnostic criteria), developmental delay, language delay, other issue, TD, or TD sibling of an ASD child.

The researchers determined that overall stability for an ASD diagnosis was .84, meaning that 84% of children retained their original ASD diagnosis at follow-up evaluation. ASD diagnostic stability increased steadily as children aged—from .5 at ages 12 to 13 months, to .79 at 14 months, and to .83 at 16 months. In general, diagnostic stability was lower among children who were diagnosed with other delays, likely because non-ASD developmental delays often self-correct within the first few years of life. Overall stability for a TD diagnosis was .79.

Most of the children who transitioned from one diagnosis to another were initially determined to have language or developmental delays and then received an ASD diagnosis at later evaluation. The least common transition was from initial ASD designation to later TD designation, representing only 1.8% of the 400 children who were initially diagnosed as having ASD. The majority (71%) of these children who received initial ASD diagnoses were

first evaluated at 12 to 13 months old, indicating that immediate referral for early intervention may have improved their long-term outcomes.

The researchers concluded that ASD diagnosis is stable by 14 months of age, and toddlers who receive an early ASD diagnosis are very unlikely to be considered TD later in life. An initial ASD diagnosis was found to be more stable than any other diagnosis, including TD. While the American Academy of Pediatrics recommends initial screening for ASD at 18 months of age, the results of this study suggest that ASD is reliably detectable and diagnosable in children as young as 14 months of age.

Disparities in Documented Diagnoses of Autism Spectrum Disorder Based on Demographic, Individual, and Service Factors

Wiggins LD, Durkin M, Esler A, Lee LC, Zahorodny W, Rice C, Yeargin-Allsopp M, Dowling NF, Hall-Lande J, Morrier MJ, Christensen D, Shenouda J, Baio J. *Autism Res.* 2020 Mar;13(3):464-473. [*PMID: 31868321*]

Identifying ASD in children can be a complex, time-intensive process that involves observing the child and obtaining a detailed developmental history from the caregiver. As a result, children whose families experience systemic barriers to accessing quality pediatric services may never receive a clinical ASD diagnosis, even when ASD symptoms are present. Current research on disparities in ASD diagnosis indicate that factors such as a child's race and ethnicity, symptom severity, and co-occurring conditions can influence timing of diagnosis. White children are generally diagnosed 1–2 years earlier than non-white children. Unfortunately, children with ASD symptoms who receive a late ASD diagnosis—or never receive one at all—have less opportunity to access interventions and other services that may improve their long-term outcomes.

The goal of this study was to determine how many children have ASD indicators but no ASD diagnosis documented in health or education records. Additionally, the study aimed to identify demographic, individual, and service-related factors that might influence the presence of an ASD diagnosis in a large and diverse group of children. The study used data from the Autism and Developmental Disabilities Monitoring (ADDM) network, funded by the Centers for Disease Control and Prevention (CDC). During surveillance year 2014, the ADDM network conducted ASD surveillance in 11 sites located in AZ, AK, CO, GA, MD, MN, MO, NJ, NC, TN, and WI. Expert clinicians reviewed health and education records of eight-year-old children for social deficits that indicate symptoms of ASD (e.g., limited interest in other children or reduced eye contact). They then applied a standardized coding scheme to determine if children met ASD criteria outlined in the Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition (DSM-5). They also coded information about behavioral characteristics, intellectual functioning, co-occurring conditions, and the presence of an existing ASD diagnosis documented in service records.

The researchers determined that 4,498 of the surveyed children met ADDM criteria for ASD surveillance. One-quarter of these children had documented ASD indicators comparable to diagnostic criteria (at least three social criteria and at least two of four behavioral criteria) but no formal ASD diagnosis documented in service records. Of these children, more than half (55%) were not receiving any ASD interventions or services in public school. Factors associated with not having a clinical diagnosis of ASD were non-White race, no intellectual disability, first developmental concern after three years of age, first developmental evaluation after three years of age, special education eligibility other than ASD, and need for fewer supports.

These results highlight the importance of reducing disparities in the diagnosis of children with ASD so that appropriate interventions can be promoted across communities. One strategy known to reduce these disparities is the use of patient navigators, who provide comprehensive guidance from diagnosis to intervention and help families overcome barriers to care. Other strategies that show promise at reducing disparities include the use of picture screens to overcome language barriers, presumptive eligibility approaches that promote early intervention for children who screen as at-risk, and extended screening efforts beyond preschool age to identify older at-risk children.

QUESTION 2

WHAT IS THE BIOLOGY UNDERLYING ASD?

Predictors of Longer-Term Development of Expressive Language in Two Independent Longitudinal Cohorts of Language-Delayed Preschoolers with Autism Spectrum Disorder

Bal VH, Fok M, Lord C, Smith IM, Mirenda P, Szatmari P, Vaillancourt T, Volden J, Waddell C, Zwaigenbaum L, Bennett T, Duku E, Elsabbagh M, Georgiades S, Ungar WJ, Zaidman-Zait A. *J Child Psychol Psychiatry*. 2019 Aug 19. [*PMID: 31429087*]

It is estimated that half to three-quarters of preschool children with ASD are minimally verbal. Although this percentage decreases with older age, language delays can persist even with intervention: studies show that one-third of young adults with ASD remain minimally verbal. Early indicators such as expressive communication, nonverbal cognition, joint attention, and motor skills can predict the trajectory of language development in young children, but little is known about the skills and behavioral markers that predict longer-term language abilities in individuals with ASD as they grow into adulthood.

In this study, researchers sought to identify the early predictors of expressive language outcomes in minimally verbal individuals with ASD from early childhood to early adulthood. The researchers used data from two independent samples of children with ASD who, at age 3, used single words or less during the administration of the PreLinguistic Autism Diagnosis Observation Schedule (ADOS). First, they assessed 86 language-delayed children with ASD from the Early Diagnosis (EDX) study as a "discovery" sample to identify the predictors of language outcomes. Then, they sought to replicate these findings using a cohort of 181 language-delayed children from the Pathways in ASD (Pathways) study.

The researchers administered the Mullens Scales of Early Learning (MSEL)—an assessment tool for language and motor skills—to children from the EDX study at age 3 and again at age 19 years. To identify the best long-term predictors of language outcomes, they implemented an exploratory statistical model called the Classification and Regression Tree (CART). They found that preschool fine motor skills were the strongest predictor of language abilities in early adulthood. Of the 40 young children who had extreme fine motor delays, 31 remained minimally verbal at 19 years of age. Additionally, an interaction between mild fine motor delay and joint attention emerged. Of the

remaining 46 children who had mild fine motor delays, 13 children who also showed strong joint attention in preschool went on to develop phrase or fluent speech (as opposed to continuing to use single words or less).

Although age of walking was not a predictor of later language skills in the EDX study sample, the researchers found that 53% of the children who walked before 13 months remained minimally verbal at age 19, while only 29% of those who walked after 13 months remained minimally verbal. This result was somewhat unexpected and suggests that minimal expressive language in autistic children is not always associated with global delays.

The researchers sought to replicate these findings in the Pathways study sample to determine if the CART model could predict language trajectories in a larger group of children and with a different assessment tool (the Merrill Palmer-Revised Scales of Development, M-P-R). Like the MSEL, the M-P-R measures language, motor, and cognitive skills. In this sample, they conducted a follow-up assessment in children at an average age of 10.5 years and again found that fine motor skills predicted later expressive language abilities; children with milder fine motor delays showed better language gains at age 10.5 than children with more impaired fine motor skills. In this study sample, however, the interaction of fine motor skills and joint attention did not predict long-term language outcomes.

Overall, this study found that fine motor skills at age 3 significantly predicted later expressive language outcomes in children with ASD and delayed language. This was found to be consistent across two independent cohorts using different measures of fine motor skills. These findings suggest the possibility of a developmental cascade, wherein early fine motor skills encourage interactions with the environment that facilitate language development. This study also demonstrated the value of using more specific, well-defined skill areas rather than broad skill markers, which would help identify levels of developmental delay and better inform targeted interventions.

QUESTION 3

WHAT CAUSES ASD, AND CAN DISABLING ASPECTS OF ASD BE PREVENTED OR PREEMPTED?

Association of Genetic and Environmental Factors with Autism in a 5-Country Cohort

Bai D, Yip BHK, Windham GC, Sourander A, Francis R, Yoffe R, Glasson E, Mahjani B, Suominen A, Leonard H, Gissler M, Buxbaum JD, Wong K, Schendel D, Kodesh A, Breshnahan M, Levine SZ, Parner ET, Hansen SN, Hultman C, Reichenberg A, Sandin S. *JAMA Psychiatry*. 2019 Jul 17. [*PMID: 31314057*]

The origins of ASD are not fully understood, but research has consistently supported a significant effect of both common and rare inherited genetic variations. Additionally, there is evidence that other, non-inherited traits may also influence the development of ASD. One type of non-inherited trait is *maternal effects*—the genetic influences originating from the mother independent of what is inherited by the child, such as gestational diabetes or complications resulting in pre-term birth. Another type of non-inherited trait is *environmental exposure*, which originates from either a shared environment (exposure that affects family members similarly) or a non-shared environment (exposure that uniquely affects an individual). Although both heritable and non-heritable traits have been associated with ASD, less is known about the potential for an additive effect of these traits on ASD risk.

The current study addressed this knowledge gap by estimating the cumulative influence of genetic variation, maternal effects, and environmental exposures on ASD risk. The researchers also aimed to determine the individual risk contribution associated with each of these factors and the consistency of risk estimates across different geographical locations.

The researchers examined five large, multigenerational datasets from children born between 1998 and 2011 across Denmark, Finland, Sweden, Israel, and Western Australia, collecting data from birth up to 16 years of age. To determine inherited and non-inherited influences of ASD risk, the researchers used health outcome data to estimate effects associated with degree of familial relation across three generations, including a given child, his/her full siblings, and his/her maternal parallel cousins (i.e. the children of the child's mother's sister). By comparing across these different relationships, the researchers were able to develop models to analyze the different components of risk and to identify any additive effect.

Of the 2,001,631 children included in the study, 22,156 (1.11%) were diagnosed with ASD. The researchers found that maternal effects had a minimal contribution, accounting for only 0.4 to 1.6% of ASD risk. Shared environmental effects on ASD risk ranged from 0 to 14.5%, while non-shared environmental effects ranged from 15 to 34%. Conversely, inherited genetic factors contributed approximately 80% of ASD risk, although this figure significantly varied by country (for example, 51% in Finland and 87% in Israel).

These findings indicate that the majority of ASD risk is attributable to inherited genetic factors, with a modest additional contribution from non-shared environmental effects. There was some variation in genetic risk across countries, indicating that there may be genetic differences between these population structures. Importantly, maternal effects accounted very minimally towards total ASD risk, indicating that maternal-targeted interventions may be less influential in reducing ASD risk.

Identification of Common Genetic Risk Variants for Autism Spectrum Disorder

Grove J, Ripke S, Als TD, Mattheisen M, Walters RK, Won H, Pallesen J, Agerbo E, Andreassen OA, Anney R, Awashti S, Belliveau R, Bettella F, Buxbaum JD, Bybjerg-Grauholm J, Bækvad-Hansen M, Cerrato F, Chambert K, Christensen JH, Churchhouse C, Dellenvall K, Demontis D, De Rubeis S, Devlin B, Djurovic S, Dumont AL, Goldstein JI, Hansen CS, Hauberg ME, Hollegaard MV, Hope S, Howrigan DP, Huang H, Hultman CM, Klei L, Maller J, Martin J, Martin AR, Moran JL, Nyegaard M, Nærland T, Palmer DS, Palotie A, Pedersen CB, Pedersen MG, dPoterba T, Poulsen JB, Pourcain BS, Qvist P, Rehnström K, Reichenberg A, Reichert J, Robinson EB, Roeder K, Roussos P, Saemundsen E, Sandin S, Satterstrom FK, Davey Smith G, Stefansson H, Steinberg S, Stevens CR, Sullivan PF, Turley P, Walters GB, Xu X; Autism Spectrum Disorder Working Group of the Psychiatric Genomics Consortium; BUPGEN; Major Depressive Disorder Working Group of the Psychiatric Genomics Consortium; 23andMe Research Team, Stefansson K, Geschwind DH, Nordentoft M, Hougaard DM, Werge T, Mors O, Mortensen PB, Neale BM, Daly MJ, Børglum AD. *Nat Genet.* 2019 Mar;51(3):431-444. [*PMID: 30804558*]

ASD is highly heritable, but the presentation of ASD is complex and varies significantly—ranging from individuals who have high support needs and intellectual disability to those who have high levels of academic and occupational functioning. ASD is a *polygenic* disorder, i.e. it is likely that combinations of several genetic variations contribute to the different forms of ASD. Researchers have identified both common and rare inherited *genetic variations* (differences in DNA sequence between individuals) that contribute to ASD risk. However, relatively small sample sizes in previous genome-wide association studies (GWAS) have limited our ability to identify the individually significant genetic variations that contribute to specific ASD traits.

Researchers conducted a GWAS meta-analysis to identify the common genetic variations that are strongly associated with ASD traits, using a significantly larger participant pool than previous efforts. They also evaluated the *polygenic architecture* of ASD subtypes in order to determine whether particular forms of ASD are more likely correlated with specific common variants or combinations of variants. Their population-based participant pool included 18,381 individuals with ASD and 27,969 age-matched control individuals born in Denmark between 1981 and 2005. The researchers processed and analyzed genotype data that had previously been validated from individuals with ASD in the iPSYCH registry, a nationwide effort to identify genetic and environmental causes of mental illness in Denmark. After processing the genotype data, 13,076 individuals with ASD and 22,664 controls were included in the meta-analysis.

The researchers identified five *loci* (specific areas of the chromosome) with genetic variations common to the risk of ASD. Using a second dataset, they further analyzed loci that were highly correlated with similarly complex *phenotypes* (observable characteristics) such as schizophrenia, major depression, and educational attainment. This led to the identification of an additional seven loci that were significantly associated with ASD.

When the researchers divided the ASD dataset into diagnostic subtypes, they found strong genetic correlations with specific traits. Cognitive traits such as educational attainment, as well as risk for adult psychiatric illness, were associated with the most significant genetic variation between ASD subtypes. Specifically, the researchers found individually significant genetic variations for higher educational attainment and intelligence only in individuals within the Asperger's syndrome and childhood autism subtypes, which are typically associated with less severe impairments. Additionally, they found that individuals within the subtypes of atypical ASD or unspecified pervasive developmental disorders (PDD) had significantly higher genetic traits associated with neuroticism than other subtypes. Heritability was stronger and common genetic variations were more prominent in individuals with Asperger's syndrome and childhood autism, while rare and *de novo* genetic variations (new genetic alterations, i.e., found in the child but not the parents) occurred more frequently in individuals with ASD and intellectual disability than other subtypes.

This study provides novel evidence of variations in polygenic architecture across subtypes of ASD. It builds on previous observations of differences among common and rare genetic variations. These insights provide a framework towards advancing the understanding of the biological foundation of ASD and its complexities.

Measles, Mumps, Rubella Vaccination and Autism: A Nationwide Cohort Study

Hviid A, Hansen JV, Frisch M, Melbye M. *Ann Intern Med.* 2019 Apr 16;170(8):513-520. [*PMID: 30831578*]

Despite definitive research supporting the safety of vaccines, the now discredited link between the measles, mumps, and rubella (MMR) vaccine and the development of ASD remains a pervasive concern among many people. Previous safety studies have been conducted with scientific rigor and are widely accepted among health care practitioners. Nonetheless, critics assert that studies conducted on the MMR vaccine and ASD risk have not ruled out possible effects in specific subgroups of potentially at-risk children. They further argue that that specific links to the regressive form of autism, in which children are thought to show declines in abilities after receiving the MMR vaccine, have not been addressed.

This study aimed to determine if the MMR vaccine increased ASD risk among specific subgroups of children who may be at higher risk of developing ASD than the general population. Additionally, the researchers sought to evaluate ASD risk within specific periods of time following MMR vaccination in order to examine potential regression after vaccination. The study included data from 657,461 children born in Denmark between 1999 and 2010. Nearly all (95%) of the children included had received the MMR vaccine, with the average age of vaccination at just over 12 months. Of the total study population, 6,517 children were diagnosed with ASD, with an average age at diagnosis of 7 years old. ASD diagnoses were coded according to the International Classification of Diseases, 10th Revision. The following coding categories were used: autistic disorder, atypical autism, Asperger syndrome, other pervasive developmental disorders, and unspecified pervasive developmental disorder.

The researchers defined ASD risk subgroups according to genetic susceptibility for ASD (i.e., sibling history of ASD) and an estimated summary index of combined environmental risk factors for ASD (including age of parents, smoking during pregnancy, method of delivery, preterm birth, birthweight, head circumference, and Apgar score). They used these definitions to estimate an "autism risk score" for each child in the dataset, and then used the scores to categorize children into four subgroups based on level of risk. They further characterized the subgroups according to sex, birth cohort, and prior vaccinations in the first year of life. They then compared children who received the MMR vaccination with those who did not—both by subgroup and also at age intervals of 1 to 3 years, 3 to 5 years, 5 to 7 years, 7 to 10 years, and more than 10 years of age.

The researchers identified several significant single risk factors for ASD: having an older or unknown father, an older mother, a poor Apgar score, low birthweight or preterm birth, a large head circumference, an assisted birth, and smoking during pregnancy. ASD risk was equal among children who had or had not received the MMR vaccine. Additionally, the MMR vaccine did not increase ASD risk among vulnerable subgroups, including children exposed to environmental risk factors, children with a sibling with ASD, and children who had received early childhood vaccinations prior to the MMR vaccine. ASD risk remained consistent at all assessed age periods following the MMR vaccine, indicating that no time period after receiving the vaccine is associated with higher risk of developing any form of ASD.

These results support findings from previous research, which maintain that the MMR vaccine does not increase ASD risk at any time after vaccination, nor for any subgroup of children—even those who have other risk factors for developing ASD. Use of subgroup analyses and time period analyses in the present study addresses many of the common criticisms that are launched against vaccine research. The researchers conclude that their study offers reassurance and provides reliable data on which clinicians and health authorities can base their decisions.

Air Pollution, Neighborhood Deprivation, and Autism Spectrum Disorder in the Study to Explore Early Development

McGuinn LA, Windham GC, Messer LC, Di Q, Schwartz J, Croen LA, Moody EJ, Rappold AG, Richardson DB, Neas LM, Gammon MD, Schieve LA, Daniels JL. *Environmental Epidemiology*. 2019 October;3(5):e067. [*https://doi.org/10.1097/EE9.0000000000000067*]

Several environmental exposures during the prenatal and early postnatal periods have been implicated in the development of ASD. Specifically, some studies have identified maternal social stress and air pollution as environmental factors that may increase a child's ASD risk. Environmental toxins and neighborhood stressors tend to co-occur in areas characterized by low socioeconomic status (SES), resulting in a phenomenon known as *neighborhood deprivation*. Epidemiologists use neighborhood deprivation as a measure of a geographic area's social, economic, and health-related stressors—all of which may individually or collectively influence a child's risk of developing ASD.

This study aimed to understand the cumulative role of neighborhood deprivation and air pollution exposure in ASD risk. Additionally, the researchers hypothesized that the chronic stress generally associated with neighborhood deprivation may lead to compromised immune systems, increasing neighborhood residents' vulnerability to harmful environmental toxins.

Using data from the CDC's ongoing Study to Explore Early Development (SEED), the researchers identified 674 children diagnosed with ASD who were born between 2003 and 2006, and 855 randomly sampled controls born within the same time period. Children who screened positive for ASD based on caregiver report were referred for comprehensive assessment. The researchers determined each child's air pollution exposure level based on their home address at birth, residential proximity to major roadways (a measure of exposure to local pollutants), and exposure to potentially harmful particulate matter (mixed microscopic particles from both local and regionally transported pollutants). They also calculated each child's neighborhood deprivation index (low, moderate, or high), determined by several neighborhood-level parameters such as household education level, household income, and housing conditions.

The researchers found that children with ASD were more likely to be male, born prematurely, and born to non-white, less-educated mothers. Children belonging to the "high deprivation" group were also more likely to be non-white and born to lower-income, less-educated mothers. Compared to moderate and low deprivation groups, mothers from the high deprivation group were more likely to have experienced particulate matter exposure and close proximity to major roadways during pregnancy. Children who lived near major roadways and were exposed to particulate matter during their first year of life were more likely to have an ASD diagnosis than those who were not. The association between major roadway proximity and ASD risk was strongest for the moderate deprivation group as compared to the high or low deprivation groups, suggesting that transported traffic particulates may be associated with different outcomes than region-specific particulates.

These findings indicate that neighborhood deprivation and air pollution exposure during the first year of life are associated with the development of ASD. Importantly, these factors likely interact reciprocally to increase overall ASD risk. That is, families who live in deprived neighborhoods are more likely exposed to early environmental factors that increase ASD risk *and* tend to have limited access to health care services and other resources that may improve ASD-related outcomes. Communities experiencing deprivation and other chronic environmental stressors may benefit from targeted interventions to reduce the effects of early ASD risk factors.

Association of Maternal Prenatal Vitamin Use with Risk for Autism Spectrum Disorder Recurrence in Young Siblings

Schmidt RJ, Iosif AM, Guerrero Angel E, Ozonoff S. *JAMA Psychiatry*. 2019 Apr 1;76(4):391-398. [*PMID: 30810722*]

The development of ASD is thought to be influenced in part by the prenatal environment, including gestational nutrition. Recent research suggests that the use of prenatal vitamins with folic acid very early in pregnancy may be associated with lower risk of developing ASD. However, mothers who have access to these prenatal vitamins and are aware of their health benefits also may have generally healthier lifestyles than those who do not. It is therefore uncertain whether reduced ASD risk can be attributed specifically to prenatal vitamin use rather than other factors such as overall maternal health. Researchers can address this uncertainty by studying families who already have a child affected by ASD, as most siblings share similar environmental, gestational, and genetic factors. With these factors held constant, research studies can provide more accurate conclusions about the association between prenatal vitamin use and ASD risk.

This study investigated the relationship between maternal prenatal vitamin use and ASD development in high-risk children (i.e. those with a sibling who has ASD). The researchers aimed to determine if early prenatal vitamin use may be a protective factor for families with ASD-affected children, whose future children are approximately 12 times more likely to also have ASD than children with no sibling history of ASD.

Using existing data from the Markers of Autism Risk in Babies: Learning Early Signs (MARBLES) study, researchers recruited children from families who sought ASD services from the California Department of Developmental Services between 2006 and 2015. Children were classified as ASD, typically developing (TD), or nontypically developing (non-TD) based on results from the Autism Diagnostic Observation Schedule (ADOS) and the Mullen Scales of Early Learning (MSEL). The researchers interviewed mothers by telephone to obtain data about their prenatal vitamin use, using brand names to determine folic acid and iron intake. They also collected data related to maternal health including demographic, lifestyle, medical, and environmental information.

The study sample included 241 younger siblings of children with ASD. According to the ADOS and MSEL results, about 23% of the younger siblings met criteria for ASD, 52% were TD, and 25% were non-TD. Although most (231) of the mothers took prenatal vitamins at some point during pregnancy, only 87 (36%) followed clinical recommendations to take prenatal vitamins during the six months prior to pregnancy. In general, mothers who took any prenatal vitamins were more likely to have higher educational attainment, own a home, have health insurance, and intentionally plan their pregnancies. About 14% of mothers in the study also reported taking other vitamin supplements during the first month of pregnancy.

After adjusting for factors of overall maternal health, the researchers determined that ASD prevalence was 17% among children whose mothers took prenatal vitamins during the first month of pregnancy as compared to 33%

among children whose mothers did not. Additionally, ASD symptoms tended to be less severe among children who were exposed to prenatal vitamins during the first month of gestation. The influence of prenatal vitamin use on ASD risk did not vary by race, ethnicity, or maternal age; however, girls were more likely than boys to have a reduced risk of ASD associated with prenatal vitamin use. There was no association between prenatal vitamin use and a designation of TD versus non-TD.

Children whose mothers who took more than 600 micrograms of folic acid were at lower risk of developing ASD but had equal risk of a non-TD diagnosis. Additionally, children whose mothers consumed higher amounts of iron during the first month of pregnancy, as compared to the bottom one-third of mothers who consumed lower amounts of iron, also had reduced risk of ASD.

The results of this study indicate that maternal prenatal vitamin use during the first month of pregnancy may reduce ASD risk among children who are at high risk as a result of sibling history of ASD. Importantly, these findings suggest that controlling for gestational exposures may have a protective effect, even among subgroups of children who are at elevated genetic risk for ASD. Because prenatal vitamins contain several nutritional components, further research is necessary to specifically determine which nutrients are associated with reduced risk of ASD.

QUESTION 4

WHICH TREATMENTS AND INTERVENTIONS WILL HELP?

Effectiveness of Community-Based Early Intervention for Children with Autism Spectrum Disorder: A Meta-Analysis

Nahmias AS, Pellecchia M, Stahmer AC, Mandell DS. *J Child Psychol Psychiatry*. 2019 Nov;60(11):1200-1209. [*PMID: 31206690*]

Research indicates that children with ASD often experience cognitive, social, and communicative improvements as a result of early interventions provided by university-based experts. However, most community-based early intervention programs—where most children with ASD receive services—often do not incorporate evidence-based approaches into their practice. Not much is known about whether community practice results in positive outcomes for autistic children, and how their outcomes compare to what is observed in university-based trials.

The purpose of this meta-analysis was to determine the effect of early intervention for ASD as it is implemented in community-based settings. Four outcome domains were considered: cognition, social skills, communication, and adaptive behavior. The researchers also aimed to identify moderating factors that may influence the effectiveness of community-based early intervention for children with ASD.

The researchers first conducted a systematic review of previous studies that investigated the relationship between early intervention in community settings and ASD outcomes. Studies were included that met the following criteria: written in English, pre-test/post-test group design, and age of children at the start of the study was less than 73 months. For a study to be included, it also had to provide information about children's cognitive, social, communication, or behavioral outcomes based on a variety of common clinical measures. Ultimately, 33 studies from 9 countries were included in the analysis. Data from these studies were then coded for different categories of early intervention programs, including "model programs" (community care associated with universities or hospitals), "specified treatment as usual" (treatments at a school or agency with specified and defined procedures), and "unspecified treatment as usual" (treatment in which participants received an unspecified array of services).

The researchers next determined the *effect size* of each intervention on ASD outcomes. Effect sizes measure the magnitude of change from baseline to post-treatment, indicating the degree to which the intervention had a positive impact on ASD outcomes. They also explored whether effect sizes differed based on group and intervention characteristics, such as country of origin and study design.

The researchers found that the average effect sizes for intervention programs were small across all outcome domains. Children in model programs did show moderate improvement in cognitive outcomes and small improvements in outcomes for communication, social behavior, and adaptive behavior. When assessing for moderating factors, the researchers found that effect sizes differed by the country in which the study was conducted. For example, early interventions in Italy showed medium effects on communication and adaptive behavior outcomes, while early interventions in Israel showed medium effects only on communication outcomes. On average, intervention duration was negatively associated with communication and adaptive behavior outcomes, meaning that early intervention programs that lasted longer had smaller effect sizes than those that were shorter in duration. This was a surprising finding. The researchers suggested that it may relate to the use of standard scores; when used to evaluate changes in outcomes over time, these scores can highlight the developmental delay of children with ASD in comparison with their typically developing peers.

Overall, the effect sizes of early interventions in community settings were much smaller than those of university-based clinical research trials. These small effect sizes may have been the result of barriers to incorporating evidence-based research into practice, such as lack of high-quality training and resources to provide ongoing program supervision. Additionally, families who enroll their children in university-based research studies tend to be of higher socioeconomic status, which is associated with improved ASD outcomes, and therefore may not accurately represent the general population. Increased efforts to improve training and resources may improve the effectiveness of early interventions in community settings.

A Multisite Randomized Controlled Two-Phase Trial of the Early Start Denver Model Compared to Treatment as Usual

Rogers SJ, Estes A, Lord C, Munson J, Rocha M, Winter J, Greenson J, Colombi C, Dawson G, Vismara LA, Sugar CA, Hellemann G, Whelan F, Talbott M. *J Am Acad Child Adolesc Psychiatry.* 2019 Sep;58(9):853-865. [*PMID: 30768394*]

The Individuals with Disabilities Education Act requires that young children with ASD be provided with high quality research-based early intervention programs. However, there have been few studies conducted with scientific rigor that support the use of early intervention for children under 3 years of age. Of this limited research, promising results have been found by studies of the Early Start Denver Model (ESDM), an intensive intervention program for young children with ASD that incorporates play- and routine-based techniques built from methods of applied behavioral analysis. The results of these studies show significantly improved language skills in 18- to 30-month-old children with ASD.

This study aimed to replicate and expand on these promising findings using a randomized controlled trial (RCT) of intensive ESDM treatment. A larger and more diverse sample of toddlers was included, encompassing multiple treatment sites. The researchers designed the trial to follow all Consolidated Standards of Reporting Trials (CONSORT) guidelines to ensure scientific rigor and transparent reporting. The study enrolled 118 children with ASD from 14 to 24 months of age, who were randomly assigned to receive either ESDM treatment or "community" treatment (e.g., interventions their parents arranged, exclusive of ESDM). ESDM treatment was implemented by trained professional therapists in 2 phases across 3 university-based ASD specialty centers.

In the first phase of the study, the ESDM participants received 1 hour of weekly ESDM parent coaching over 12 weeks. In the second phase, they received at least 10 hours weekly of one-on-one ESDM intervention in a home or childcare setting and 4 hours monthly of ESDM parent coaching for 24 months. Using the Early Screening of Autistic Traits Questionnaire, the Infant Toddler Checklist, the Modified Checklist for Autism in Toddlers, the Vineland Adaptive Behavior Scales, and the Autism Diagnostic Observation Schedule (ADOS), the researchers assessed the children for language improvement, adaptive behavior, autism severity, and developmental quotient (DQ, which provides a general measure of cognitive ability). Assessments were conducted by examiners who were naïve with respect to treatment group at 4 time periods: at enrollment, end of phase 1, end of the first year of phase 2, and end of the study period. The primary outcome measure was improvement in children's language abilities, based on the Mullen Scales for Early Learning.

Eighty-one participants completed the study through phase 2. At the end of phase 2, the researchers found that, at 2 of the study sites, the ESDM group showed significant improvements in their language skills as compared to the community group. Overall, the ESDM group was found to be approximately five months more advanced in their language skills than children in the community group. However, the ESDM group and the community group showed no significant differences in adaptive behavior, ASD symptom severity, or DQ. Both the ESDM and community group made comparable improvements in these domains.

The researchers also aimed to explore whether children's initial DQ would moderate effects of treatment on group outcomes. For language outcomes, initial DQ did not moderate the effect of ESDM in comparison to community treatment. However, for ADOS severity, initial DQ was found to moderate the effect of ESDM in comparison to community treatment. For children in the ESDM group and not the community group, those with higher initial DQ showed greater reductions in ADOS symptom severity than children with lower initial DQ.

The present study partially replicated findings from previous studies of ESDM, concluding that children who receive ESDM treatment show greater language advances than children who receive community interventions, but no difference in adaptive behavior and DQ outcomes. These results support implementation of ESDM as a high-quality early intervention for young children with ASD. Importantly, the researchers suggest that other early interventions may also result in significant improvements for children with ASD, but these approaches will require similar community-based efficacy studies conducted with scientific rigor and implemented with fidelity to help ensure that families receive high-quality services.

Effect of Wearable Digital Intervention for Improving Socialization in Children with Autism Spectrum Disorder: A Randomized Clinical Trial

Voss C, Schwartz J, Daniels J, Kline A, Haber N, Washington P, Tariq Q, Robinson TN, Desai M, Phillips JM, Feinstein C, Winograd T, Wall DP. *JAMA Pediatr*. 2019 May 1;173(5):446-454. [*PMID: 30907929*]

Most children with ASD face challenges with socialization, often struggling to maintain eye contact, engage in joint attention, and interpret facial expressions. Applied behavioral analysis (ABA), a therapeutic technique that teaches adaptive behaviors, is considered by experts to be the gold-standard intervention for children with ASD. However, many families encounter barriers to accessing ABA, including high costs and long waitlists. Mobile technology-based social learning aids are an increasingly popular option for families who are unable to access traditional ABA services or are seeking to supplement ABA with strategies that are more generalizable to real-world contexts. Despite the potential benefits of these technologies, few clinical studies have investigated their efficacy as interventions for ASD.

This study tested the effectiveness of a wearable social learning aid called Superpower Glass (SG) for children with ASD. Powered by Google Glass, SG is a digital glasses aid that is designed to augment children's at-home social interactions by providing facial engagement and feedback. The technology uses facial recognition software to analyze emotions and provide the child with a simple emoticon to indicate another person's emotional state. SG also provides engagement activities that help the child understand how facial expression relates to emotion. The glasses collect data that sync to a smartphone app, enabling caregivers to track the child's progress.

Researchers hypothesized that children who used SG in conjunction with traditional ABA would show greater improvements in social skills as compared to children who only received ABA treatment as usual. They enrolled 71 children with ASD between 6 and 12 years of age who were already receiving ABA twice a week at home. Forty children received the SG intervention in addition to ABA, while the 31 control participants continued ABA without the intervention. Participants who received the SG intervention were instructed to use the glasses and practice the engagement activities for four 20 minute sessions at home 4 times per week for 6 weeks.

The researchers assessed the children before and after the 6 week intervention, using the Vineland Adaptive Behavioral Scale (VABS-II) and the Affect Recognition Domain of the Developmental Neuropsychological Assessment (NEPSY-II). They also designed and administered the Emotion Guessing Game (EGG), which evaluated the child's ability to recognize emotional expressions produced by a live actor.

The study results revealed that children who received the SG intervention showed significant improvement in the socialization domain of the VABS-II. Slight positive improvements were found in the other outcome measures, but these were not statistically significant. Additional follow-up evaluations found that children did not maintain social improvements on the VABS-II 6 weeks after discontinuing use of the SG technology. The researchers noted that on average, children used SG for only half of the recommended sessions, suggesting that social skills may have improved more significantly if participants had used the device as initially intended. Future research can work to improve consistent engagement on behalf of both parents and children.

These findings support the use of technology-based social learning aids as a supplement to enhance traditional ABA interventions. Digital devices like the SG represent important progress towards accessible, home-based care for children with ASD.

QUESTION 5

WHAT KINDS OF SERVICES AND SUPPORTS ARE NEEDED TO MAXIMIZE QUALITY OF LIFE FOR PEOPLE ON THE AUTISM SPECTRUM?

Effectiveness of Training Therapists to Deliver an Individualized Mental Health Intervention for Children with ASD in Publicly Funded Mental Health Services: A Cluster Randomized Clinical Trial
Brookman-Frazee L, Roesch S, Chlebowski C, Baker-Ericzen M, Ganger W. *JAMA Psychiatry.* 2019 Jun 1;76(6):574-583. [*PMID: 30840040*]

Approximately 70% of school-aged children with ASD are diagnosed with at least one non-ASD co-occurring psychiatric disorder. These co-occurring conditions frequently present as challenging or disruptive behaviors, which can be confounded with symptoms related to ASD and difficult to treat. Many of these children with ASD receive publicly funded community mental health services. However, mental health providers in these settings often feel ill-equipped to address the complex needs of children with ASD, creating significant concern about the quality of mental health care being provided. There are evidence-based behavioral intervention strategies that have been effective in addressing challenging behaviors in children with ASD, but community mental health providers and therapists typically receive limited or no ASD-specific training in the delivery of these interventions. This can create variability in how mental health providers deliver a given intervention and reduce its effectiveness. Furthermore, no systematic research has been conducted to examine the effectiveness of these interventions within publicly funded community settings.

To address this implementation gap, researchers conducted a study to determine the effectiveness of training therapists on the delivery of An Individualized Mental Health Intervention for ASD (AIM HI). AIM HI comprises a training protocol for therapists in support of a clinical intervention of parent- and child-directed strategies to reduce challenging behaviors in children with ASD. The training protocol for therapists includes an introductory workshop, didactic instruction, and case-specific performance feedback from an AIM HI trainer over the 6-month intervention period.

Therapists were recruited from publicly funded outpatient and school-based mental health programs. Children with ASD were recruited from the caseloads of participating therapists. The children with ASD were aged 5 to 13 years and exhibited both clinically significant ASD symptoms and at least one challenging behavior. Participants were

randomly assigned to the AIM HI intervention or a control group that provided routine care as usual. The therapists were assessed for program fidelity in 2 month intervals across the 6 month training period. The children with ASD were assessed for challenging behaviors by parent report using the Eyberg Child Behavior Inventory (ECBI) and the Social Skills Improvement System (SSIS) at the start of the study, and again at 6-, 12-, and 18-month follow-up visits.

A total of 202 children with ASD from 29 publicly funded mental health programs received the AIM HI intervention supported with therapist training. The researchers found significantly greater reduction in both the number and severity of challenging behaviors in children who received the AIM HI intervention as compared to children who received care as usual. When evaluating therapist fidelity to the AIM HI program, the researchers found that children showed greater improvements when their therapist received higher ratings in treatment continuity and session structure during training assessment.

This study was the first to evaluate a behavioral intervention for children with ASD in a publicly funded community mental health setting. The findings support the effectiveness of training mental health providers who are not ASD specialists in reducing challenging behaviors in children with ASD. When non-specialist providers have the opportunity to receive extended training and assessment for psychosocial intervention, the gap between science and practice is reduced—resulting in greater fidelity to the intervention and improved outcomes for children with ASD.

QUESTION 5: WHAT KINDS OF SERVICES AND SUPPORTS ARE NEEDED TO MAXIMIZE QUALITY OF LIFE FOR PEOPLE ON THE AUTISM SPECTRUM?

The Effect of Medicaid Waivers on Ameliorating Racial/Ethnic Disparities Among Children with Autism
LaClair M, Mandell DS, Dick AW, Iskandarani K, Stein BD, Leslie DL. *Health Serv Res.* 2019 Aug;54(4):912-919. [*PMID: 31132161*]

ASD diagnostic rates vary among children of different races and ethnicities; white, non-Hispanic children tend to be diagnosed with ASD at a younger age, diagnosed more frequently, and are more likely to receive ASD screening and services than black or Hispanic children. To address these disparities, some states have implemented Medicaid Home and Community-Based Services (HCBS) waivers, which increase access to autism services for children who do not qualify for Medicaid or provide services additional to those who are already enrolled in Medicaid.

Research indicates that states offering HCBS waivers report lower racial and ethnic disparities in ASD service access than do states without waivers. Some state waivers are considered more generous, meaning that they may have higher spending limits or enroll more children. Additionally, higher-income families—who are more likely to have the resources needed to complete the time-intensive HCBS waiver enrollment process—may benefit disproportionately from more generous HCBS policies. Therefore, it is possible that the use of HCBS waivers may intensify, rather than reduce, racial and ethnic disparities in accessing ASD services.

This study examined the effects of HCBS waivers on reducing racial/ethnic disparities in unmet needs for services among ASD families. Researchers analyzed data on children with ASD and special health care needs aged 2 to 17 years from the National Survey of Children's Health and the National Survey of Children with Special Health Care Needs. States with HCBS waivers that specifically targeted ASD services were included in the study group, while states with non-targeted waivers served as the control group. Researchers considered the following racial and ethnic categories: white non-Hispanic, black non-Hispanic, and Hispanic (black or white).

The researchers found that among children with ASD, 27% of white children, 27% of Hispanic children, and 18% of black children reported unmet needs. More black and Hispanic children had household incomes below the federal poverty line than white children. Increasing generosity of HCBS waivers (as measured by cost, cost limits, and enrollment limits) was associated with reduced unmet needs among black children with ASD compared to white children. There was no significant association between waiver generosity and unmet needs for Hispanic children. Additionally, the presence of a waiver alone was not significantly associated with a change in unmet health care need for any of the groups.

These findings indicate that, although HCBS waivers alone did not reduce disparities in unmet ASD service needs, increasing generosity of waivers was associated with reduced disparities between black and white children with ASD. Critically, HCBS waiver implementation alone is insufficient to reduce existing racial and ethnic inequalities in access to ASD services—rather, the content and characteristics of HCBS waiver policies can help drive reductions in existing disparities.

QUESTION 6

HOW CAN WE MEET THE NEEDS OF PEOPLE WITH ASD AS THEY PROGRESS INTO AND THROUGH ADULTHOOD?

A 20-Year Study of Suicide Death in a Statewide Autism Population

Kirby AV, Bakian AV, Zhang Y, Bilder DA, Keeshin BR, Coon H. *Autism Res.* 2019 Apr;12(4):658-666. [*PMID: 30663277*]

Recent research has found that individuals with ASD are at higher risk for suicide, suicide attempts, and suicidal ideation. However, little work has been done to understand the incidence and specific characteristics of suicide risk in the ASD population. One study conducted in Sweden found that individuals with ASD are almost 8 times more likely to die by suicide than the general population and that females with ASD were more than 13 times more likely to die by suicide than females in the general population. These concerning statistics highlight the urgent need for population-based studies of suicide risk for ASD individuals in the United States.

The aim of this study was to examine the incidence and characteristics of suicide risk among people with ASD, using a large sample of population-based data from the state of Utah. The researchers predicted that suicide incidence would be significantly higher among the ASD population than the non-ASD population, and that suicide rates would be higher among females with ASD than females without ASD. Additionally, they hypothesized that ASD males would be more likely to use violent methods of suicide (e.g., firearm, blunt force injury) than ASD females.

Data were collected from 4 existing sources of statewide data that covered the time period of 1998–2017. These included: the Utah registry of autism and developmental disorders; the Utah Office of the Medical Examiner suicide surveillance data; the Utah Population Database that provided demographics, vital records, medical data, and genealogical data; and the Indicator-Based Information System for Public Health that contributed whole population statistics in Utah. Cumulative incidence rates of suicide deaths were calculated at 5-year intervals in both ASD and non-ASD populations. Additional analyses were conducted to identify differences in demographics and methods of suicide.

During the 19-year timeframe of the study, 49 people with ASD died by suicide. In the first 15 years of the study (1998–2012), the cumulative incidence of suicide did not differ between ASD and non-ASD populations.

However, this trend shifted in 2013–2017. During this time period, the cumulative incidence for suicide in the ASD population was 0.17%, which is significantly higher than the incidence of 0.11% in the non-ASD population. While there was no difference in cumulative incidence between males and females with ASD during this time period, there were significant differences between the female ASD population (0.17%) compared to the female non-ASD population (0.05%). The researchers also found that individuals with ASD who died by suicide were significantly younger than individuals without ASD who died by suicide (32.4 years vs. 41.8 years). Further, individuals who died by suicide in the ASD population were less likely to use a firearm as a means of suicide than individuals in the non-ASD population. Males and females with ASD did not differ in method of suicide.

This study was the first statewide, population-based study of suicide death among individuals with ASD, finding that individuals with ASD were at higher risk for suicide than individuals without ASD. The cumulative incidence of suicide among individuals with ASD increased after 2013. Because ASD diagnostic criteria has broadened over time, this may account for the low incidences of suicide that were observed at earlier time periods. Critically, females with ASD were over 3 times more likely to die by suicide than females without ASD, and younger individuals with ASD were twice as likely to die by suicide than younger individuals without ASD. This heightened risk of suicide, particularly for females and young individuals with ASD, suggests a critical need for further population-based research, as well as suicide prevention strategies tailored to the unique needs of people with ASD.

Loss in Services Precedes High School Exit for Teens with Autism Spectrum Disorder: A Longitudinal Study

Laxman DJ, Taylor JL, DaWalt LS, Greenberg JS, Mailick MR. *Autism Res.* 2019 Jun;12(6):911-921. [*PMID: 31033222*]

In the United States, children with ASD receive federally mandated school-based services under the Individual with Disabilities Education Act (IDEA). This federal mandate includes access to early intervention and special education services, such as speech language pathology services and Applied Behavioral Analysis (ABA) therapy, until the child receives a high school diploma or has aged out of the school system. It is commonly believed that as children with ASD transition out of public school and into young adulthood, they tend to experience a significant loss of these services—a "service cliff" that disrupts their transition and creates a vulnerable situation in which they experience significant unmet service needs.

Recent research suggests that children with ASD may experience a reduction in services even before this transition-aged "service cliff." In this study, researchers sought to test this directly by examining changes in service use and levels of unmet service needs (defined as a service or level of service that was needed but not received) in individuals with ASD before, during, and after high school. Additionally, the researchers considered whether changes in service use and level of unmet service needs differ between individuals with and without co-occurring intellectual disability (ID). They predicted that individuals with ASD would experience a decline in services during the high school years, with a sharper decline after leaving high school. They further hypothesized that individuals without a co-occurring ID would experience greater change in service use and unmet service needs than individuals with co-occurring ID.

The researchers examined data from a longitudinal study, which collected data from families in Massachusetts and Wisconsin at 4 time periods between 1998 and 2012. The study included families of 204 individuals with ASD who were in high school or who had a high school exit date within the previous 18 months. At each time point, the researchers collected data from the primary caregiver on services received and unmet service need across nine service areas: physical therapy, occupational therapy, speech therapy, psychological and psychiatric care, crisis intervention programs, personal care services, recreational/social activities, transportation services, and respite care. They also collected the date that the student left high school (and stopped receiving school-based services), status of co-occurring ID, sex, residential status, and household income.

Fifty-nine percent of the individuals with ASD in the study sample had co-occurring ID. Overall, both those with and without co-occurring ID experienced reductions in service use during high school and after leaving high school. *During* the high school years, those without co-occurring ID experienced a sharper decline in service use than those with co-occurring ID. *After* high school exit, those without co-occurring ID continued to experience a consistent reduction in service use, but those with co-occurring ID experienced a drastic decline in services—a finding that is best exemplified by the "service cliff" that occurs upon leaving high school. Both those with and without co-occurring ID experienced a decline in service use for speech therapy, occupational therapy, and respite services

both before and at the time of high school exit, but little change in service use for physical therapy, psychiatric services, and crisis services. Those with co-occurring ID experienced an increase over time in personal care services, transportation services, and recreational services.

When looking at unmet service need, the researchers found a greater level of unmet need after leaving high school than during high school, with no differences between those with and without co-occurring ID. A higher household income was associated with fewer unmet service needs. ASD individuals living with their family experienced greater unmet service needs than those living outside the family home.

The results of this study support prior research indicating that for individuals with ASD, declines in service use begin during the high school years and continue after leaving high school. Further, levels of unmet needs increase after leaving high school, signifying that continued supports are needed in the transition to adulthood. Declines in service use do not indicate declines in need. Individuals with ASD and co-occurring ID experience different needs during and after high school. For those without ID, service declines had already begun before high school exit and continued through the transition to adulthood; but for those with co-occurring ID, the time right around high school exit was an especially vulnerable period. Individuals with ASD and their families require strategies that can help ease their transition from high school and prepare them to advocate for continuing services into adulthood.

Use of Vocational Rehabilitation Supports for Postsecondary Education Among Transition-Age Youth on the Autism Spectrum

Rast JE, Roux AM, Shattuck PT. *J Autism Dev Disord*. 2019 Mar 8. [*PMID: 30848406*]

Youth with ASD transitioning into young adulthood may consider the prospects of increased independence through employment. Although many young adults with ASD have skills that are valued by employers, employment rates for this group are low. Post-secondary education (PSE), such as college or vocational training, can improve employment success and career outlook. However, few young adults with ASD enroll in these programs, as they may need additional supports and accommodations that often are not available at PSE institutions. One potential facilitator of PSE success is the use of vocational rehabilitation (VR) services. In the United States, VR provides job placement and training for individuals with disabilities, including those with ASD. The Workforce Innovation and Opportunity Act of 2014 (WIOA) included provisions for VR to promote enrollment in PSE through financial support, training, and advocacy.

In this study, the researchers sought to understand the use and impact of VR training in support of PSE and employment for transition-age youth (TAY) with ASD as compared to 1) TAY with non-ASD intellectual or developmental disabilities (IDDs), including Cerebral Palsy and traumatic brain injury, and 2) TAY with other disabilities, such as physical disabilities. They examined data from the United States Department of Education's Rehabilitation Services Administration Case Service Report for 2015, focusing on young adults aged 14 to 24 who received VR services. The primary outcome was paid full-time, part-time, or self-employment within an integrated work setting (in which most employees are not individuals with disabilities) at the time of exit from VR training. They compared individuals who were receiving general VR services to those who were receiving VR specifically for PSE training, which included services to help the individual improve educationally or vocationally.

The researchers found that of those who were receiving VR services, only about one-fifth (18.3%) of TAY with ASD received VR training for PSE, which was lower than TAY with other disabilities (32%), but slightly higher than TAY with IDDs (15.3%). TAY with ASD who did receive VR PSE training were younger, less likely to have a significant disability, and less likely be receiving social security disability income or other on-the-job supports than TAY with ASD who did not receive VR PSE training. TAY with ASD who received VR PSE training had better employment outcomes and were 1.59 times more likely to exit the VR program with employment than those who did not receive VR PSE training.

These findings suggest that VR training for PSE increases the likelihood of employment for TAY with ASD, but it is an underutilized resource. Increased awareness of the educational training provided by VR may benefit TAY with ASD who want to pursue PSE. It can also help PSE become attainable for TAY with ASD who might not otherwise consider it. VR training can therefore connect TAY with ASD to the PSE opportunities that may improve employment outcomes and increase independence in adulthood.

Competitive Employment for Transition-Aged Youth with Significant Impact from Autism: A Multi-Site Randomized Clinical Trial

Wehman P, Schall C, McDonough J, Sima A, Brooke A, Ham W, Whittenburg H, Brooke V, Avellone L, Riehle E. *J Autism Dev Disord*. 2019 Mar 1. [*PMID: 30825082*]

Many young adults with ASD struggle to find or keep meaningful paid employment that occurs within an integrated setting. Many individuals with ASD are not employed, and those who are tend to be underemployed, employed without pay, work in a segregated work setting, or work for less pay than their peers. Few studies have been conducted to identify the key components of successful employment specifically for young adults with ASD. However, there is evidence that supported employment, which provides ongoing support and on-the-job training, can lead to improved employment outcomes. Customized employment extends the concept of supported employment by optimizing the strengths of the individual while minimizing barriers to success. Project SEARCH is a supportive employment program that assists youth and young adults with developmental disabilities, including ASD, in acquiring vocational skills. The program places high school students in transition-to-work internships that provide meaningful work experience benefitting both the student and the employer.

In this study, researchers added ASD-specific supports to the Project SEARCH program to determine if the additional supports improved employment outcomes for young adults with ASD. These supports included social communication training, provision of visual cues, and behavior support and self-regulation strategies. The target outcome was competitive employment that was paid minimum wage or higher within an integrated work setting, with the employee performing the same or similar tasks as those without disabilities.

The researchers conducted a randomized trial at four hospitals in Virginia to compare the Project SEARCH plus ASD support intervention against standard school-based services. Participants included 156 students with ASD between the ages of 18 and 21 who were randomized between the Project SEARCH plus ASD group and the control group of support as usual. The Project SEARCH plus ASD consisted of a 9-month program that placed students in an unpaid rotating internship within a local hospital. Concurrently, students received direct instruction from special education professionals to further enhance skill development and increase independence in the work setting. All members of the program team met regularly to coordinate training and student needs. After graduating from the program, students continued to receive employment support. The researchers gathered data at three time points: at the beginning of the school year, at graduation, and at a 1-year follow-up.

The Project SEARCH plus ASD supports intervention had a significant impact on employment outcomes. At graduation, 32% of individuals in the Project SEARCH plus ASD supports group were employed, as compared to 5% of individuals in the control group. At the 1-year follow-up, 73% of the individuals in the Project SEARCH plus ASD supports intervention were employed, as compared to 17% of individuals in the control group. Moreover, 90.6% of individuals from the Project SEARCH plus ASD supports group maintained employment across the 1-year-post-graduation period. The intervention ensured that students had a seamless transition from school-based services to community-based

services as they entered adulthood, which contributed to the acquisition of meaningful paid employment after high school graduation. When comparing wages, hours worked, and weeks to employment between the two groups, the researchers found that individuals in the Project SEARCH plus ASD supports intervention worked on average more hours per week and were paid a higher hourly wage than individuals in the control group.

The results of this study support the effectiveness of a customized, supportive employment intervention for high school students with ASD. Large-scale implementation of this program could help reduce the high rates of unemployment among young adults with ASD, as well as provide the supports needed for continued, meaningful employment.

QUESTION 7

HOW DO WE CONTINUE TO BUILD, EXPAND, AND ENHANCE THE INFRASTRUCTURE SYSTEM TO MEET THE NEEDS OF THE ASD COMMUNITY?

Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 4 Years—Early Autism and Developmental Disabilities Monitoring Network, Seven Sites, United States, 2010, 2012, and 2014

Christensen DL, Maenner MJ, Bilder D, Constantino JN, Daniels J, Durkin MS, Fitzgerald RT, Kurzius-Spencer M, Pettygrove SD, Robinson C, Shenouda J, White T, Zahorodny W, Pazol K, Dietz P. *MMWR Surveill Summ.* 2019 Apr 12;68(2):1-19. [*PMID: 30973853*]

The Autism and Developmental Disabilities Monitoring (ADDM) Network is an active surveillance system funded by the Centers for Disease Control and Prevention (CDC) to track the prevalence and characteristics of children with ASD in the United States. The findings from ADDM-reported data have yielded valuable insights on the changing prevalence and characteristics of ASD. However, research shows that early diagnosis and intervention of ASD improves long-term outcomes, and the American Academy of Pediatrics recommends ASD screening for all children between the ages of 18 and 24 months. Even with early screening, most children with ASD are not diagnosed until age 4. To better understand ASD in young children, the Early ADDM Network was established in 2010 to track ASD prevalence and characteristics among children aged 4 years old. The Early ADDM Network is a subset of the ADDM network and covered 7 of 13 ADDM sites, including Arizona, Colorado, Missouri, New Jersey, North Carolina, Utah, and Wisconsin, for at least one of the surveillance years included in this report (2010, 2012, and 2014).

Case determination for both the ADDM and the Early ADDM is conducted in a two-phase process using data collected from multiple sources, including children's health and school records. Children met the case definition of ASD if their behaviors were consistent with the DSM-IV-TR criteria for autistic disorder, pervasive developmental disorder-not otherwise specified (PDD-NOS, including atypical autism), or Asperger disorder. Researchers also conducted an analysis using DSM-5 criteria, which were published in 2013, as compared to older DSM-IV-TR criteria.

Overall, ASD prevalence among 4-year-old children was 13.4 per 1,000 in 2010, 15.3 in 2012, and 17.0 in 2014—ranging from 8.1 (Missouri in 2012) to 28.4 (New Jersey in 2014). Prevalence was higher among boys at all sites, with boy-to-girl ratios ranging from 2.6:1 (Arizona and Wisconsin in 2010) to 5.2:1 (Colorado in 2014). Prevalence among

white children ranged from 7.7 per 1,000 (Missouri in 2014) to 29.3 (New Jersey in 2014), among black children from 3.8 (Missouri in 2010) to 24.7 (New Jersey in 2014), and among Hispanic children from 9.1 (Arizona in 2010) to 28.2 (New Jersey in 2014). Overall, few differences in ASD prevalence were found by race/ethnicity among children aged 4 years, and those that were identified occurred in 2010 but not in later years.

For two of the sites (Arizona and New Jersey), scores on intellectual ability tests were available for all surveillance years. These data revealed that the percentage of 4-year-old children with ASD who had co-occurring intellectual disabilities remained stable over time; 47.0%, 43.6%, and 46.0% in 2010, 2012, and 2014, respectively. The proportion of children with ASD who had co-occurring intellectual disabilities was significantly higher among 4-year-olds than among 8-year-olds for all sites and surveillance years, with the exception of Arizona in 2010. The percentage of children who had received their first comprehensive developmental evaluation by 36 months of age ranged from 48.8% (Missouri in 2012) to 88.9% (Wisconsin in 2014). The median age for first ASD diagnosis ranged from 28 months (North Carolina in 2014) to 39 months (Missouri and Wisconsin in 2012). Interestingly, the overall prevalence estimate using DMS-IV-TR diagnostic criteria was about 20% higher than the overall prevalence estimate using DSM-5 criteria. The authors hypothesize that this may be due to the fact that the DSM-5 surveillance case definition requires documentation of the more extensive behavioral criteria for ASD in the DSM-5 compared with the DSM-IV-TR or an ASD diagnosis by a community provider, which 4-year-old children may not yet have had the opportunity to receive. Moving forward from the 2016 surveillance year, all Network sites have used the DSM-5 criteria.

This study provides valuable information about the prevalence of ASD in younger children. Prevalence varied widely across sites, in part due to differences in the availability of records. Prevalence among 4-year-old children was 60-80% higher in sites that reviewed both health care and education records than those that reviewed only health care records. This suggests that the public education system plays a critical role in early identification of children with ASD. Overall, ASD prevalence was found to be higher for 8-year-old children than 4-year-old children, which reflects the challenges in diagnosing younger children and the variability in how ASD symptoms can manifest as children age. Improving parental awareness of early ASD signs and symptoms, as well as encouraging public school systems to identify early social and behavioral challenges, may help identify and treat children with ASD at a younger age, thus contributing to better outcomes in the future.

QUESTION 7: HOW DO WE CONTINUE TO BUILD, EXPAND, AND ENHANCE THE INFRASTRUCTURE SYSTEM TO MEET THE NEEDS OF THE ASD COMMUNITY?

Selection Bias on Intellectual Ability in Autism Research: A Cross-Sectional Review and Meta-Analysis

Russell G, Mandy W, Elliott D, White R, Pittwood T, Ford T. *Mol Autism*. 2019 Mar 1;10:9. [*PMID*: 30867896]

To produce research results that are valid and generalizable, researchers must ensure that their study participants are representative of the entire population of interest. They need to consider accessibility of the target population, similarity among participants, and characteristics of participants that might confound results. The exclusion of a subset of a population is called *selection bias*. Individuals with intellectual disability (ID) are vulnerable to exclusion from ASD research studies, which can challenge the validity and generalizability of results to the full range of autistic individuals. Recent estimates suggest that 50-55% of individuals with ASD have co-occurring ID. Exclusion of these individuals from research could result in interventions that are ineffective in addressing their needs, as well as other negative consequences. It is therefore important to explore the presence of selection bias in ASD research.

The researchers in this study conducted a cross-sectional review and meta-analysis of published ASD research studies to determine the number of studies that do not include individuals with ID. They also sought to determine the quality of reporting potential selection bias in these publications. The researchers reviewed all studies published in the following ASD-specific journals in the year of 2016: *Molecular Autism*, *Autism Research*, *Journal of Autism and Developmental Disorders*, *and Autism: International Journal of Research and Practice*. Only empirical research studies were included for analysis.

The researchers identified the population of interest in each study. Studies were included that stated that their population of interest was the entire autism spectrum and that their findings were applicable to this. Studies were excluded that stated that their population of interest was specific sub-groups of ASD in terms of high or low 'cognitive functioning.' Studies of children below the age of 2 years were also excluded. To identify potential selection bias in each study, the researchers recorded the proportion of the ASD study population that did not have ID, as defined by an IQ above 70. They also assessed the quality of reporting selection bias by identifying the number of studies that did not report any data on the participants' intellectual ability or did not acknowledge the potential that the generalizability of the results could be limited due to the exclusion of individuals with ID.

The resulting meta-analysis included 301 studies that claimed to include a population across the entire autism spectrum, which reflected data from 7,215,166 participants, including 100,245 participants with ASD. Out of the 301 studies, only 55% provided data on ID status and 25% specifically excluded individuals with ASD and co-occurring ID. Of the 165 studies that reported ID data, 82% showed selection bias against individuals with ID. Over half of these studies did not mention the potential lack of generalizability of their results.

Only 17% of the 301 studies reported the proportion of ASD participants who were either verbal or non-verbal. The researchers estimated that in total, 94% of the ASD study participants did not have ID and 6% did have ID. The researchers also estimated that only 2% of ASD study participants were non- or minimally verbal.

QUESTION 7: HOW DO WE CONTINUE TO BUILD, EXPAND, AND ENHANCE THE INFRASTRUCTURE SYSTEM TO MEET THE NEEDS OF THE ASD COMMUNITY?

Next, the researchers reviewed publications that cited the studies that did not include ASD participants with ID. It was found that 91% of these citations erroneously referred to the original research findings as applicable or generalizable to all individuals with ASD.

This study provides evidence that ASD research tends to underrepresent individuals with ID, despite reporting results that suggest generalizability to the entire ASD population. This selection bias may occur in part because it is more challenging to recruit individuals with ID. It is nonetheless important to overcome barriers to including individuals with ID in research in order to further our understanding of all subtypes of ASD. The authors recommend the development of inclusive strategies for participants with ID and suggest that future studies that do exclude participants with ID be required to provide justification for the exclusion and report results with greater transparency.

ARTICLES SELECTED FOR THE 2019 SUMMARY OF ADVANCES

QUESTION 1: HOW CAN I RECOGNIZE THE SIGNS OF ASD, AND WHY IS EARLY DETECTION SO IMPORTANT?

Guthrie W, Wallis K, Bennett A, Brooks E, Dudley J, Gerdes M, Pandey J, Levy SE, Schultz RT, Miller JS. **Accuracy of Autism Screening in a Large Pediatric Network**. *Pediatrics*. 2019 Oct;144(4). pii: e20183963. [*PMID: 31562252*]

Pierce K, Gazestani VH, Bacon E, Barnes CC, Cha D, Nalabolu S, Lopez L, Moore A, Pence-Stophaeros S, Courchesne E. **Evaluation of the Diagnostic Stability of the Early Autism Spectrum Disorder Phenotype in the General Population Starting at 12 Months**. *JAMA Pediatr*. 2019 Jun 1;173(6):578-587. [*PMID: 31034004*]

Wiggins LD, Durkin M, Esler A, Lee LC, Zahorodny W, Rice C, Yeargin-Allsopp M, Dowling NF, Hall-Lande J, Morrier MJ, Christensen D, Shenouda J, Baio J. **Disparities in Documented Diagnoses of Autism Spectrum Disorder Based on Demographic, Individual, and Service Factors**. *Autism Res*. 2020 Mar;13(3):464-473. [*PMID: 31868321*]

QUESTION 2: WHAT IS THE BIOLOGY UNDERLYING ASD?

Bal VH, Fok M, Lord C, Smith IM, Mirenda P, Szatmari P, Vaillancourt T, Volden J, Waddell C, Zwaigenbaum L, Bennett T, Duku E, Elsabbagh M, Georgiades S, Ungar WJ, Zaidman-Zait A. **Predictors of Longer-Term Development of Expressive Language in Two Independent Longitudinal Cohorts of Language-Delayed Preschoolers with Autism Spectrum Disorder**. *J Child Psychol Psychiatry*. 2019 Aug 19. [*PMID: 31429087*]

QUESTION 3: WHAT CAUSES ASD, AND CAN DISABLING ASPECTS OF ASD BE PREVENTED OR PREEMPTED?

Bai D, Yip BHK, Windham GC, Sourander A, Francis R, Yoffe R, Glasson E, Mahjani B, Suominen A, Leonard H, Gissler M, Buxbaum JD, Wong K, Schendel D, Kodesh A, Breshnahan M, Levine SZ, Parner ET, Hansen SN, Hultman C, Reichenberg A, Sandin S. **Association of Genetic and Environmental Factors with Autism in a 5-Country Cohort**. *JAMA Psychiatry*. 2019 Jul 17. [*PMID: 31314057*]

Grove J, Ripke S, Als TD, Mattheisen M, Walters RK, Won H, Pallesen J, Agerbo E, Andreassen OA, Anney R, Awashti S, Belliveau R, Bettella F, Buxbaum JD, Bybjerg-Grauholm J, Bækvad-Hansen M, Cerrato F, Chambert K, Christensen JH, Churchhouse C, Dellenvall K, Demontis D, De Rubeis S, Devlin B, Djurovic S, Dumont AL, Goldstein JI, Hansen CS, Hauberg ME, Hollegaard MV, Hope S, Howrigan DP, Huang H, Hultman CM, Klei L, Maller J, Martin J, Martin AR, Moran JL, Nyegaard M, Nærland T, Palmer DS, Palotie A, Pedersen CB, Pedersen MG, dPoterba T, Poulsen JB, Pourcain BS, Qvist P, Rehnström K, Reichenberg A, Reichert J, Robinson EB, Roeder K, Roussos P, Saemundsen E, Sandin S, Satterstrom FK, Davey Smith G, Stefansson H, Steinberg S, Stevens CR, Sullivan PF, Turley P, Walters GB, Xu X; Autism Spectrum Disorder Working Group of the Psychiatric Genomics Consortium; BUPGEN; Major Depressive Disorder Working Group of the Psychiatric Genomics Consortium; 23andMe Research Team, Stefansson K, Geschwind DH, Nordentoft M, Hougaard DM, Werge T, Mors O, Mortensen PB, Neale BM, Daly MJ, Børglum AD. **Identification of Common Genetic Risk Variants for Autism Spectrum Disorder**. *Nat Genet.* 2019 Mar;51(3):431-444. [*PMID: 30804558*]

Hviid A, Hansen JV, Frisch M, Melbye M. **Measles, Mumps, Rubella Vaccination and Autism: A Nationwide Cohort Study**. *Ann Intern Med.* 2019 Apr 16;170(8):513-520. [*PMID: 30831578*]

McGuinn LA, Windham GC, Messer LC, Di Q, Schwartz J, Croen LA, Moody EJ, Rappold AG, Richardson DB, Neas LM, Gammon MD, Schieve LA, Daniels JL. **Air Pollution, Neighborhood Deprivation, and Autism Spectrum Disorder in the Study to Explore Early Development**. *Environmental Epidemiology.* 2019 October;3(5):e067. [*https://doi.org/10.1097/EE9.0000000000000067*]

Schmidt RJ, Iosif AM, Guerrero Angel E, Ozonoff S. **Association of Maternal Prenatal Vitamin Use with Risk for Autism Spectrum Disorder Recurrence in Young Siblings**. *JAMA Psychiatry.* 2019 Apr 1;76(4):391-398. [*PMID: 30810722*]

QUESTION 4: WHICH TREATMENTS AND INTERVENTIONS WILL HELP?

Nahmias AS, Pellecchia M, Stahmer AC, Mandell DS. **Effectiveness of Community-Based Early Intervention for Children with Autism Spectrum Disorder: A Meta-Analysis**. *J Child Psychol Psychiatry.* 2019 Nov;60(11):1200-1209. [*PMID: 31206690*]

Rogers SJ, Estes A, Lord C, Munson J, Rocha M, Winter J, Greenson J, Colombi C, Dawson G, Vismara LA, Sugar CA, Hellemann G, Whelan F, Talbott M. **A Multisite Randomized Controlled Two-Phase Trial of the Early Start Denver Model Compared to Treatment as Usual**. *J Am Acad Child Adolesc Psychiatry.* 2019 Sep;58(9):853-865. [*PMID: 30768394*]

Voss C, Schwartz J, Daniels J, Kline A, Haber N, Washington P, Tariq Q, Robinson TN, Desai M, Phillips JM, Feinstein C, Winograd T, Wall DP. **Effect of Wearable Digital Intervention for Improving Socialization in Children with Autism Spectrum Disorder: A Randomized Clinical Trial**. *JAMA Pediatr.* 2019 May 1;173(5): 446-454. [*PMID: 30907929*]

QUESTION 5: WHAT KINDS OF SERVICES AND SUPPORTS ARE NEEDED TO MAXIMIZE QUALITY OF LIFE FOR PEOPLE ON THE AUTISM SPECTRUM?

Brookman-Frazee L, Roesch S, Chlebowski C, Baker-Ericzen M, Ganger W. **Effectiveness of Training Therapists to Deliver an Individualized Mental Health Intervention for Children with ASD in Publicly Funded Mental Health Services: A Cluster Randomized Clinical Trial**. *JAMA Psychiatry*. 2019 Jun 1;76(6):574-583. [*PMID: 30840040*]

LaClair M, Mandell DS, Dick AW, Iskandarani K, Stein BD, Leslie DL. **The Effect of Medicaid Waivers on Ameliorating Racial/Ethnic Disparities Among Children with Autism**. *Health Serv Res*. 2019 Aug;54(4):912-919. [*PMID: 31132161*]

QUESTION 6: HOW CAN WE MEET THE NEEDS OF PEOPLE WITH ASD AS THEY PROGRESS INTO AND THROUGH ADULTHOOD?

Kirby AV, Bakian AV, Zhang Y, Bilder DA, Keeshin BR, Coon H. **A 20-Year Study of Suicide Death in a Statewide Autism Population**. *Autism Res*. 2019 Apr;12(4):658-666. [*PMID: 30663277*]

Laxman DJ, Taylor JL, DaWalt LS, Greenberg JS, Mailick MR. **Loss in Services Precedes High School Exit for Teens with Autism Spectrum Disorder: A Longitudinal Study**. *Autism Res*. 2019 Jun;12(6):911-921. [*PMID: 31033222*]

Rast JE, Roux AM, Shattuck PT. **Use of Vocational Rehabilitation Supports for Postsecondary Education Among Transition-Age Youth on the Autism Spectrum**. *J Autism Dev Disord*. 2019 Mar 8. [*PMID: 30848406*]

Wehman P, Schall C, McDonough J, Sima A, Brooke A, Ham W, Whittenburg H, Brooke V, Avellone L, Riehle E. **Competitive Employment for Transition-Aged Youth with Significant Impact from Autism: A Multi-Site Randomized Clinical Trial**. *J Autism Dev Disord*. 2019 Mar 1. [*PMID: 30825082*]

QUESTION 7: HOW DO WE CONTINUE TO BUILD, EXPAND, AND ENHANCE THE INFRASTRUCTURE SYSTEM TO MEET THE NEEDS OF THE ASD COMMUNITY?

Christensen DL, Maenner MJ, Bilder D, Constantino JN, Daniels J, Durkin MS, Fitzgerald RT, Kurzius-Spencer M, Pettygrove SD, Robinson C, Shenouda J, White T, Zahorodny W, Pazol K, Dietz P. **Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 4 Years—Early Autism and Developmental Disabilities Monitoring Network, Seven Sites, United States, 2010, 2012, and 2014**. *MMWR Surveill Summ*. 2019 Apr 12;68(2):1-19. [*PMID: 30973853*]

Russell G, Mandy W, Elliott D, White R, Pittwood T, Ford T. **Selection Bias on Intellectual Ability in Autism Research: A Cross-Sectional Review and Meta-Analysis**. *Mol Autism*. 2019 Mar 1;10:9. [*PMID: 30867896*]

FULL LISTING OF NOMINATED ARTICLES

(SELECTED ARTICLES APPEAR *GREEN)

QUESTION 1: HOW CAN I RECOGNIZE THE SIGNS OF ASD, AND WHY IS EARLY DETECTION SO IMPORTANT?

*Guthrie W, Wallis K, Bennett A, Brooks E, Dudley J, Gerdes M, Pandey J, Levy SE, Schultz RT, Miller JS. **Accuracy of Autism Screening in a Large Pediatric Network**. *Pediatrics*. 2019 Oct;144(4). pii: e20183963. [*PMID: 31562252*]

*Pierce K, Gazestani VH, Bacon E, Barnes CC, Cha D, Nalabolu S, Lopez L, Moore A, Pence-Stophaeros S, Courchesne E. **Evaluation of the Diagnostic Stability of the Early Autism Spectrum Disorder Phenotype in the General Population Starting at 12 Months**. *JAMA Pediatr*. 2019 Jun 1;173(6):578-587. [*PMID: 31034004*]

Rødgaard EM, Jensen K, Vergnes JN, Soulières I, Mottron L. **Temporal Changes in Effect Sizes of Studies Comparing Individuals With and Without Autism: A Meta-Analysis**. *JAMA Psychiatry*. 2019 Aug 21. [*PMID: 31433441*]

Shapira SK, Tian LH, Aylsworth AS, Elias ER, Hoover-Fong JE, Meeks NJL, Souders MC, Tsai AC, Zackai EH, Alexander AA, Yeargin-Allsopp M, Schieve LA. **A Novel Approach to Dysmorphology to Enhance the Phenotypic Classification of Autism Spectrum Disorder in the Study to Explore Early Development**. *J Autism Dev Disord*. 2019 May;49(5):2184-2202. [*PMID: 30783897*]

*Wiggins LD, Durkin M, Esler A, Lee LC, Zahorodny W, Rice C, Yeargin-Allsopp M, Dowling NF, Hall-Lande J, Morrier MJ, Christensen D, Shenouda J, Baio J. **Disparities in Documented Diagnoses of Autism Spectrum Disorder Based on Demographic, Individual, and Service Factors**. *Autism Res*. 2020 Mar;13(3):464-473. [*PMID: 31868321*]

Wiggins LD, Rice CE, Barger B, Soke GN, Lee LC, Moody E, Edmondson-Pretzel R, Levy SE. **DSM-5 Criteria for Autism Spectrum Disorder Maximizes Diagnostic Sensitivity and Specificity in Preschool Children**. *Soc Psychiatry Psychiatr Epidemiol*. 2019 Jun;54(6):693-701. [*PMID: 30850887*]

QUESTION 2: WHAT IS THE BIOLOGY UNDERLYING ASD?

Avagliano Trezza R, Sonzogni M, Bossuyt SNV, Zampeta FI, Punt AM, van den Berg M, Rotaru DC, Koene LMC, Munshi ST, Stedehouder J, Kros JM, Williams M, Heussler H, de Vrij FMS, Mientjes EJ, van Woerden GM, Kushner SA, Distel B, Elgersma Y. **Loss of Nuclear UBE3A Causes Electrophysiological and Behavioral Deficits in Mice And is Associated with Angelman Syndrome**. *Nat Neurosci*. 2019 Aug;22(8):1235-1247. [*PMID: 31235931*]

*Bal VH, Fok M, Lord C, Smith IM, Mirenda P, Szatmari P, Vaillancourt T, Volden J, Waddell C, Zwaigenbaum L, Bennett T, Duku E, Elsabbagh M, Georgiades S, Ungar WJ, Zaidman-Zait A. **Predictors of Longer-Term Development of Expressive Language in Two Independent Longitudinal Cohorts of Language-Delayed Preschoolers with Autism Spectrum Disorder**. *J Child Psychol Psychiatry*. 2019 Aug 19. [PMID: 31429087]

Chew TA, Orlando BJ, Zhang J, Latorraca NR, Wang A, Hollingsworth SA, Chen DH, Dror RO, Liao M, Feng L. **Structure and Mechanism of the Cation-Chloride Cotransporter NKCC1**. *Nature*. 2019 Aug;572(7770):488-492. [*PMID: 31367042*]

Fröhlich H, Kollmeyer ML, Linz VC, Stuhlinger M, Groneberg D, Reigl A, Zizer E, Friebe A, Niesler B, Rappold G. **Gastrointestinal Dysfunction in Autism Displayed by Altered Motility and Achalasia in *Foxp1*$^{+/-}$ Mice**. *Proc Natl Acad Sci U S A*. 2019 Oct 29;116(44):22237-22245. [*PMID: 31611379*]

Ingiosi A, Schoch H, Wintler TP, Singletary KG, Righelli D, Roser L, Medina E, Risso D, Frank MG, Peixoto L. **Shank3 Modulates Sleep and Expression of Circadian Transcription Factors**. *eLife*. 2019 Apr 11;8. pii: e42819. [*PMID: 30973326*]

Pagani M, Bertero A, Liska A, Galbusera A, Sabbioni M, Barsotti N, Colenbier N, Marinazzo D, Scattoni ML, Pasqualetti M, Gozzi A. **Deletion of Autism Risk Gene Shank3 Disrupts Prefrontal Connectivity**. *J Neurosci*. 2019 Jul 3;39(27):5299-5310. [*PMID: 31061091*]

Saneyoshi T, Matsuno H, Suzuki A, Murakoshi H, Hedrick NG, Agnello E, O'Connell R, Stratton MM, Yasuda R, Hayashi Y. **Reciprocal Activation within a Kinase-Effector Complex Underlying Persistence of Structural LTP**. *Neuron*. 2019 Jun 19;102(6):1199-1210.e6. [*PMID: 31078368*]

Schafer ST, Paquola ACM, Stern S, Gosselin D, Ku M, Pena M, Kuret TJM, Liyanage M, Mansour AA, Jaeger BN, Marchetto MC, Glass CK, Mertens J, Gage FH. **Pathological Priming Causes Developmental Gene Network Heterochronicity in Autistic Subject-Derived Neurons**. *Nat Neurosci*. 2019 Feb;22(2):243-255. [*PMID: 30617258*]

Sharon G, Cruz NJ, Kang DW, Gandal MJ, Wang B, Kim YM, Zink EM, Casey CP, Taylor BC, Lane CJ, Bramer LM, Isern NG, Hoyt DW, Noecker C, Sweredoski MJ, Moradian A, Borenstein E, Jansson JK, Knight R, Metz TO, Lois C, Geschwind DH, Krajmalnik-Brown R, Mazmanian SK. **Human Gut Microbiota from Autism Spectrum Disorder Promote Behavioral Symptoms in Mice**. *Cell*. 2019 May 30;177(6):1600-1618.e17. [*PMID: 31150625*]

Velmeshev D, Schirmer L, Jung D, Haeussler M, Perez Y, Mayer S, Bhaduri A, Goyal N, Rowitch DH, Kriegstein AR. **Single-Cell Genomics Identifies Cell Type-Specific Molecular Changes in Autism**. *Science*. 2019 May 17; 364(6441):685-689. [*PMID: 31097668*]

QUESTION 3: WHAT CAUSES ASD, AND CAN DISABLING ASPECTS OF ASD BE PREVENTED OR PREEMPTED?

Al-Haddad BJS, Jacobsson B, Chabra S, Modzelewska D, Olson EM, Bernier R, Enquobahrie DA, Hagberg H, Östling S, Rajagopal L, Adams Waldorf KM, Sengpiel V. **Long-Term Risk of Neuropsychiatric Disease After Exposure to Infection In Utero**. *JAMA Psychiatry*. 2019 Jun 1;76(6):594-602. [*PMID: 30840048*]

*Bai D, Yip BHK, Windham GC, Sourander A, Francis R, Yoffe R, Glasson E, Mahjani B, Suominen A, Leonard H, Gissler M, Buxbaum JD, Wong K, Schendel D, Kodesh A, Breshnahan M, Levine SZ, Parner ET, Hansen SN, Hultman C, Reichenberg A, Sandin S. **Association of Genetic and Environmental Factors with Autism in a 5-Country Cohort**. *JAMA Psychiatry*. 2019 Jul 17. [*PMID: 31314057*]

Breuss MW, Antaki D, George RD, Kleiber M, James KN, Ball LL, Hong O, Mitra I, Yang X, Wirth SA, Gu J, Garcia CAB, Gujral M, Brandler WM, Musaev D, Nguyen A, McEvoy-Venneri J, Knox R, Sticca E, Botello MCC, Uribe Fenner J, Pérez MC, Arranz M, Moffitt AB, Wang Z, Hervás A, Devinsky O, Gymrek M, Sebat J, Gleeson JG. **Autism Risk in Offspring Can Be Assessed through Quantification of Male Sperm Mosaicism**. *Nat Med*. 2020 Jan;26(1):143-150. [*PMID: 31873310*]

Castelbaum L, Sylvester CM, Zhang Y, Yu Q, Constantino JN. **On the Nature of Monozygotic Twin Concordance and Discordance for Autistic Trait Severity: A Quantitative Analysis**. *Behav Genet*. 2019 Dec 18. [*PMID: 31853901*]

Cross-Disorder Group of the Psychiatric Genomics Consortium. **Genomic Relationships, Novel Loci, and Pleiotropic Mechanisms Across Eight Psychiatric Disorders**. *Cell*. 2019 Dec 12;179(7):1469-1482.e11. [*PMID: 31835028*]

D'Abate L, Walker S, Yuen RKC, Tammimies K, Buchanan JA, Davies RW, Thiruvahindrapuram B, Wei J, Brian J, Bryson SE, Dobkins K, Howe J, Landa R, Leef J, Messinger D, Ozonoff S, Smith IM, Stone WL, Warren ZE, Young G, Zwaigenbaum L, Scherer SW. **Predictive Impact of Rare Genomic Copy Number Variations in Siblings of Individuals with Autism Spectrum Disorders**. *Nat Commun*. 2019 Dec 5;10(1):5519. [*PMID: 31801954*]

*Grove J, Ripke S, Als TD, Mattheisen M, Walters RK, Won H, Pallesen J, Agerbo E, Andreassen OA, Anney R, Awashti S, Belliveau R, Bettella F, Buxbaum JD, Bybjerg-Grauholm J, Bækvad-Hansen M, Cerrato F, Chambert K, Christensen JH, Churchhouse C, Dellenvall K, Demontis D, De Rubeis S, Devlin B, Djurovic S, Dumont AL, Goldstein JI, Hansen CS, Hauberg ME, Hollegaard MV, Hope S, Howrigan DP, Huang H, Hultman CM, Klei L, Maller J, Martin J, Martin AR, Moran JL, Nyegaard M, Nærland T, Palmer DS, Palotie A, Pedersen CB, Pedersen MG, dPoterba T, Poulsen JB, Pourcain BS, Qvist P, Rehnström K, Reichenberg A, Reichert J, Robinson EB, Roeder K, Roussos P, Saemundsen E, Sandin S, Satterstrom FK, Davey Smith G, Stefansson H, Steinberg S, Stevens CR, Sullivan PF, Turley P, Walters GB, Xu X; Autism Spectrum Disorder Working Group of the Psychiatric Genomics Consortium; BUPGEN; Major Depressive Disorder Working Group of the Psychiatric Genomics Consortium; 23andMe Research Team, Stefansson K, Geschwind DH, Nordentoft M, Hougaard DM, Werge T, Mors O, Mortensen PB, Neale BM, Daly MJ, Børglum AD. **Identification of Common Genetic Risk Variants for Autism Spectrum Disorder**. *Nat Genet*. 2019 Mar;51(3):431-444. [*PMID: 30804558*]

*Hviid A, Hansen JV, Frisch M, Melbye M. **Measles, Mumps, Rubella Vaccination and Autism: A Nationwide Cohort Study**. *Ann Intern Med*. 2019 Apr 16;170(8):513-520. [*PMID: 30831578*]

Jo H, Eckel SP, Wang X, Chen JC, Cockburn M, Martinez MP, Chow T, Molshatzki N, Lurmann FW, Funk WE, Xiang AH, McConnell R. **Sex-Specific Associations of Autism Spectrum Disorder with Residential Air Pollution Exposure in a Large Southern California Pregnancy Cohort**. *Environ Pollut*. 2019 Nov;254(Pt A):113010. [*PMID: 31554142*]

*McGuinn LA, Windham GC, Messer LC, Di Q, Schwartz J, Croen LA, Moody EJ, Rappold AG, Richardson DB, Neas LM, Gammon MD, Schieve LA, Daniels JL. **Air Pollution, Neighborhood Deprivation, and Autism Spectrum Disorder in the Study to Explore Early Development.** *Environmental Epidemiology.* 2019 October;3(5):e067. [*https://doi.org/10.1097/EE9.0000000000000067*]

*Schmidt RJ, Iosif AM, Guerrero Angel E, Ozonoff S. **Association of Maternal Prenatal Vitamin Use with Risk for Autism Spectrum Disorder Recurrence in Young Siblings.** *JAMA Psychiatry.* 2019 Apr 1;76(4):391-398. [*PMID: 30810722*]

Septier M, Peyre H, Amsellem F, Beggiato A, Maruani A, Poumeyreau M, Amestoy A, Scheid I, Gaman A, Bolognani F, Honey G, Bouquet C, Ly-Le Moal M, Bouvard M, Leboyer M, Bourgeron T, Delorme R. **Increased Risk of ADHD in Families with ASD.** *Eur Child Adolesc Psychiatry.* 2019 Feb;28(2):281-288. [*PMID: 30267210*]

Zhou J, Park CY, Theesfeld CL, Wong AK, Yuan Y, Scheckel C, Fak JJ, Funk J, Yao K, Tajima Y, Packer A, Darnell RB, Troyanskaya OG. **Whole-Genome Deep-Learning Analysis Identifies Contribution of Noncoding Mutations to Autism Risk.** *Nat Genet.* 2019 Jun;51(6):973-980. [*PMID: 31133750*]

QUESTION 4: WHICH TREATMENTS AND INTERVENTIONS WILL HELP?

*Nahmias AS, Pellecchia M, Stahmer AC, Mandell DS. **Effectiveness of Community-Based Early Intervention for Children with Autism Spectrum Disorder: A Meta-Analysis.** *J Child Psychol Psychiatry.* 2019 Nov;60(11):1200-1209. [*PMID: 31206690*]

*Rogers SJ, Estes A, Lord C, Munson J, Rocha M, Winter J, Greenson J, Colombi C, Dawson G, Vismara LA, Sugar CA, Hellemann G, Whelan F, Talbott M. **A Multisite Randomized Controlled Two-Phase Trial of the Early Start Denver Model Compared to Treatment as Usual.** *J Am Acad Child Adolesc Psychiatry.* 2019 Sep;58(9):853-865. [*PMID: 30768394*]

Sam AM, Cox AW, Savage MN, Waters V, Odom SL. **Disseminating Information on Evidence-Based Practices for Children and Youth with Autism Spectrum Disorder: AFIRM.** *J Autism Dev Disord.* 2019 Feb 28. [*PMID: 30820727*]

Tang X, Drotar J, Li K, Clairmont CD, Brumm AS, Sullins AJ, Wu H, Liu XS, Wang J, Gray NS, Sur M, Jaenisch R. **Pharmacological Enhancement of *KCC2* Gene Expression Exerts Therapeutic Effects on Human Rett Syndrome Neurons and *Mecp2* Mutant Mice.** *Sci Transl Med.* 2019 Jul 31;11(503). pii: eaau0164. [*PMID: 31366578*]

*Voss C, Schwartz J, Daniels J, Kline A, Haber N, Washington P, Tariq Q, Robinson TN, Desai M, Phillips JM, Feinstein C, Winograd T, Wall DP. **Effect of Wearable Digital Intervention for Improving Socialization in Children with Autism Spectrum Disorder: A Randomized Clinical Trial.** *JAMA Pediatr.* 2019 May 1;173(5):446-454. [*PMID: 30907929*]

QUESTION 5: WHAT KINDS OF SERVICES AND SUPPORTS ARE NEEDED TO MAXIMIZE QUALITY OF LIFE FOR PEOPLE ON THE AUTISM SPECTRUM?

Barry CL, Kennedy-Hendricks A, Mandell D, Epstein AJ, Candon M, Eisenberg M. **State Mandate Laws for Autism Coverage and High-Deductible Health Plans.** *Pediatrics.* 2019 Jun;143(6). [*PMID: 31092588*]

*Brookman-Frazee L, Roesch S, Chlebowski C, Baker-Ericzen M, Ganger W. **Effectiveness of Training Therapists to Deliver an Individualized Mental Health Intervention for Children with ASD in Publicly Funded Mental Health Services: A Cluster Randomized Clinical Trial**. *JAMA Psychiatry*. 2019 Jun 1;76(6):574-583. [*PMID: 30840040*]

*LaClair M, Mandell DS, Dick AW, Iskandarani K, Stein BD, Leslie DL. **The Effect of Medicaid Waivers on Ameliorating Racial/Ethnic Disparities Among Children with Autism**. *Health Serv Res*. 2019 Aug;54(4):912-919. [*PMID: 31132161*]

Monz BU, Houghton R, Law K, Loss G. **Treatment Patterns in Children with Autism in the United States**. *Autism Res*. 2019 Mar;12(3):517-526. [*PMID: 30629336*]

QUESTION 6: HOW CAN WE MEET THE NEEDS OF PEOPLE WITH ASD AS THEY PROGRESS INTO AND THROUGH ADULTHOOD?

*Kirby AV, Bakian AV, Zhang Y, Bilder DA, Keeshin BR, Coon H. **A 20-Year Study of Suicide Death in a Statewide Autism Population**. *Autism Res*. 2019 Apr;12(4):658-666. [*PMID: 30663277*]

*Laxman DJ, Taylor JL, DaWalt LS, Greenberg JS, Mailick MR. **Loss in Services Precedes High School Exit for Teens with Autism Spectrum Disorder: A Longitudinal Study**. *Autism Res*. 2019 Jun;12(6):911-921. [*PMID: 31033222*]

*Rast JE, Roux AM, Shattuck PT. **Use of Vocational Rehabilitation Supports for Postsecondary Education Among Transition-Age Youth on the Autism Spectrum**. *J Autism Dev Disord*. 2019 Mar 8. [*PMID: 30848406*]

*Wehman P, Schall C, McDonough J, Sima A, Brooke A, Ham W, Whittenburg H, Brooke V, Avellone L, Riehle E. **Competitive Employment for Transition-Aged Youth with Significant Impact from Autism: A Multi-Site Randomized Clinical Trial**. *J Autism Dev Disord*. 2019 Mar 1. [*PMID: 30825082*]

QUESTION 7: HOW DO WE CONTINUE TO BUILD, EXPAND, AND ENHANCE THE INFRASTRUCTURE SYSTEM TO MEET THE NEEDS OF THE ASD COMMUNITY?

*Christensen DL, Maenner MJ, Bilder D, Constantino JN, Daniels J, Durkin MS, Fitzgerald RT, Kurzius-Spencer M, Pettygrove SD, Robinson C, Shenouda J, White T, Zahorodny W, Pazol K, Dietz P. **Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 4 Years—Early Autism and Developmental Disabilities Monitoring Network, Seven Sites, United States, 2010, 2012, and 2014**. *MMWR Surveill Summ*. 2019 Apr 12;68(2):1-19. [*PMID: 30973853*]

*Russell G, Mandy W, Elliott D, White R, Pittwood T, Ford T. **Selection Bias on Intellectual Ability in Autism Research: A Cross-Sectional Review and Meta-Analysis**. *Mol Autism*. 2019 Mar 1;10:9. [*PMID: 30867896*]

INTERAGENCY AUTISM COORDINATING COMMITTEE MEMBER ROSTER

CHAIR

Joshua Gordon, M.D., Ph.D.
Director
National Institute of Mental Health
National Institutes of Health
Bethesda, MD

FEDERAL MEMBERS

Melinda Baldwin, Ph.D.
Child Welfare Program Specialist
Children's Bureau
Administration on Children, Youth, and Families
Administration for Children and Families
Washington, DC

Diana W. Bianchi, M.D.
Director
Eunice Kennedy Shriver National Institute of Child Health and Human Development
National Institutes of Health
Bethesda, MD

Linda Birnbaum, Ph.D., D.A.B.T., A.T.S.
Director
National Institute of Environmental Health Sciences and National Toxicology Program
National Institutes of Health
Research Triangle Park, NC

Francis S. Collins, M.D., Ph.D.
Director
National Institutes of Health
Bethesda, MD

Judith A. Cooper, Ph.D.
Deputy Director
National Institute on Deafness and Other Communication Disorders
National Institutes of Health
Bethesda, MD

Elaine Cohen Hubal, Ph.D. (alternate)
Senior Science Advisor
Office of Research and Development
National Exposure Research Laboratory
Environmental Protection Agency
Washington, DC

Tiffany R. Farchione, M.D.
Deputy Director
Division of Psychiatry Products
U.S. Food and Drug Administration
Silver Spring, MD

Melissa L. Harris
Acting Deputy Director
Disabled and Elderly Health Programs Group
Centers for Medicaid and CHIP Services
Centers for Medicare and Medicaid Services
Baltimore, MD

Jennifer Johnson, Ed.D.
Deputy Director, Administration on Intellectual and Developmental Disabilities
Administration for Community Living
Washington, DC

Laura Kavanagh, M.P.P.
Deputy Associate Administrator
Maternal and Child Health Bureau
Health Resources and Services Administration
Rockville, MD

Walter J. Koroshetz, M.D.
Director
National Institute of Neurological Disorders and Stroke
National Institutes of Health
Bethesda, MD

Laura Pincock, Pharm.D., M.P.H.
Pharmacist Officer
Agency for Healthcare Research and Quality
Rockville, MD

Marcella Ronyak, Ph.D., L.C.S.W., C.D.P.
Director
Division of Clinical & Community Services
Indian Health Service Headquarters
Rockville, MD

Stuart K. Shapira, M.D., Ph.D.
Associate Director for Science and Chief Medical Officer
National Center on Birth Defects and Developmental Disabilities
Centers for Disease Control and Prevention
Atlanta, GA

Cheryl Williams
Director, Office of Medical Policy
Office of Disability Policy
Social Security Administration
Baltimore, MD

Larry Wexler, Ed.D.
Director
Research to Practice
Office of Special Education Programs
U. S. Department of Education
Washington, DC

Nicole Williams, Ph.D.
Program Manager
Congressionally Directed Medical Research Programs
U.S. Department of Defense
Frederick, MD

PUBLIC MEMBERS

David Amaral, Ph.D.
Distinguished Professor
Department of Psychiatry & Behavioral Sciences
University of California, Davis (UC)
Research Director
UC Davis MIND Institute
Sacramento, CA

James Ball, Ed.D., B.C.B.A.-D.
President and CEO
JB Autism Consulting
Cranbury, NJ

Samantha Crane, J.D.
Legal Director and Director of Public Policy
Autistic Self Advocacy Network
Washington, DC

Geraldine Dawson, Ph.D.
Professor
Department of Psychiatry and Behavioral Sciences
Duke University School of Medicine
Director
Duke Center for Autism and Brain Development
Durham, NC

David S. Mandell, Sc.D.
Director
Center for Mental Health Policy and Services Research
Associate Professor
Psychiatry and Pediatrics
Perelman School of Medicine
University of Pennsylvania
Philadelphia, PA

Kevin Pelphrey, Ph.D.
Harrison-Wood Jefferson Scholars Foundation
Professor of Neurology & Professor
Curry School of Education
University of Virginia

Edlyn Peña, Ph.D.
Assistant Professor of Educational Leadership
Director of Doctoral Studies
California Lutheran University
Thousand Oaks, CA

Louis Reichardt, Ph.D.
Director
Simons Foundation Autism Research Initiative
New York, NY

Robert H. Ring, Ph.D.
Chief Executive Officer
Kaerus Bioscience
Newtown, PA

John Elder Robison
Neurodiversity Scholar in Residence
College of William and Mary
Amherst, MA

Alison Tepper Singer, M.B.A.
President
Autism Science Foundation
Scarsdale, NY

Julie Lounds Taylor, Ph.D.
Assistant Professor of Pediatrics
Investigator, Vanderbilt Kennedy Center
Vanderbilt University Medical Center
Nashville, TN

OFFICE OF AUTISM RESEARCH COORDINATION
NATIONAL INSTITUTES OF HEALTH

6001 Executive Boulevard, Room Room 7215, Bethesda, MD 20892
National Institute of Mental Health
National Institutes of Health
Email: *IACCPublicInquiries@mail.nih.gov*
Website: *http://www.iacc.hhs.gov*

Susan A. Daniels, Ph.D.
Director

Oni Celestin, Ph.D.
Health Science Policy Analyst

Katrina Ferrara, Ph.D.
Health Science Policy Analyst

Rebecca Martin, M.P.H.
Public Health Analyst

Angelice Mitrakas, B.A.
Management Analyst

Julianna Rava, M.P.H.
Health Science Policy Analyst

Matthew Vilnit, M.B.A.
Operations Coordinator

Jeffrey Wiegand, B.S.
Web Development Manager

IACC
INTERAGENCY AUTISM
COORDINATING COMMITTEE

OFFICE OF
AUTISM RESEARCH
COORDINATION
NATIONAL INSTITUTES OF HEALTH