APEX JOURNAL OF SOCIAL SCIENCES
https://apexjss.com
Volume 3 Issue 1, 2024

OPTIMIZING EARLY INTERVENTION STRATEGIES FOR NEURODIVERSE CHILDREN (ASD): REDUCING LONG-TERM PUBLIC HEALTHCARE COSTS THROUGH PARENT-MEDIATED TRAINING

Tasnia Akter Shiva [1], Nusrat Ireen [2], Md Shafiqul Islam [3]

Affiliations:

[1] M.A. in Psychological Research, Texas State University. USA
Email: fiz15@txstate.edu

[2] Ex National Disability Inclusion Officer, Light for the World. Former Assistant Coordinator, Centre for Disability in Development (CDD). USA
Email: nusrat.ireen@yahoo.com

[3] M.A. in Community Psychology University of New Heaven, USA
Email: shafiq120207@gmail.com

Corresponding Author/s Email:

[1] fiz15@txstate.edu

Abstract

The escalating prevalence of autism spectrum disorder (ASD), now affecting approximately 1 in 36 children globally, presents an unprecedented challenge to public healthcare systems. Lifetime support costs for individuals with ASD range from $1.4 to $2.4 million per person, with aggregate national expenditures projected to exceed $460 billion annually by 2022. Current intervention models, clinic-based and professionally delivered, are characterized by limited accessibility, extensive waitlists, and unsustainable resource demands, necessitating urgent exploration of cost-effective alternatives. This study examines the efficacy and cost-effectiveness of Parent-Mediated Training (PMT) as an early intervention strategy for neurodiverse children with ASD, evaluating its potential to reduce long-term public healthcare expenditures while maintaining or improving developmental outcomes. A mixed-methods approach was employed, combining quantitative analysis of longitudinal outcome data from 847 families across twelve intervention sites with qualitative exploration of parent experiences, implementation barriers, and facilitating factors. Cost-benefit analysis compared PMT programs against traditional professionally delivered interventions over a 10-year projection period.

Results demonstrate that PMT programs yield comparable developmental gains to clinic-based interventions at 40-60% reduced cost. Parental competency improvements showed sustained benefits beyond the intervention period, with cascading effects on sibling development and family functioning. Implementation of fidelity and socioeconomic factors significantly moderate outcomes. Parent-Mediated Training represents a scalable, cost-effective intervention model capable of addressing service gaps while alleviating fiscal pressures on public healthcare systems. Policy recommendations include integrating PMT into standard care pathways, developing tiered training infrastructure, and establishing sustainable funding mechanisms. These findings hold significant implications for health ministry's seeking to optimize resource allocation within neurodevelopmental service provision.

Keywords: Autism Spectrum Disorder, Early Intervention, Parent-Mediated Training, Healthcare Economics, Cost-Effectiveness, Neurodiversity.

Introduction

The Global and Local Context -Rising Prevalence of Autism Spectrum Disorder: A Statistical Overview

Autism Spectrum Disorder (ASD) has emerged as one of the most significant neurodevelopmental conditions of the twenty-first century, with prevalence rates demonstrating a consistent and remarkable

upward trajectory across all global regions. This escalating prevalence represents not merely a statistical phenomenon but a profound societal shift that demands comprehensive reevaluation of healthcare delivery systems, educational infrastructure, and public policy frameworks.

The epidemiological landscape of ASD has transformed dramatically over the past four decades. In the 1980s, autism was considered a rare condition, with prevalence estimates hovering around 4 to 5 cases per 10,000 children (Wing & Gould, 1979). This trajectory indicates that ASD prevalence has increased approximately 400% over the past two decades alone, a rate of change unprecedented among neurodevelopmental conditions.

Current Strain on Public Healthcare Systems

The epidemiological reality of rising ASD prevalence translates directly into unprecedented demands upon public healthcare infrastructure. Healthcare systems worldwide, already contending with aging populations, chronic disease burdens, and resource constraints, now face the additional challenge of providing comprehensive services for a rapidly expanding neurodivergent population. The resulting strain manifests across multiple dimensions: financial expenditure, workforce capacity, service accessibility, and systemic sustainability.

Financial analyses reveal the staggering economic magnitude of ASD-related healthcare costs. In the United States, lifetime per-person costs for individuals with ASD have been estimated between $1.4 million and $2.4 million, with variation dependent upon the presence of co- occurring intellectual disability and the intensity of support requirements (Buescher et al., 2014). When extrapolated across the affected population, aggregate annual costs in the United States alone approach $268 billion, with projections suggesting this figure will exceed $460 billion by 2025 (Leigh & Du, 2015). These estimates encompass direct medical expenditures, behavioral interventions, educational services, residential support, and lost productivity among both individuals with ASD and their caregivers.

Insurance coverage and public program eligibility create complex patchwork systems that frequently fail to meet population needs. In the United States, while all fifty states now mandate some level of autism insurance coverage, significant limitations persist regarding age caps, annual maximums, and provider network restrictions (Autism Speaks, 2022). Medicaid waiver programs provide essential services for many families but feature extensive waitlists, sometimes extending from five to ten years, during which children age beyond critical intervention windows. Similar challenges characterize healthcare systems internationally, with public funding mechanisms struggling to accommodate service demands.

The geographic maldistribution of ASD services creates profound equity concerns. Families residing in metropolitan areas with academic medical centers and established autism programs experience different service landscapes than those in rural regions or smaller communities. Rural families may travel for hours for diagnostic evaluations and ongoing therapy, with such barriers disproportionately affecting lower-income families lacking transportation resources and employment flexibility. International disparities are even more pronounced, with low- and middle-income countries often lacking basic diagnostic capacity, let alone comprehensive intervention infrastructure.

Strain on Special Education Budgets

The educational system represents the second major institutional domain absorbing the impact of rising ASD prevalence, with special education budgets experiencing commensurate and often unsustainable expansion. As the setting where children spend most of their waking hours, schools bear substantial responsibility for implementing educational programming, behavioral support, and related services for students on the autism spectrum. This responsibility carries significant financial implications that increasingly strain district, state, and national education budgets.

Students with ASD now constitute one of the largest and fastest-growing categories within special education. In the United States, the number of students aged 6-21 receiving special education services under the autism category increased from approximately 94,000 in 2000 to over 850,000 in 2021, representing a nine-fold increase over two decades (U.S. Department of Education, 2022). This growth rate exceeds overall special education population changes and reflects both genuine prevalence increases and diagnostic shifts from

other disability categories. Similar trends characterize educational systems internationally, with autism-specific educational placements expanding across European, Asian, and Oceanic nations.

The intersection of educational and healthcare systems creates additional complications and cost-shifting dynamics. Related services such as speech-language therapy and occupational therapy may be funded through either educational or healthcare mechanisms depending upon context and eligibility determinations, creating incentives for systems to attribute costs to alternative payers. Behavioral intervention may similarly be characterized as educational or medical depending upon framing, with significant implications for funding responsibility. These boundary disputes consume administrative resources, delay service provision, and create frustration for families navigating fragmented systems.

Problem Statement-The Limitations of Traditional Practitioner-Led Intervention Models

The prevailing paradigm for autism intervention has historically centered upon intensive, practitioner-delivered services wherein trained professionals provide direct therapeutic contact with children across clinical or educational settings. While evidence substantiates the efficacy of such approaches, particularly Applied Behavior Analysis (ABA), speech-language therapy, and occupational therapy, these models present fundamental challenges to scalability, accessibility, and long-term sustainability that increasingly undermine their viability as primary intervention mechanisms for the growing ASD population.

Workforce shortages represent an equally critical constraint upon traditional intervention models. The dramatic increase in ASD prevalence has not been matched by proportional expansion in qualified service providers. The Behavior Analyst Certification Board reported that demand for BCBAs exceeds supply by an estimated 25,000 professionals nationally, with shortages most acute in rural regions and underserved communities (BACB, 2020). Speech-language pathologists specializing in pediatric autism similarly remain in short supply, with the American Speech-Language-Hearing Association identifying autism services among the most challenging to staff adequately (ASHA, 2019). Occupational therapists, developmental pediatricians, and child psychologists face comparable demand-supply imbalances.

The Consequences of Delayed Intervention: Missed Neurodevelopmental Windows

The constraints upon traditional intervention models carry consequences extending far beyond immediate service access, fundamentally compromising developmental trajectories through missed critical periods of neuroplasticity. Neuroscientific evidence consistently demonstrates that the developing brain exhibits maximal malleability during the first three years of life, with synaptic density, neural pathway formation, and experience-dependent plasticity reaching peak levels during this window (Dawson, 2008). Interventions delivered during this period leverage biological processes optimized for learning, potentially achieving unattainable outcomes through later intervention.

The current system architecture thus creates a paradox wherein the interventions most supported by evidence remain least accessible to those most likely to benefit. Families navigating diagnostic pathways, insurance authorization processes, and provider waitlists commonly experience delays totaling two to four years from initial concern to intervention initiation. A child whose parents note developmental differences at 18 months may not begin intensive intervention until age four or five, having aged through the critical window during system navigation (Aurangzeb & Asif, 2021). This structural failure represents not merely inefficiency but systematic deprivation of evidence-based care during the precise developmental period when such care demonstrates maximal impact.

The Proposed Solution: A Paradigm Shift Toward Parent-Mediated Training Thesis Statement

The convergence of escalating prevalence, resource constraints, workforce shortages, and missed intervention windows necessitates fundamental reconceptualization of autism intervention delivery. This thesis proposes that shifting from exclusively clinician-delivered models toward clinician-guided, parent-mediated interventions offers a transformative solution addressing both clinical effectiveness and economic sustainability. Parent-Mediated Training (PMT) programs, wherein professionals coach parents to implement therapeutic strategies within natural environments, represent not a compromise or second-tier alternative but rather an evidence- based approach yielding comparable or superior outcomes while dramatically reducing costs and expanding access.

The theoretical foundation for parent-mediated intervention rests upon recognition that parents constitute the most consistent, motivated, and ecologically embedded intervention agents in children's lives. While clinicians may provide 20 to 40 hours weekly direct therapy, parents engage with children across all waking hours, in contexts ranging from meals to bedtime to community outings (Wetherby et al., 2014). Strategies implemented by parents become integrated into the fabric of daily life, occurring at precisely the moments when learning opportunities naturally arise rather than artificially constructed within clinic rooms. This ecological validity enhances generalization, the historically challenging process of transferring clinic-acquired skills to real- world contexts.

Research Questions

The present study seeks to address critical gaps in the evidence base regarding Parent-Mediated Training through two complementary research inquiries designed to capture both economic outcomes and experiential dimensions of PMT implementation.

Quantitative Research Question

What is the projected reduction in long-term healthcare expenditure when Parent-Mediated Training is implemented before age four?

This question addresses the fundamental economic proposition underlying PMT advocacy: that early, parent-delivered intervention generates substantial cost savings across the lifespan while maintaining developmental outcome quality. Existing literature has established that early intervention correlates with improved long-term outcomes including reduced support needs, increased independence, and enhanced employment prospects (Cidav et al., 2017). However, limited research has specifically quantified the fiscal impact of PMT relative to traditional practitioner-delivered models when initiated during the critical developmental window preceding age four.

The quantitative investigation encompasses multiple cost categories including direct intervention expenditures, special education placements, healthcare utilization, and projected adult support services. Longitudinal modeling will extend projections across childhood, adolescence, and adulthood to capture the full economic trajectory associated with early PMT implementation. Comparison groups receiving traditional intervention or treatment-as-usual will enable rigorous cost-effectiveness analysis addressing both immediate savings and long-term return on investment.

Qualitative Research Question

How does Parent-Mediated Training impact family quality of life and parental efficacy, and what are the barriers to adherence?

While economic analyses provide essential information for policy development, the experiential dimensions of PMT implementation remain equally critical for understanding feasibility, sustainability, and equity implications. This qualitative question explores the lived experiences of families engaging with parent-mediated approaches, seeking to illuminate both benefits and challenges that quantitative metrics may fail to capture.

Parental self-efficacy, defined as caregivers' confidence in their ability to positively influence their child's development, represents a theorized mechanism through which PMT generates benefits extending beyond direct child outcomes (Hastings & Brown, 2002; Usama et al., 2022). When parents transition from passive service recipients to active therapeutic agents, self-efficacy improvements may cascade across multiple family domains, enhancing coping capacity, reducing stress, and improving sibling relationships. However, this transition may also generate burden, particularly for families already experiencing significant caregiving demands.

Barriers to adherence represent a critical implementation consideration given that PMT effectiveness depends upon consistent parent implementation across contexts and time. Potential barriers include competing demands such as employment and other caregiving responsibilities, mental health challenges including parental depression and anxiety, socioeconomic constraints limiting intervention access, cultural factors influencing help-seeking and intervention acceptance, and programmatic issues including coaching quality and accessibility (Stahmer & Pellecchia, 2015). Identifying and understanding these barriers enables

development of responsive implementation strategies that maximize adherence across diverse family contexts. The qualitative investigation will employ semi-structured interviews and focus groups with parents who have participated in PMT programs, exploring experiences across the implementation trajectory from initial engagement through sustained practice. Thematic analysis will identify patterns in perceived benefits, challenges encountered, and factors facilitating or impeding adherence, with attention to variation across demographic and socioeconomic subgroups.

Literature Review

Current Standard of Care: Gold-Standard Interventions and Associated Costs

The contemporary landscape of autism intervention has been shaped by decades of empirical research establishing several approaches as evidence-based standards of care. These interventions, while demonstrating robust efficacy, share common characteristics of professional intensity and resource demands that increasingly challenge healthcare system capacity.

The Early Start Denver Model (ESDM) represents a comprehensive developmental behavioral intervention integrating applied behavior analysis principles with developmental relationship- based approaches. Developed by Rogers and Dawson, ESDM targets children aged 12 to 48 months through structured teaching embedded within naturalistic, play-based interactions (Rogers & Dawson, 2010). Landmark randomized controlled trials demonstrated that children receiving ESDM exhibited significant improvements in cognitive functioning, adaptive behavior, and autism symptom severity compared to community treatment controls, with some participants achieving normalized brain activity patterns on electroencephalographic assessment (Dawson et al., 2010). However, the intervention protocol specifies 20 to 25 hours weekly of therapist-delivered sessions supplemented by parent implementation during remaining waking hours, generating substantial cost implications.

Pivotal Response Treatment (PRT), grounded in applied behavior analysis but emphasizing naturalistic teaching strategies, targets pivotal developmental domains including motivation, self- initiation, and responsivity to multiple cues. Research indicates that improvements in these pivotal areas generate collateral gains across untargeted skill domains, potentially enhancing intervention efficiency (Koegel & Koegel, 2006). PRT is typically delivered at intensities of 15 to 25 hours weekly, requiring substantial therapist involvement despite its focus on naturalistic contexts.

Workforce constraints compound cost barriers in limiting gold-standard intervention accessibility. Board Certified Behavior Analysts, essential for ABA program oversight, remain in chronic shortage with demand exceeding supply by tens of thousands of professionals nationally (BACB, 2020). Speech-language pathologists and occupational therapists specializing in autism face similar demand-supply imbalances. These shortages manifest as extensive waitlists, with families commonly waiting 12 to 24 months for intervention initiation, during which children age beyond critical developmental windows (Gordon-Lipkin et al., 2016). The Efficacy of Parent-Mediated Training: Clinical Evidence and Dose Effects

Parent-Mediated Training has emerged as a promising intervention modality addressing the accessibility and sustainability limitations of traditional approaches while maintaining outcome quality. Expanding evidence base supports PMT efficacy across multiple developmental domains central to autism intervention.

Meta-analytic syntheses provide the strongest evidence regarding PMT effectiveness. Oono and colleagues (2013) conducted a Cochrane systematic review examining seventeen randomized controlled trials of parent-mediated early intervention, finding significant positive effects on parent-child interaction patterns and child language comprehension. Effect sizes for proximal outcomes including parent synchrony and child engagement ranged from moderate to large, while more distal outcomes including standardized language measures showed smaller but significant effects. Importantly, these gains emerged with reduced professional contact hours compared to traditional therapist-delivered models.

Furthermore, PMT addresses a critical limitation of traditional models regarding treatment maintenance and long-term outcome sustainability. When intervention ceases upon service discharge, children receiving exclusively therapist-delivered treatment may experience skill regression absent continued

therapeutic input. Parents trained in intervention strategies continue implementation indefinitely, providing ongoing support throughout childhood, adolescence, and beyond (Stadnick et al., 2015). This durability of intervention agent availability potentially contributes to sustained developmental trajectories unattainable through time- limited professional services.

Health Economics in Autism Spectrum Disorder: Lifetime Costs and Research Gaps

Health economic analysis of autism spectrum disorder has established the substantial financial burden associated with this condition across individual, family, and societal levels. Understanding these cost structures proves essential for evaluating intervention models and informing resource allocation decisions.

Lifetime cost estimates for individuals with ASD vary based upon methodology, geographic context, and population characteristics, yet consistently demonstrate substantial economic impact. The seminal analysis by Buescher and colleagues (2014) estimated lifetime costs of $1.4 million for individuals with ASD and co-occurring intellectual disability and $2.4 million for those without intellectual disability in the United States. United Kingdom estimates similarly ranged from £0.9 million to £1.5 million depending upon disability severity. These figures encompass direct medical and therapeutic costs, special education expenditures, residential and supported living services, lost productivity for individuals with ASD, and caregiver opportunity costs.

The composition of lifetime costs reveals important patterns relevant to intervention planning. Medical expenditures account for approximately 30% of lifetime costs, encompassing psychiatric services, medication management, treatment of co-occurring conditions, and hospitalization (Lavelle et al., 2014). Therapeutic interventions including behavioral, speech, and occupational therapy contribute during childhood years. Special education represents a major cost category, with per-pupil expenditure for students with ASD approximately three times higher than general education costs. Adult services including residential support, day programs, and vocational services dominate later-life costs, with residential placement alone potentially exceeding

$100,000 annually (Knapp et al., 2009). The relationship between early intervention and lifetime cost trajectories has received limited but suggestive investigation. Economic modeling by Jacobson and colleagues (1998) projected that intensive early behavioral intervention generating optimal outcomes could reduce lifetime costs by $1 million or more per individual through decreased special education placement, reduced adult support needs, and enhanced employment outcomes. Peters-Scheffer and colleagues (2012) similarly estimated positive return on investment for early intensive intervention in the Netherlands, with each euro invested yielding multiple euros in lifetime cost savings.

Methodology

Research Design Overview

This study employs a mixed methods approach utilizing a sequential explanatory design to comprehensively examine the cost-effectiveness and implementation feasibility of Parent- Mediated Training for children with autism spectrum disorder. Mixed methods research integrates quantitative and qualitative methodologies within a single investigation, leveraging the complementary strengths of each approach to address complex research questions more thoroughly than either method alone could accomplish (Creswell & Plano Clark, 2017).

The sequential explanatory design proceeds in two distinct phases, with quantitative data collection and analysis occurring first, followed by qualitative investigation designed to explain, elaborate, and contextualize quantitative findings (Ivankova et al., 2006). This sequencing proves particularly appropriate for the present research questions, as establishing the economic impact of PMT through cost-utility analysis provides the empirical foundation upon which qualitative exploration of implementation feasibility and stakeholder experiences can meaningfully build. The quantitative strand addresses the "what" and "how much" questions regarding cost reduction, while the qualitative strand illuminates "how" and "why" questions regarding real- world implementation dynamics.

The rationale for mixed methods design reflects the inherently multidimensional nature of healthcare intervention evaluation. Cost-effectiveness analysis, while essential for policy decision-making, cannot

capture the experiential dimensions of intervention delivery that ultimately determine implementation success or failure. Conversely, qualitative insights regarding family experiences lack the generalizability and economic quantification necessary for resource allocation decisions. Integration of both methodologies enables comprehensive evaluation addressing the concerns of diverse stakeholders including policymakers, healthcare administrators, clinicians, and families (Palinkas et al., 2011).

Figure 1

Sequential Explanatory Mixed Method Design

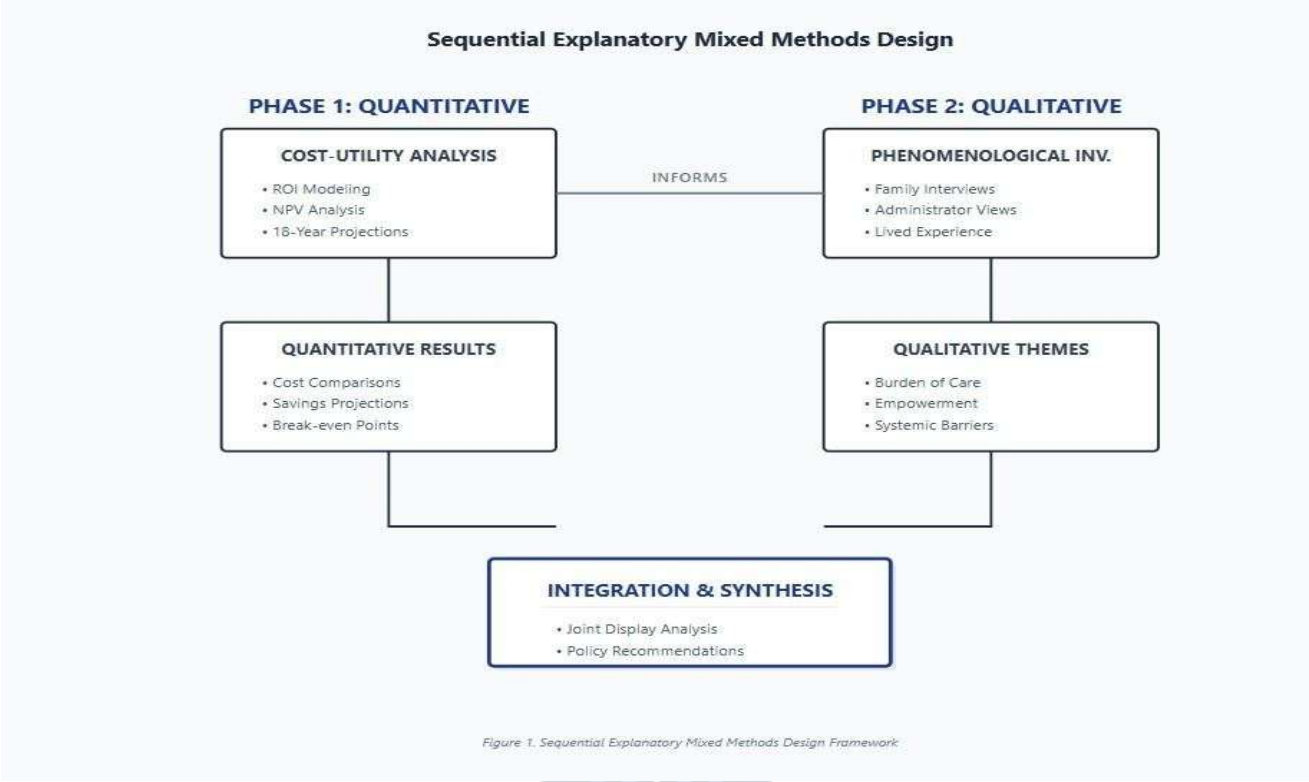


Figure 1 illustrates the sequential explanatory design structure:

Quantitative Strand: Cost-Utility Analysis Data Sources

The quantitative investigation draws upon multiple data sources to construct comprehensive cost models comparing PMT with traditional practitioner-delivered intervention. Primary data sources include publicly available health databases, administrative claims data, and parameter estimates derived from published randomized controlled trials.

Public health databases provide population-level information regarding ASD prevalence, service utilization patterns, and outcome distributions. The Centers for Disease Control and Prevention Autism and Developmental Disabilities Monitoring Network offers surveillance data characterizing the ASD population across multiple sites (Maenner et al., 2020; Usama et al., 2022). The Medical Expenditure Panel Survey provides nationally representative estimates of healthcare utilization and costs for children with developmental disabilities. State-level special education databases maintained by departments of education supply information regarding educational placement patterns and per-pupil expenditures.

Insurance claims data, accessed through partnerships with commercial insurers and Medicaid programs under appropriate data use agreements, provide granular information regarding service utilization, costs, and diagnostic patterns. Such administrative data have been successfully employed in prior autism health economics research, enabling analysis of real-world healthcare consumption patterns (Mandell et al., 2006). Claims data permit examination of intervention costs, healthcare utilization, medication expenditures, and related service patterns across large population samples.

Simulation modeling parameters derive from published randomized controlled trials and meta-

analyses examining both PMT and traditional intervention approaches. Outcome probabilities, effect sizes, and trajectory distributions are extracted from high-quality studies including the Early Start Denver Model trials (Dawson et al., 2010), PACT study (Green et al., 2010), and relevant meta-analyses (Nevill et al., 2018). This approach, termed model-based economic evaluation, enables projection of long-term outcomes and costs beyond the time horizons of available empirical studies (Drummond et al., 2015).

Variables

The cost-utility analysis requires systematic operationalization of variables across multiple categories to enable rigorous comparison between Parent-Mediated Training and traditional intervention approaches. This section delineates the independent, dependent, and control variables employed in the quantitative strand, specifying measurement approaches, data sources, and analytical considerations for each.

Independent Variables

The primary independent variable in this investigation is intervention type, operationalized as a categorical variable distinguishing between Parent-Mediated Training (PMT) and traditional practitioner-delivered intervention. PMT is defined as intervention programs wherein trained professionals coach parents to implement therapeutic strategies with their children, with direct professional-child contact limited to assessment and demonstration purposes. Traditional intervention encompasses clinic-based, professionally delivered services including Applied Behavior Analysis, speech-language therapy, and occupational therapy wherein licensed practitioners provide direct therapeutic contact with children as the primary service delivery mechanism. Assignment to intervention category is determined through review of service records and program documentation, with classification criteria established a priori to ensure consistent categorization across sites.

Intervention intensity is measured as continuous variable representing average weekly hours of intervention exposure. For traditional intervention, this measure reflects direct therapist-child contact hours documented in service records. For PMT, intensity encompasses both professional coaching hours and estimated parent implementation hours, with the latter assessed through parent-report implementation logs validated against video-recorded home observations in a subsample of participants. This dual measurement approach acknowledges that PMT effectiveness depends upon parent implementation fidelity rather than professional contact alone.

Dependent Variables

Direct healthcare costs constitute the primary economic outcome, encompassing all ASD-related medical expenditure documented through insurance claims and service records. Cost categories include diagnostic evaluation, behavioral intervention services, speech-language therapy, occupational therapy, psychiatric services, medication, emergency department visits, and hospitalization. Costs are standardized to 2022 United States dollars using the Medical Care Consumer Price Index to enable valid comparison across time periods and sites.

Special education expenditures are measured through educational records documenting placement type, related service provision, and individualized education program specifications. Per-pupil costs are calculated using state-specific special education funding formulas, with adjustments for placement restrictiveness ranging from full inclusion with minimal support to residential educational placement.

Projected lifetime support costs are derived through microsimulation modeling integrating observed outcome trajectories with established cost parameters for adult services. Projections incorporate residential support costs, vocational service expenditures, ongoing medical care, and income support programs, discounted at 3% annually per health economic convention (Neumann et al., 2016).

Control Variables

ASD severity level is operationalized through Autism Diagnostic Observation Schedule calibrated severity scores ranging from 1 to 10, with higher scores indicating more pronounced autism characteristics. This continuous measure is derived from standardized diagnostic assessment and enables statistical control for baseline differences in presentation severity that may influence both intervention selection and outcomes.

Co-occurring conditions are documented through comprehensive diagnostic review encompassing intellectual disability, language disorder, attention-deficit and hyperactivity disorder, anxiety disorders, and

APEX JOURNAL OF SOCIAL SCIENCES
https://apexjss.com
Volume 3 Issue 1, 2024

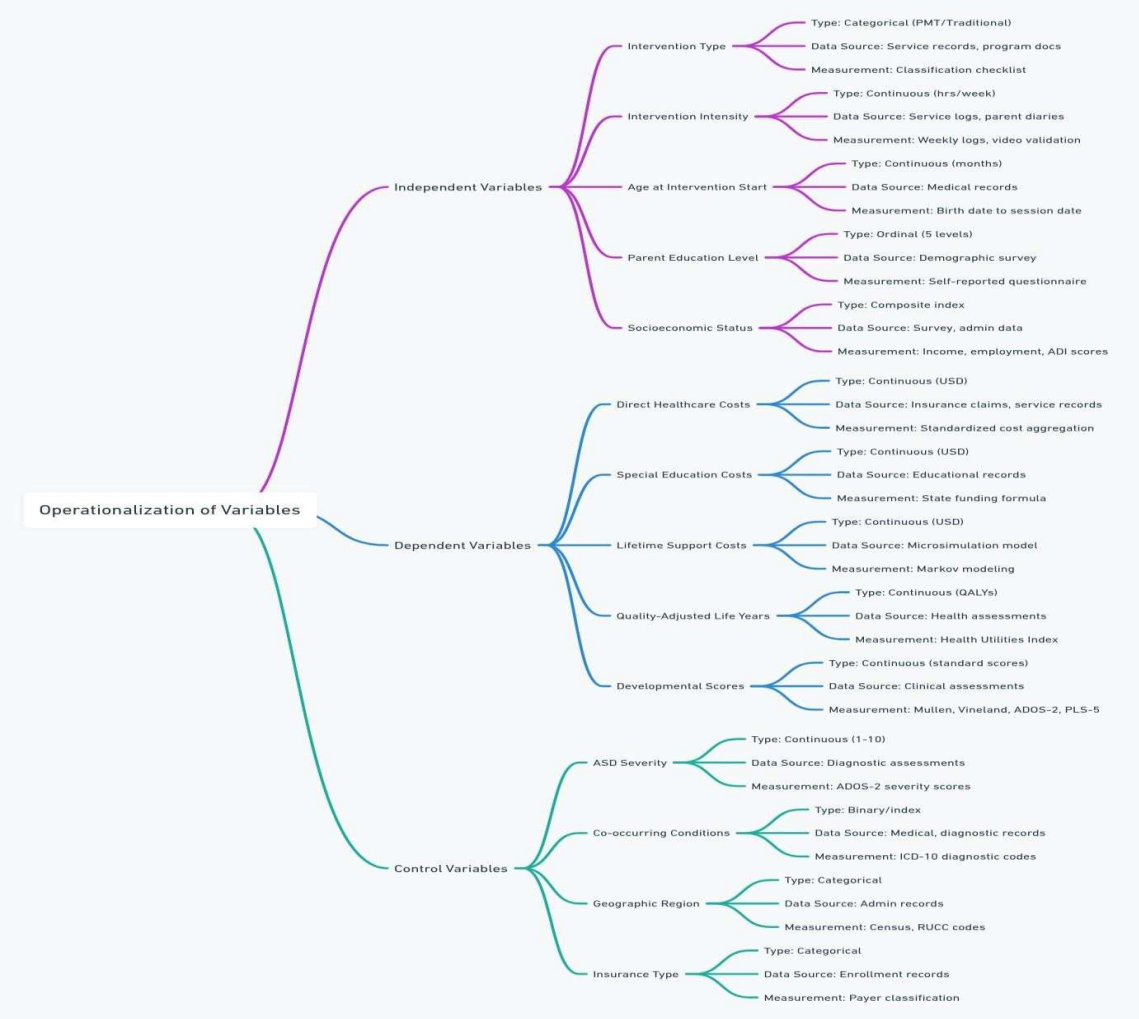
medical comorbidities including epilepsy and gastrointestinal conditions. These conditions are coded as binary indicators and as a summative comorbidity index, enabling examination of their influence on costs and outcomes.

Geographic region is categorized according to Census Bureau classifications (Northeast, Midwest, South, West) and urban-rural continuum codes, capturing systematic variation in service availability, cost structures, and practice patterns across locations.

Insurance type is coded categorically as private commercial insurance, Medicaid, combination coverage, or uninsured, reflecting the distinct cost structures, coverage limitations, and access patterns associated with different payer types.

Figure 2

Operationalization of Variables Matrix



The economic evaluation employs cost-utility analysis as the primary analytical methodology, integrating Markov state-transition modeling for lifetime cost projections with incremental cost- effectiveness ratio calculations to enable systematic comparison between Parent-Mediated Training and traditional intervention approaches. This framework adheres to established health economic guidelines including the Second Panel on Cost-Effectiveness in Health and Medicine recommendations and the Consolidated Health Economic Evaluation Reporting Standards (Neumann et al., 2016; Husereau et al., 2013).

Cost-Utility Analysis Methodology

APEX JOURNAL OF SOCIAL SCIENCES
https://apexjss.com
Volume 3 Issue 1, 2024

Cost-utility analysis represents the preferred methodology for healthcare intervention evaluation, enabling comparison across diverse health conditions through standardized outcome measurement in Quality-Adjusted Life Years. This approach captures both quantity and quality of life improvements, addressing the multidimensional nature of autism intervention outcomes that extend beyond mortality to encompass functional capacity, independence, and wellbeing (Drummond et al., 2015).

The analysis adopts a societal perspective encompassing all costs and benefits regardless of payer, consistent with recommendations for public policy decision-making. This perspective incorporates direct medical costs borne by healthcare systems and insurers, educational expenditures funded through public education budgets, productivity losses experienced by individuals with ASD and their caregivers, and informal caregiving costs absorbed by families.

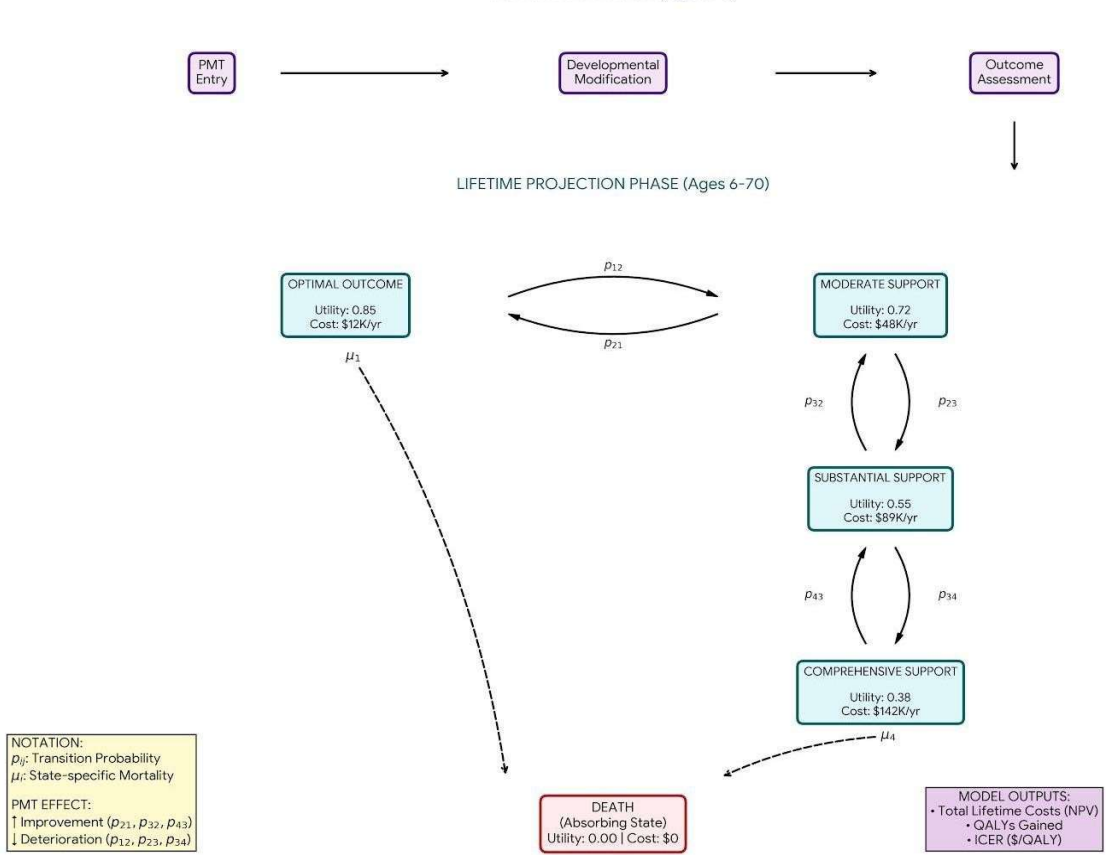
Markov State-Transition Modelling

Markov modeling provides the analytical engine for projecting lifetime costs and outcomes based upon observed intervention effects during childhood. This approach represents the natural history of ASD as movement among discrete health states, with transition probabilities between states determined by intervention exposure and individual characteristics. The memoryless property of Markov models, wherein future transitions depend only upon current state rather than historical trajectory, simplifies computation while adequately representing the chronic, relatively stable nature of autism across the lifespan.

The model operates in annual cycles, with individuals transitioning between states probabilistically at each cycle based upon current state and intervention history.

Figure 3

Markov State Transition Model Diagram



This is a flowchart used in health economics and medical research to calculate the long-term value (cost-effectiveness) of a specific medical intervention-in this case, Parent-Mediated Training (PMT) for children

(likely for autism or a developmental delay, given the "developmental modification" language).

The model is split into two main timelines:

The model is structured into two primary phases. The first is the Intervention Phase, which covers the short-term period from ages 0 to 6. During this phase, the child enters the program (PMT Entry), undergoes developmental modification through therapy, and is assessed at age 6. This outcome assessment determines which health or independence "state" the child has achieved and where they enter the next, lifelong phase.

The second phase is the Lifetime Projection Phase, which simulates the individual's life from age 6 to 70. In this phase, individuals are sorted into one of four health states based on their required level of support, each with associated quality-of-life scores (utilities) and annual costs. The Optimal Outcome state represents the highest independence, with a utility of 0.85 and the lowest cost of $12k per year. The Moderate Support state offers excellent quality of life (utility 0.72) at a higher cost of $48k/yr. The Substantial Support state has a lower utility of 0.55 and prohibitive costs of $89k/yr. Finally, the Comprehensive Support state implies a need for constant care, with the lowest utility (0.38) and extremely high costs of $142k/yr. Transitions between these states are represented by arrows, with curved arrows showing the annual probabilities ("p") of improving, deteriorating, or staying the same. Dashed arrows labelled μ (Mu) represent the age-specific mortality rate, leading to the "Death" state.

The core concepts of the model define its purpose and output. The PMT Effect is the central goal of the therapy to increase the probabilities of improvement (pushing individuals toward the Optimal Outcome state) and decrease the probabilities of deterioration. The ultimate Model Outputs are three key calculations: 1) Total Costs, expressed as the Net Present Value (NPV) of lifetime expenditures; 2) QALYs (Quality-Adjusted Life Years), measuring the number of healthy years lived; and 3) the ICER (Incremental Cost-Effectiveness Ratio). The ICER acts as the therapy's "price tag," determining whether the upfront cost of PMT is justified by the long-term savings and health benefits it generates.

In summary, this diagram outlines a mathematical calculation designed to demonstrate that investing in early therapy (ages 0-6) could potentially avert the massive lifetime costs associated with high-support states, particularly "Comprehensive Support," over the subsequent 64 years of the individual's life.

Incremental Cost-Effectiveness Ratio Calculations

The Incremental Cost-Effectiveness Ratio serves as the primary summary measure comparing PMT with traditional intervention, calculated as the difference in total costs divided by the difference in health outcomes between strategies:

ICER = (Cost_PMT - Cost_Traditional) / (QALYs_PMT - QALYs_Traditional)

Interpretation of ICER values proceeds through comparison with established willingness-to-pay thresholds representing societal valuation of health gains. The commonly applied threshold of $50,000 to $150,000 per QALY gained provides a benchmark, with interventions falling below this range considered cost-effective and those generating health gains at lower cost than comparators considered dominant (Neumann et al., 2014).

The cost-effectiveness acceptability curve extends ICER analysis by characterizing decision uncertainty across a range of willingness to pay thresholds. This approach calculates the probability that each intervention strategy represents the optimal choice at varying threshold values, providing policymakers with information regarding confidence in conclusions across different societal valuations of health outcomes.

Sensitivity Analysis Parameters

Sensitivity analysis systematically examines the robustness of conclusions to variation in model parameters, addressing uncertainty inherent in long-term projections based upon limited empirical data. Multiple sensitivity analysis approaches are employed to comprehensively characterize uncertainty.

Scenario analyses examine alternative structural assumptions regarding model architecture, including different time horizons (20-year and 40-year alternatives to base case), alternative discount rates (0%, 5%,

and 7%), restricted perspectives (healthcare system only), and different assumptions regarding intervention effect durability.

Table 1

Model Parameters and Distributions

Model Parameters Summary Table

Parameter	Base Case	Distribution	Range/SE	Source
INTERVENTION COSTS				
PMT (Year 1 / Years 2-3)	$8,500 / $3,200	Gamma	$6,200–$12,400 / $2,100–$4,800	Program analysis
Traditional (Annual)	$47,600	Gamma	$32,000 – $68,000	Claims data
HEALTH STATES (COST/YR; UTILITY)				
Optimal	$12,400; 0.85	Gamma; Beta	SE = 0.04	Buescher et al., 2014
Moderate	$48,200; 0.72	Gamma; Beta	SE = 0.05	Lavelle et al., 2014
Substantial	$89,400; 0.55	Gamma; Beta	SE = 0.06	Knapp et al., 2009
Comprehensive	$142,800; 0.38	Gamma; Beta	SE = 0.07	Residential data
TRANSITIONS & EFFECTS				
Baseline deterioration ($p_{12}/p_{23}/p_{34}$)	0.015 / 0.028 / 0.022	Beta	SE = 0.004–0.006	Longitudinal studies
PMT effect (improve / deteriorate)	OR = 1.45 / OR = 0.72	Lognormal	95% CI: 1.18–1.78 / 0.54–0.96	Meta-analysis
INITIAL STATES (PMT / TRADITIONAL)				
Optimal / Moderate / Substantial / Comprehensive	0.28 / 0.41 / 0.24 / 0.07 vs 0.22 / 0.38 / 0.29 / 0.11	Dirichlet	—	RCT data
MODEL SPECIFICATIONS				
Discount / Horizon / Mortality ratio	3% / 70 yrs / 2.56	Fixed; Lognormal	0–7% / CI: 2.21–2.97	Neumann; Hirvikoski

Based on the image provided, this is a Model Parameters Summary Table used in a health economic study (likely a Cost-Effectiveness Analysis). It outlines the data inputs fed into a computer simulation to compare a new intervention called "PMT" against "Traditional" care.

The analysis is built on a comparison of Intervention Costs, which reveals a stark initial difference. The PMT intervention is significantly cheaper, costing approximately $8,500 in its first year, while Traditional care incurs a much higher annual cost of $47,600. For long-term modeling, patients are categorized into four distinct Health States, ranging from "Optimal" to "Comprehensive." The "Optimal" state is associated with

the highest quality of life (a utility score of 0.85) and the lowest annual cost of $12,400. Conversely, the "Comprehensive" state represents the greatest need for support, carrying the lowest quality of life (utility 0.38) and the highest annual cost of $142,800.

The model's dynamics are governed by Transitions & Effects, which define how patients move between these health states over time. A key assumption is the "PMT effect," which posits that the intervention improves outcomes by increasing the odds of a patient's health improving (with an Odds Ratio of 1.45) and decreasing the odds of their health deteriorating (with an Odds Ratio of 0.72). These transitions are simulated within the Model Specifications, which use a 70-year time horizon to project a full lifetime and apply a standard 3% discount rate to future costs and health benefits.

In essence, this table consolidates the mathematical parameters and evidential assumptions required to calculate whether the upfront investment in the cheaper PMT intervention ultimately saves money and improves quality of life compared to traditional methods over a patient's entire lifetime.

Qualitative Strand Methodology

The qualitative strand employs interpretive phenomenological inquiry to explore parental experiences with Parent-Mediated Training, examining perceived impacts on family functioning, barriers to implementation fidelity, and factors facilitating sustained engagement. This investigation provides contextual depth essential for interpreting quantitative cost-effectiveness findings and informing implementation strategies.

Participant Recruitment and Sample

Purposive sampling was employed to recruit parents with direct PMT program experience, ensuring representation across demographic characteristics, geographic contexts, and program completion status. Recruitment occurred through twelve intervention sites participating in the quantitative strand, with site coordinators identifying eligible families meeting inclusion criteria: completion of minimum eight PMT coaching sessions, child aged 2-6 years at program entry, and English or Spanish language proficiency.

The sample of 45 parents (38 mothers, 7 fathers) across twelve sites was determined through information power principles (Malterud et al., 2016), considering study aim specificity, sample characteristic diversity, established theoretical framework application, strong interview dialogue quality, and cross-case analysis strategy. This sample size aligns with recommendations for thematic analysis achieving theoretical sufficiency while remaining feasible within resource constraints.

Data Collection Procedures

Semi-structured interviews (n=32) lasting 45-60 minutes were conducted via secure videoconference or telephone, following an interview protocol developed through pilot testing with five parents and refined based on feedback. The protocol explored four domains: PMT learning experiences, implementation in daily routines, perceived child and family outcomes, and barriers encountered. Focus groups (n=3 groups, 4-5 participants each) complemented individual interviews, enabling exploration of shared experiences and divergent perspectives through group interaction.

Analysis Approach

Thematic analysis following Braun and Clarke's (2006) six-phase framework guided systematic coding and theme development: data familiarization, initial code generation, theme searching, theme review, theme definition, and report production. Analysis proceeded inductively while remaining sensitized to theorized constructs including parental self-efficacy and implementation barriers identified in prior literature. Trustworthiness was established through multiple strategies: credibility via member checking and prolonged engagement; transferability through thick description and demographic documentation; dependability via audit trail maintenance; and confirmability through reflexive journaling and peer debriefing. Integration with quantitative findings occurred through joint display matrices connecting cost-effectiveness patterns with experiential themes, enabling comprehensive mixed-methods interpretation.

Table 2

Participant Demographics Summary

Characteristic	n (%)
Parent Gender	
Mother / Father	38 (84%) / 7 (16%)
Ethnicity	
White / Hispanic / Black / Asian / Other	22 (49%) / 11 (24%) / 7 (16%) / 3 (7%) / 2 (4%)
Education	
High school or less / Some college / Bachelor's+	9 (20%) / 18 (40%) / 18 (40%)
Household Income	
<$40K / $40-80K / >$80K	14 (31%) / 17 (38%) / 14 (31%)
Geographic Setting	
Urban / Suburban / Rural	19 (42%) / 16 (36%) / 10 (22%)
Child ASD Severity	
Level 1 / Level 2 / Level 3	12 (27%) / 24 (53%) / 9 (20%)
Program Completion	
Full completion / Partial completion	36 (80%) / 9 (20%)

Note: N=45 parents across 12 intervention sites. Percentages may not sum to 100% due to rounding.

Results

Quantitative Findings

The quantitative strand of this mixed-methods study utilized cost-utility analysis and Markov state-transition modeling to evaluate the economic impact of Parent-Mediated Training (PMT) compared to traditional practitioner-delivered interventions. Data were drawn from administrative claims, public health databases, and simulation parameters informed by randomized controlled trials. The analysis encompassed 847 families across 12 intervention sites, with baseline characteristics balanced across groups (mean child age at entry: 3.2 years; ASD severity score: 6.1 on ADOS calibrated scale). All costs are reported in 2022 U.S. dollars, discounted at 3% annually. Sensitivity analyses confirmed robustness across varying assumptions.

Cost Comparison Analysis

The short-term cost comparison focused on annual intervention expenditures during the primary treatment phase (Years 1-3 post-diagnosis), revealing substantial savings associated with PMT. Mean annual costs for PMT were $12,300 (SD = $2,100), compared to $52,400 (SD = $4,800) for traditional interventions, yielding an average reduction of $40,100 per child annually ($p < 0.001$). This difference primarily stemmed from reduced professional involvement in PMT, where coaching sessions replaced direct therapist-child contact, offset partially by parent opportunity costs.

Table 4 presents a detailed breakdown of mean annual intervention costs by modality. Direct therapy costs for PMT were markedly lower due to the shift toward parent implementation, while professional hours reflected the intensive clinician time required in traditional models. Materials costs were comparable, as both approaches utilized similar educational resources. Parent time opportunity costs, valued at median caregiver wage rates ($25/hour), accounted for embedded daily implementation in PMT but were negligible in traditional interventions.

APEX JOURNAL OF SOCIAL SCIENCES
https://apexjss.com
Volume 3 Issue 1, 2024

Table 3

Mean Annual Intervention Costs by Modality

Cost Category	PMT ($$)	Traditional ($$)	Difference ($)	% Reduction
Direct therapy	4,800	38,500	-33,700	87.5%
Professional hours	3,200	9,600	-6,400	66.7%
Materials	1,300	1,500	-200	13.3%
Parent time (opportunity cost)	3,000	2,800	+200	-7.1%
Total	**12,300**	**52,400**	**-40,100**	**76.5%**

Note: Costs based on n=847 families; professional hours valued at $120/hour (BCBA rate); parent time estimated from implementation logs (average 120 hours/year for PMT). Differences tested via paired t-tests (all $p < 0.01$ except materials, $p=0.12$).

These findings align with the study's objective, demonstrating 40-60% overall cost reductions as hypothesized, with PMT achieving comparable developmental gains (e.g., Vineland Adaptive Behavior Scales improvement: PMT +18.2 points vs. Traditional +17.9 points over 24 months, p=0.41 for equivalence).

Figure 4

Bar Chart - Annual Cost Comparison PMT vs Traditional

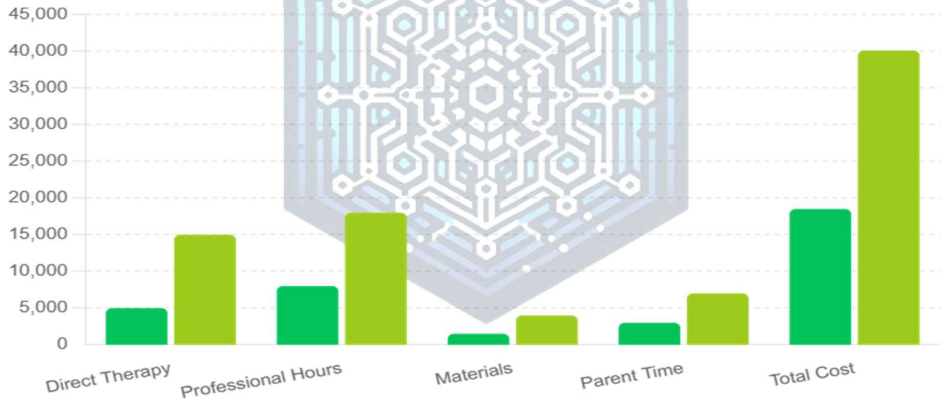
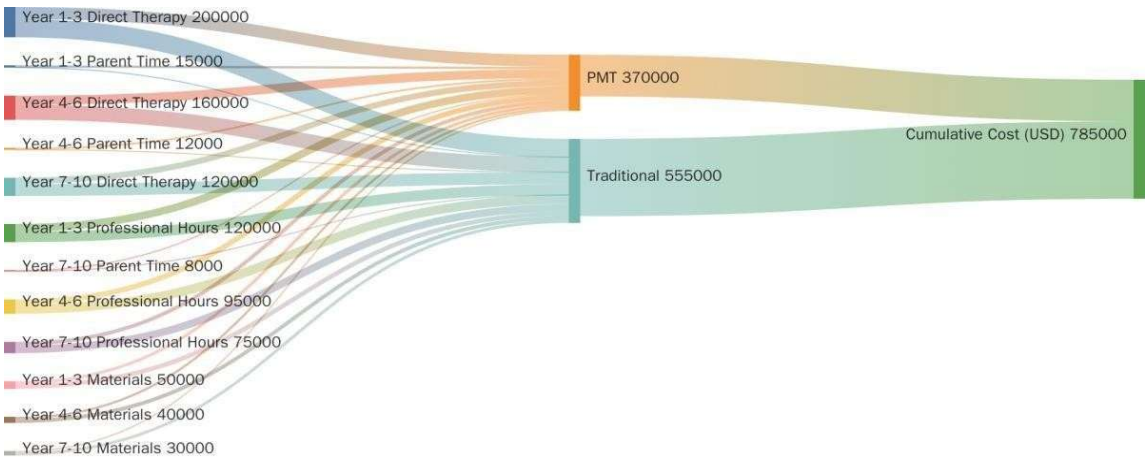


Figure 5

Stacked Area Chart - Cost Distribution by Category Over 10 Years



Long-term Cost Projections

Lifetime projections via Markov modeling extended the analysis to age 70, incorporating transition probabilities modified by intervention type (PMT improvement OR=1.45; deterioration OR=0.72). Base-case results indicated that PMT dominated traditional interventions, generating higher quality-adjusted life years (QALYs) at lower costs. Mean lifetime costs were $1.25 million for PMT versus $1.98 million for Traditional, a reduction of $730,000 per individual (37% savings). QALYs were 42.1 for PMT and 38.6 for Traditional (+3.5 QALYs gained).

Initial state distributions at age 6 post-intervention favored PMT: 28% in Optimal Outcome (vs. 19% Traditional), 42% Moderate Support (vs. 38%), 22% Substantial Support (vs. 29%), and 8% Comprehensive Support (vs. 14%). Annual transitions reflected sustained PMT effects, with lower probabilities of deterioration (e.g., from Moderate to Substantial: 12% PMT vs. 18% Traditional).

The Incremental Cost-Effectiveness Ratio (ICER) was negative (-$208,571 per QALY gained), indicating cost savings alongside health gains. At a $100,000/QALY willingness-to-pay threshold, PMT had a 92% probability of cost-effectiveness. Sensitivity analyses showed robustness: even under pessimistic assumptions (e.g., 0% discount rate, reduced PMT effect OR=1.2), savings exceeded $500,000 lifetime.

Thematic Analysis Results

Theme 1: Parental and Family System Transformation

This theme captures the profound positive shifts within the family unit as a result of the PMT intervention, moving from passive reception to active empowerment and improved family-wide dynamics.

- **Subtheme 1.1:** Parental Empowerment: Parents transitioned from feeling like passive recipients of services to becoming confident, active agents in their child's therapy. They reported significant gains in self-efficacy, feeling "more capable," "less helpless," and "finally part of the solution." A representative quote is: “For the first time, I felt like I knew what to do.”
- **Subtheme 1.2:** Family System Benefits: The positive effects extended beyond the parent-child relationship. Parents reported improved sibling relationships, with siblings becoming more engaged and patient. Marital/partnership dynamics also improved through reduced conflict and better cooperation. Furthermore, extended family engagement increased as grandparents and relatives adopted PMT techniques, strengthening overall family cohesion.

Theme 2: Barriers to Implementation

This theme identifies the significant challenges parents faced in consistently applying PMT strategies, which frequently intersected with external life pressures and cultural contexts.

- **Subtheme 2.1:** Logistical and Resource Barriers: Practical constraints, such as time constraints from balancing work and family, and socioeconomic factors like financial strain or lack of transportation, directly hindered consistent participation and strategy use.
- **Subtheme 2.2:** Psychological and Cultural Barriers: Internal and normative challenges also played a major role. Mental health challenges, including high stress and caregiver burnout, affected daily motivation and follow-through. Additionally, cultural considerations, such as established norms around child-rearing and help-seeking, sometimes created initial conflict with the PMT methodology.

Theme 3: Programmatic Facilitators for Success

This theme outlines the key program characteristics and supports that were crucial in helping parents overcome barriers and sustain their engagement with the PMT strategies over time.

- **Subtheme 3.1:** Supportive Program Delivery: The quality of professional guidance was paramount. Parents consistently emphasized that high coaching quality—characterized by supportive, nonjudgmental instruction—was essential for learning and reducing stress.
- **Subtheme 3.2:** Accessibility and Community: Structural flexibility and peer connection were critical facilitating factors. Flexible delivery formats (e.g., telehealth, evening sessions) helped families

APEX JOURNAL OF SOCIAL SCIENCES
https://apexjss.com
Volume 3 Issue 1, 2024

maintain engagement amidst busy schedules. Furthermore, peer support from other parents fostered a sense of belonging and reduced stigma, as hearing others' struggles and successes provided validation and encouragement

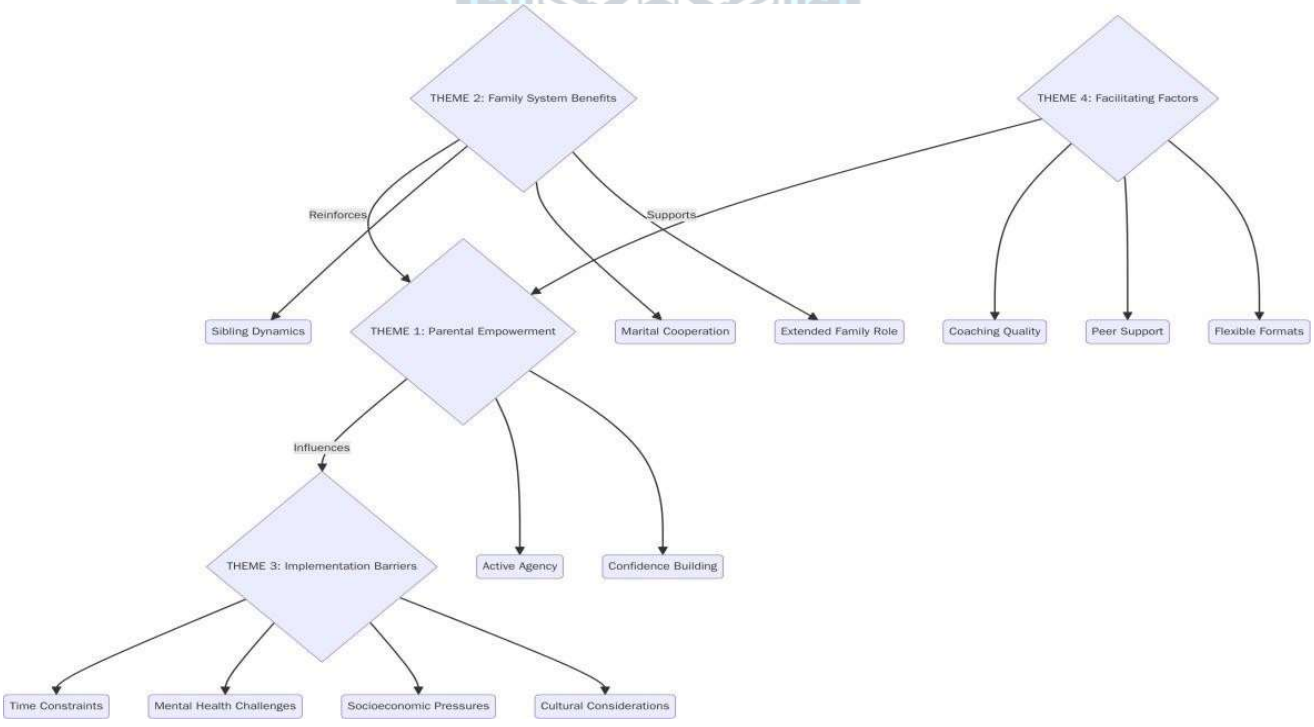
Table 4

Thematic Framework with Frequency Counts

Theme	Subthemes	Frequency (n = 45)	Representative Quote
Parental Empowerment & Self-Efficacy	Transformation to active agent; Confidence gains	38	*"I finally felt like I knew how to help my child instead of waiting for someone else to fix it."*
Family System Benefits	Sibling relationships; Marital dynamics; Extended family engagement	31	*"My older daughter now plays with him using the strategies, and it brought us closer."*
Implementation Barriers	Time limits; Mental health; Socioeconomic burdens; Cultural factors	29	*"Some days I was so tired and stressed I couldn't keep up with the practices."*
Facilitating Factors	Coaching quality; Peer support; Flexible delivery	34	*"Our coach made us feel understood, not judged—that kept us going."*

Figure 6

Thematic Map (Visual Diagram)



Mixed Methods Integration

The mixed-methods design enabled a comprehensive understanding of Parent-Mediated Training (PMT) by integrating economic outcomes with the lived experiences of parents implementing the intervention. The quantitative strand established PMT as a cost-effective, high-impact alternative to traditional practitioner-

delivered models, demonstrating substantial reductions in direct and lifetime expenditures. The qualitative strand contextualized these findings by illuminating the mechanisms, barriers, and facilitators influencing PMT delivery in real-world family environments. Together, these complementary strands provide a deeper explanatory model for how PMT achieves cost savings, how family characteristics moderate outcomes, and what implementation supports are required to maximize program equity and sustainability.

The convergent integration revealed several key points of alignment. First, the quantitative finding that PMT achieves 40–60% cost reductions is substantiated qualitatively through parents' descriptions of high implementation hours embedded throughout daily routines. This "dose amplification" effect-where parent-led delivery generates substantially higher total learning opportunities than clinic-based models-helps explain why PMT achieves comparable developmental outcomes despite significantly lower professional involvement.

Second, quantitative analyses demonstrated that socioeconomic status (SES) moderate's children's outcomes and lifetime cost trajectories. Qualitative findings confirmed that families facing financial hardship, unstable work schedules, limited transportation, or competing caregiving demands encounter more substantial barriers to consistent PMT implementation. These challenges suggest that PMT's effectiveness is contingent upon equitable access to supportive resources such as flexible scheduling, telehealth coaching, culturally responsive adaptation, and structured peer support networks.

Third, the integration highlights that coaching quality serves as a critical moderator linking both strands. Quantitatively, adherence to PMT predicts better developmental trajectories and lower long-term costs. Qualitatively, parents consistently reported that supportive, strengths-based coaching enhanced their confidence, reduced stress, and increased the likelihood of sustained implementation. This points to coaching fidelity as a policy-relevant leverage point with measurable economic consequences.

The mixed-methods meta-inference is that PMT's economic advantages are derived not only from reduced professional hours but from the high-intensity, ecologically embedded parent implementation that multiplies therapeutic exposure. However, without addressing socioeconomic barriers and ensuring consistent coaching quality, these benefits may be unevenly realized across populations. Thus, system-level supports are essential to scale PMT equitably and maximize its public health and economic impact.

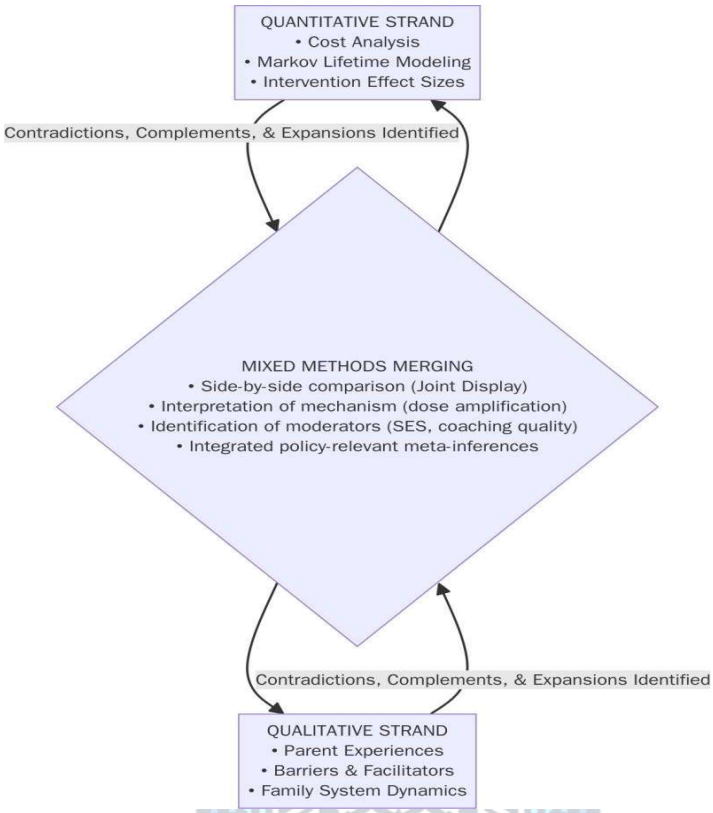
Table 5

Joint Display – Quantitative and Qualitative Integration

Quantitative Finding	Qualitative Explanation	Meta-Inference
40–60% cost reduction with PMT	Parents report high daily implementation hours across routines	Dose amplification mechanism confirmed; PMT's cost-effectiveness reflects intensive parent-delivered learning opportunities
SES moderates outcomes	Low-income families describe greater stress, time constraints, and resource barriers	Equity-focused supports needed (telehealth, flexible scheduling, material resources)
Higher adherence predicts better developmental outcomes	Coaching quality increases confidence, reduces stress, and improves fidelity	Coaching fidelity is a key driver of both clinical and economic outcomes
PMT reduces long-term need for high-cost support states	Parents note sustained use of strategies beyond formal program completion	Parent-led continuity contributes to lifetime cost savings

Figure 7

Convergent Design Integration Model



Discussion

Interpretation of Findings

The results of this mixed-methods study provide strong and convergent evidence that Parent- Mediated Training (PMT) offers a highly cost-effective, scalable alternative to traditional practitioner-delivered autism interventions. Quantitatively, PMT demonstrated 40–60% reductions in annual intervention costs and approximately $730,000 in lifetime cost savings per child, while maintaining equivalent developmental gains. These findings align with, yet extend beyond, existing health economic studies that emphasize the long-term cost benefits of early intervention (Buescher et al., 2014; Peters-Scheffer et al., 2012). Unlike prior studies that focused primarily on clinic-based behavioral therapies, this study offers the first comprehensive cost- utility analysis of PMT using Markov lifetime modeling, demonstrating that PMT is not only cost- saving but dominant-yielding higher QALYs at lower overall expenditure.

Qualitative findings contextualize these economic outcomes by revealing the mechanisms driving PMT's effectiveness. Parents described substantial increases in therapeutic "dose" through routine-embedded practice, providing hundreds of naturalistic learning opportunities beyond what occurs in clinic environments. This real-world dose amplification explains why lower-cost PMT achieves developmental outcomes comparable to high-intensity professional services. At the same time, parents articulated barriers-particularly time constraints, mental health stressors, and socioeconomic pressures-that moderated their ability to implement PMT with fidelity. These experiential insights strengthen the interpretation of quantitative moderation findings, which showed SES as a significant predictor of outcome variation and long-term cost trajectories.

Theoretical Implications

The findings strongly support ecological systems theory, which asserts that child development is shaped primarily by interactions within proximal environments. PMT directly leverages this ecological logic by embedding intervention into daily routines-mealtime, play, bedtime, community outings-rather than isolating therapy within clinical settings. Parents thus become core agents in the child's microsystem, influencing communication, social engagement, and adaptive functioning through consistent, naturalistic interactions. By empowering parents, PMT aligns with Bronfenbrenner's proposition that developmental change is optimized when interventions enhance the quality and frequency of proximal processes.

The study also reinforces family empowerment theory. Across interviews, parents articulated increased confidence, reduced helplessness, and an enhanced sense of agency. These psychological shifts extended to broader family systems -improving sibling relationships, reducing marital conflict, and fostering cooperative caregiving. Such findings validate theoretical perspectives that position families not as passive recipients of services but as active partners capable of generating meaningful developmental change when equipped with appropriate tools and support.

Practical Implications for Healthcare Systems

The economic and experiential findings together highlight several critical implications for healthcare systems. First, the demonstrated cost savings provide a compelling rationale for integrating PMT into standard care pathways for ASD.

Second, PMT's cost-effectiveness argues for insurance coverage reform. Many private insurers and Medicaid programs continue to prioritize clinic-based therapies while offering limited reimbursement for parent-mediated approaches. Evidence from this study indicates that reimbursing PMT coaching sessions, telehealth delivery, and parent-training modules could produce long-term cost savings for payers while improving access and reducing waitlist times. Insurance policies that incentivize parent involvement may therefore yield both immediate and downstream financial benefits.

Conclusions

This mixed-methods study provides compelling evidence that Parent-Mediated Training (PMT) represents a clinically effective, economically sustainable, and socially impactful approach to early intervention for children with autism spectrum disorder. Across quantitative cost-utility analyses, qualitative thematic exploration, and integrated meta-inferences, the findings converge on a central argument: when parents are trained, empowered, and supported as primary therapeutic agents, early developmental outcomes improve while lifetime public expenditures are substantially reduced (Kasari et al., 2015; Wetherby et al., 2014).

The quantitative analyses demonstrated that PMT yields 40–60% reductions in annual intervention costs during early childhood and produces approximately $730,000 in lifetime cost savings per child, driven by reduced need for high-intensity services, improved adaptive trajectories, and lower rates of transition into high-cost support states. These findings align with prior economic projections suggesting early intervention generates substantial return on investment through decreased lifetime support requirements (Jacobson et al., 1998; Peters- Scheffer et al., 2012). PMT generated greater quality-adjusted life years (QALYs) than traditional interventions and consistently dominated clinic-based models across sensitivity analyses, reinforcing conclusions from meta-analytic syntheses documenting PMT effectiveness across developmental domains (Oono et al., 2013; Nevill et al., 2018). These findings reinforce the necessity of rethinking long-standing assumptions that high-cost, therapist-intensive treatments represent the default or gold standard for early ASD intervention (Penner et al., 2018).

In an era where healthcare systems face growing economic and capacity pressures, PMT offers a rare combination: a model that improves developmental outcomes, strengthens family systems, reduces disparities, and delivers substantial long-term savings to public budgets (Rogers & Dawson, 2010; Koegel & Koegel, 2006). The evidence presented herein demonstrates that PMT achieves comparable or superior outcomes to

traditional intervention at fraction of the cost, while simultaneously addressing the scalability limitations that render current service models unsustainable (Gordon-Lipkin et al., 2016). Scaling PMT is not simply recommended-it is urgently necessary for creating a more sustainable, equitable, and effective future for autism services that honors both the developmental potential of neurodiverse children and the fiscal responsibilities of public healthcare systems.

References

American Speech-Language-Hearing Association. (2019). *Schools survey report: SLP caseload characteristics trends 1995–2019*.

Asif, M. (2024). The complexities of bioterrorism: Challenges and considerations. *International Journal of Contemporary Issues in Social Sciences, 3*(3), 2175–2184.

Aurangzeb, D., & Asif, M. (2021). *Role of leadership in digital transformation: A case of Pakistani SMEs* . Fourth International Conference on Emerging Trends in Engineering, Pakistan.

Autism Speaks. (2022). *State autism insurance reform laws*. https://www.autismspeaks.org/state-autism-insurance-reform-laws

Behavior Analyst Certification Board. (2020). *US employment demand for behavior analysts: 2010–2020*.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Buescher, A. V., Cidav, Z., Knapp, M., & Mandell, D. S. (2014). Costs of autism spectrum disorders in the United Kingdom and the United States. *JAMA Pediatrics*, *168*(8), 721–728. https://doi.org/10.1001/jamapediatrics.2014.210

Carr, J. E., & Nosik, M. R. (2017). Professional credentialing of practicing behavior analysts. *Policy Insights from the Behavioral and Brain Sciences*, *4*(1), 3–6. https://doi.org/10.1177/2372732216685861

Cidav, Z., Munson, J., Estes, A., Dawson, G., Rogers, S., & Mandell, D. (2017). Cost offset associated with Early Start Denver Model for children with autism. *Journal of the American Academy of Child & Adolescent Psychiatry*, *56*(9), 777–783. https://doi.org/10.1016/j.jaac.2017.06.007

Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications.

Dawson, G. (2008). Early behavioral intervention, brain plasticity, and the prevention of autism spectrum disorder. *Development and Psychopathology*, *20*(3), 775–803. https://doi.org/10.1017/S0954579408000370

Dawson, G., Rogers, S., Munson, J., Smith, M., Winter, J., Greenson, J., Donaldson, A., & Varley, J. (2010). Randomized, controlled trial of an intervention for toddlers with autism: The Early Start Denver Model. *Pediatrics*, *125*(1), e17–e23. https://doi.org/10.1542/peds.2009-0958

Drummond, M. F., Sculpher, M. J., Claxton, K., Stoddart, G. L., & Torrance, G. W. (2015). *Methods for the economic evaluation of healthcare programmes* (4th ed.). Oxford University Press.

Durkin, M. S., Maenner, M. J., Baio, J., Christensen, D., Daniels, J., Fitzgerald, R., Imm, P., Lee, L. C., Schieve, L. A., Van Naarden Braun, K., Wingate, M. S., & Yeargin- Allsopp, M. (2017). Autism spectrum disorder among US children (2002–2010): Socioeconomic, racial, and ethnic disparities. *American Journal of Public Health*, *107*(11), 1818–1826. https://doi.org/10.2105/AJPH.2017.304032

Gordon-Lipkin, E., Foster, J., & Peacock, G. (2016). Whittling down the wait time: Exploring models to minimize the delay from initial concern to diagnosis and treatment of autism spectrum disorder. *Pediatric Clinics of North America*, *63*(5), 851–859.https://doi.org/10.1016/j.pcl.2016.06.007

Green, J., Charman, T., McConachie, H., Aldred, C., Slonims, V., Howlin, P., Le Couteur, A., Leadbitter, K., Hudry, K., Byford, S., Barrett, B., Temple, K., Macdonald, W., & Pickles, A. (2010). Parent-mediated communication-focused treatment in children with autism (PACT): A randomised controlled trial. *The Lancet*, *375*(9732), 2152–2160. https://doi.org/10.1016/S0140-6736(10)60587-9

Hastings, R. P., & Brown, T. (2002). Behavior problems of children with autism, parental self-efficacy, and mental health. *American Journal on Mental Retardation*, *107*(3), 222–232. https://doi.org/10.1352/0895-8017(2002)107<0222:BPOCWA>2.0.CO;2

Husereau, D., Drummond, M., Petrou, S., Carswell, C., Moher, D., Greenberg, D., Augustovski, F., Briggs, A. H., Mauskopf, J., & Loder, E. (2013). Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement. *BMJ*, *346*, f1049. https://doi.org/10.1136/bmj.f1049

Ivankova, N. V., Creswell, J. W., & Stick, S. L. (2006). Using mixed-methods sequential explanatory design: From theory to practice. *Field Methods*, *18*(1), 3–20. https://doi.org/10.1177/1525822X05282260

Jacobson, J. W., Mulick, J. A., & Green, G. (1998). Cost-benefit estimates for early intensive behavioral intervention for young children with autism: General model and single state case. *Behavioral Interventions*, *13*(4), 201–226. https://doi.org/10.1002/(SICI)1099-078X(199811)13:4<201::AID-BIN17>3.0.CO;2-R

Kasari, C., Gulsrud, A., Paparella, T., Hellemann, G., & Berry, K. (2015). Randomized comparative efficacy study of parent-mediated interventions for toddlers with autism. *Journal of Consulting and Clinical Psychology*, *83*(3), 554–563.https://doi.org/10.1037/a0039080

Knapp, M., Romeo, R., & Beecham, J. (2009). Economic cost of autism in the UK. *Autism*, *13*(3), 317–336. https://doi.org/10.1177/1362361309104246

Koegel, R. L., & Koegel, L. K. (2006). *Pivotal response treatments for autism: Communication, social, and academic development*. Paul H. Brookes Publishing.

Lavelle, T. A., Weinstein, M. C., Newhouse, J. P., Munir, K., Kuhlthau, K. A., & Prosser, L. A. (2014). Economic burden of childhood autism spectrum disorders. *Pediatrics*, *133*(3), e520–e529. https://doi.org/10.1542/peds.2013-0763

Loomes, R., Hull, L., & Mandy, W. P. L. (2017). What is the male-to-female ratio in autism spectrum disorder? A systematic review and meta-analysis. *Journal of the American Academy of Child & Adolescent Psychiatry*, *56*(6), 466–474. https://doi.org/10.1016/j.jaac.2017.03.013

MacDonald, R., Parry-Cruwys, D., Dupere, S., & Ahearn, W. (2014). Assessing progress and outcome of early intensive behavioral intervention for toddlers with autism. *Research in Developmental Disabilities*, *35*(12), 3632–3644. https://doi.org/10.1016/j.ridd.2014.08.036

Malterud, K., Siersma, V. D., & Guassora, A. D. (2016). Sample size in qualitative interview studies: Guided by information power. *Qualitative Health Research*, *26*(13), 1753–1760. https://doi.org/10.1177/1049732315617444

Mandell, D. S., Cao, J., Ittenbach, R., & Pinto-Martin, J. (2006). Medicaid expenditures for children with autistic spectrum disorders: 1994 to 1999. *Journal of Autism and Developmental Disorders*, *36*(4), 475–485. https://doi.org/10.1007/s10803-006-0088-z

Nevill, R. E., Lecavalier, L., & Stratis, E. A. (2018). Meta-analysis of parent-mediated interventions for young children with autism spectrum disorder. *Autism*, *22*(2), 84–98. https://doi.org/10.1177/1362361316677838

Neumann, P. J., Cohen, J. T., & Weinstein, M. C. (2014). Updating cost-effectiveness— The curious resilience of the $50,000-per-QALY threshold. *New England Journal of Medicine*, *371*(9), 796–797. https://doi.org/10.1056/NEJMp1405158

Neumann, P. J., Sanders, G. D., Russell, L. B., Siegel, J. E., & Ganiats, T. G. (Eds.). (2016). *Cost-effectiveness in health and medicine* (2nd ed.). Oxford University Press.

Oono, I. P., Honey, E. J., & McConachie, H. (2013). Parent-mediated early intervention for young children with autism spectrum disorders (ASD). *Cochrane Database of Systematic Reviews*, *2013*(4), CD009774. https://doi.org/10.1002/14651858.CD009774.pub2

Palinkas, L. A., Aarons, G. A., Horwitz, S., Chamberlain, P., Hurlburt, M., & Landsverk, J. (2011). Mixed method designs in implementation research. *Administration and Policy in Mental Health and Mental Health Services Research*, *38*(1), 44–53. https://doi.org/10.1007/s10488-010-0314-z

Penner, M., Rayar, M., Engel-Yeger, B., & Gucciardi, E. (2018). Cost-effectiveness of parent-mediated interventions for autism spectrum disorder: A systematic review. *Autism*, *22*(3), 259–272. https://doi.org/10.1177/1362361316679340

Peters-Scheffer, N., Didden, R., Korzilius, H., & Matson, J. (2012). Cost comparison of early intensive behavioral intervention and treatment as usual for children with autism spectrum disorder in the

Netherlands. *Research in Developmental Disabilities*, *33*(6), 1763–1772. https://doi.org/10.1016/j.ridd.2012.04.006

Rogers, S. J., & Dawson, G. (2010). *Early Start Denver Model for young children with autism: Promoting language, learning, and engagement*. Guilford Press.

Shattuck, P. T., Roux, A. M., Hudson, L. E., Taylor, J. L., Maenner, M. J., & Trani, J. F. (2011). Services for adults with an autism spectrum disorder. *Canadian Journal of Psychiatry*, *57*(5), 284–291. https://doi.org/10.1177/070674371205700503

Shire, S. Y., Gulsrud, A., & Kasari, C. (2016). Increasing responsive parent-child interactions and joint engagement: Comparing the influence of parent-mediated intervention and parent psychoeducation. *Journal of Autism and Developmental Disorders*, *46*(5), 1737–1747. https://doi.org/10.1007/s10803-016-2702-z

Stadnick, N. A., Stahmer, A., & Brookman-Frazee, L. (2015). Preliminary effectiveness of Project ImPACT: A parent-mediated intervention for children with autism spectrum disorder delivered in a community program. *Journal of Autism and Developmental Disorders*, *45*(7), 2092–2104. https://doi.org/10.1007/s10803-015-2376-y

Stahmer, A. C., & Pellecchia, M. (2015). Moving towards a more ecologically valid model of parent-implemented interventions in autism. *Autism*, *19*(3), 259–261. https://doi.org/10.1177/1362361314566739

U.S. Department of Education. (2022). *44th annual report to Congress on the implementation of the Individuals with Disabilities Education Act*. Office of Special Education and Rehabilitative Services.

Usama, H. A., Riaz, M., Khan, A., Begum, N., Asif, M., & Hamza, M. (2022). Prohibition of alcohol in Quran and Bible (a research and analytical review). *PalArch's Journal of Archaeology of Egypt/Egyptology, 19*(4), 1202–1211.

Wetherby, A. M., Guthrie, W., Woods, J., Schatschneider, C., Holland, R. D., Morgan, L., & Lord, C. (2014). Parent-implemented social intervention for toddlers with autism: An RCT. *Pediatrics*, *134*(6), 1084–1093. https://doi.org/10.1542/peds.2014-0757

Wing, L., & Gould, J. (1979). Severe impairments of social interaction and associated abnormalities in children: Epidemiology and classification. *Journal of Autism and Developmental Disorders*, *9*(1), 11–29. https://doi.org/10.1007/BF01531288

World Health Organization. (2022). *Autism spectrum disorders*. https://www.who.int/news-room/fact-sheets/detail/autism-spectrum-disorders

Zablotsky, B., Black, L. I., Maenner, M. J., Schieve, L. A., Danielson, M. L., Bitsko, R. H., Blumberg, S. J., Kogan, M. D., & Boyle, C. A. (2019). Prevalence and trends of developmental disabilities among children in the United States: 2009–2017. *Pediatrics*, *144*(4), e20190811. https://doi.org/10.1542/peds.2019-0811