

Much has changed over the last seven decades since autism was first identified as a diagnosis in 1943¹. We now know that autism covers more than one disorder, most likely caused by a combination of genetic and environmental factors, and is still widely misunderstood. There are still no approved pharmaceutical treatments for its biological causes.

Precision Medicine will help us accelerate the investigation of this complex multi-factorial condition with a goal of understanding the various forms of the disorder to improve the health of all people with autism.

The History of Autism

DIAGNOSIS

Psychiatric Diagnosis

1908 Autism first used to describe a subset of schizophrenia

1920s Electroshock therapy used to treat autism

1943 Leo Kanner MD publishes paper on "rare disorder," "early infantile autism"

1944 Hans Asperger identifies subgroup of high-functioning, socially awkward boys

1948 The longitudinal study of environmental effects in complex diseases, the Framingham heart study

1955 - 1964 The Refrigerator Mother theory Popularized by Bruno Bettelheim, debunked by Bernie Rimland

1977 Twins study concludes autism is biological condition

1987 The origin of the term "Genomics"

1987 DSM-3 expands autism to a "spectrum" and includes a checklist of diagnostic criteria

1989 National Center for Human Genome Research

1994 Asperger's Syndrome is added to the DSM

1996 Center for Inherited Disease Research started

2003 Autism Genome Project completed with inconclusive findings

2003 First human genome sequenced

2006 Nike launches its first wearable tracker

2007 iPhone released

2009 The term Precision Medicine coined by Clayton Christensen

2010s Fecal microbiota transplant studies in ASD patients

2013 The DSM-5 redefines the social and language conditions into one umbrella diagnosis of autism spectrum disorder (ASD). Asperger's Syndrome is no longer a separate condition.

Behavioral Diagnosis

1993 Study concludes Applied Behavior Analysis (ABA) therapy can treat autism

1997 AGRE database created

1999 Chromosomal2 is the first chromosome fully sequenced

2006 Interactive Autism Network (IAN) database developed

2014 I-100 standards

2015 IBM's Watson Health launches

2017 FDA clears the Apple Watch by AliveCor as the first medical device accessory

2018 Apple's Health Record

Biology Diagnosis

Medicine

Data

Culture

Policy

Governance

ENR

Near Future

1900 1920 1940 1960 1980 1985 1990 1995 1 in 1,000 1995 2000 2005 2010 2015 2020

1936 Turing machine

1960 First super computer

1972 The introduction of electronic medical records

1967 Autism Research Institute (ARI) founded

1965 Autism Society of America (ASA) founded

1988 Rain Man movie raises public awareness of autism

1995 Cure Autism Now (CAN) founded

1998 Controversial issues of MMR vaccine thought to be a cause of autism. This finding was quickly debunked.

1991 US Government makes autism a special education category

1998 Herceptin approved by FDA to treat HER2+ Breast cancer

2005 FDA releases guidance for pharmacogenomic data in medications

2015 Precision Medicine announced

2018 23andMe receives the FDA authorization for a direct-to-consumer genetic test

2018 All of Us research program announced by NIH

Autism, a complex chronic disease, is still poorly understood.

Sleeping issues

80%

of people with autism or more have one or more chronic sleep problems

Gastrointestinal (GI) Disorders

80X

more common among children with autism than other children

Feeding and eating issues

70X

more common among children with autism than other children

1 in 59 Children
diagnosed with ASD
in 2018² Boys are **4 times** more likely
to be diagnosed than girls.

The increase is due in part to improvements
in monitoring and diagnostic techniques.

This project aims to better understand Autism Spectrum Disorder (ASD) via a novel, tech-enabled longitudinal approach, with the ultimate goal of managing and treating the syndrome at the individual level.

Frequency / Context	Sample Type	Analysis Methods
Monthly, crisis, good times	Microsampling	Whole blood, Metabolomics, Lipidomics, Cytokines, Proteomics
Quarterly	Blood samples	PBMCS, Urine

Ideally every 3-6 months

A horizontal timeline with a light blue background. A dashed line runs across the top. Below the line, seven circular markers are spaced evenly. Each marker has a blue dot and a label below it. The labels are: Metabolomics Lipidome, Food tracking Chronometer, Microbiome Sarkis, Genome, Cortisol Saliva test, Immune Cytokines, and Clinical tests Glucose. A dashed line extends from the last marker to the right.

Test	Frequency
Metabolomics Lipidome	Ideally every 3-6 months
Food tracking Chronometer	Ideally every 3-6 months
Microbiome Sarkis	Ideally every 3-6 months
Genome	Ideally every 3-6 months
Cortisol Saliva test	Ideally every 3-6 months
Immune Cytokines	Ideally every 3-6 months
Clinical tests Glucose	Ideally every 3-6 months

A horizontal timeline from 2010 to 2025. The timeline is marked with years: 2010, 2015, 2020, and 2025. Above the timeline, the frequency of interventions is indicated: 'Daily' for 2010, 2015, and 2020, and 'Weekly' for 2025. Below the timeline, five intervention categories are listed, each with a red dot on the timeline line:

- Wearables** (2010): Includes 'SensOmicS Watch'.
- Diet/ food logging** (2015)
- Questionnaires** (2020): Includes 'Life long stress'.
- Behavior tracking** (2020): Includes 'GPS'.
- Exposures** (2025): Includes 'Home monitors'.

 A dashed line extends from the 2025 point to the right edge of the timeline.

Longitudinal, multi-data. Personal Health Dashboard

API for wearables Database for all data Security Processing Sample Storage

Recruiting Existing

IRB Approval

Study Coordinator
People-oriented.
Involved with community.
Annual meeting with cohort.
Tell people what's going on with the data.

Customer service/
interface into engineering
Hiccups with input-output,
data management

Enrollment &
Patient consent

To improve diagnosis, the causes and risk factors for cases of autism spectrum disorder need to be accurately identified. High fidelity ODLs (observations of daily living) combined with genetics and biome data, will pave the way for researchers to develop better ASD diagnosis.

By collecting data from a cohort study consisting of deep profiling across the nation, will generate subclassification data of one heterogenous spectrum into many specific, treatable subtypes.

Biometrics will track key physiological changes. Near-invisible wearables and ambient devices will collect and predict real time, next hour, or next week remedies. Take care of your loved ones, manage your care plans, and control your data from anywhere, at anytime.

CARE
PLANS
FOR YOU

ext appt
/12/2020

DAILY
MONTHLY
QUARTERLY
YEARLY



DETERMINANTS OF HEALTH

24%
SOCIAL
CIRCUMSTANCES

MENT

INDIVIDUAL
BEHAVIOR

22%
GENETICS