


**NEUROTECHNOLOGY FUNDAMENTALS
& EMERGING DEVICES
FOR THE TREATMENT OF PARALYSIS**

PT 2008: ANNUAL CONFERENCE & EXPOSITION OF
THE AMERICAN PHYSICAL THERAPY ASSOCIATION
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Objectives

- Discuss the different categories of neurotechnology devices applicable to persons with paralysis
- Assess the uses of neurotechnology devices in the areas of respiratory therapy, neural prostheses and neural rehabilitation
- Explore the barriers to the use of neurotechnology devices in clinical practice
- Describe the barriers to the development of neurotechnology devices
- Evaluate information resources available to rehabilitation professionals that can assist in the promotion of the use of neurotechnology for people with paralysis


Session Agenda

- Introduction to Neurotechnology
 - Jennifer French, Neurotech Network
 - George Fulk, PT, PhD, Clarkson University
- User Demonstrations & Practitioner Testimonials
 - Laszlo Nagy & Wendy Smith McBrayer, Synapse Medical/University Hospital
 - Lorrie Hemerly & Keith McBride, DPT, Bioness/University of Maryland
 - Stephanie Copeland & Patrick Jacobs, PhD, Florida Atlantic University
- Future Developments in Devices
 - Paul Yoo, PhD, Duke University
 - Beverly Walters, MD, Cyberkinetics/Neurosurgeon
 - David Hankin, Alfred Mann Foundation
- Discussion – Barriers for Acceptance
- Resources for your practice

Neurotechnology

The application of medical electronics and engineering to restore or improve the function of the human nervous system.

The Body
Electric



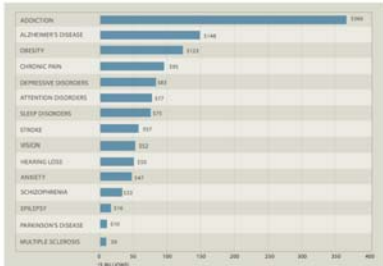
The Scope of Neurological Disease and Illness in United States

- It is estimated that neurological diseases and illnesses affect 100 million Americans
- A wide range of medical challenges:

Alzheimer's Disease Addiction Amyotrophic Lateral Sclerosis (ALS) Attention disorders Autism Cerebral Palsy Chronic pain Depression Epilepsy Hearing loss	Multiple Sclerosis Muscular Dystrophy Obesity Post-Traumatic Stress Disorder Parkinson's Disease Schizophrenia Sleep disorders Spinal cord injury Stroke Traumatic Brain Injury
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Source: Neurotechnology Industry Organization www.neurotechindustry.org

National Economic Burden of Neurological Disease & Illness is over \$1 Trillion/year



Condition	Economic Burden (Billions)
Addiction	\$196
Alzheimer's Disease	\$146
Obesity	\$134
Chronic Pain	\$95
Depressive Disorders	\$82
Attention Disorders	\$77
Sleep Disorders	\$75
Stroke	\$67
Vision	\$52
Hearing Loss	\$50
Anxiety	\$47
Schizophrenia	\$33
Epilepsy	\$19
Parkinson's Disease	\$18
Multiple Sclerosis	\$9

Source: Neurotechnology Industry Organization www.neurotechindustry.org

Evolution of Neurotechnology

- 1950 – 1970 - many firsts for implants
- 1969 – NIH Neural Prosthesis Program
- 1976 – FDA began to regulate implant devices
- 1980's - Advances of new technology and electronics
- 1990's – Move from the lab to the clinic
- 2000 & beyond – Device availability


Areas within Neurotechnology

- NeuroModulation
- Neural Prosthesis
- NeuroRehabilitation
- NeuroSensing & NeuroDiagnostics


**There are variation of these main categories*

Neuromodulation


- Deep Brain Stimulation
- Vagus Nerve Stimulation
- Spinal Cord Stimulation
- Sacral Nerve Stimulation
- Surface Stimulation
- Gastric Stimulators
- Occipital Nerve Stimulation




Spinal Cord Stimulation - Pain



TENS for pain



Vagus Nerve Stimulator - Epilepsy



Sacral Nerve Stimulator – Overactive Bladder

Picture Sources: Medtronic, Cyberonics, Empti

Neural Prostheses

- Lower extremity
- Upper extremity
- Cochlear Implants
- Retinal Implants
- Bladder Stimulators
- Diaphragm Pacing System



Retinal Implants for vision



Cochlear Implant for hearing



Drop Foot Stimulation - Gait



FES for standing & stepping

Picture sources: Boston Retinal Implant Project MIT, Cochlear Corp, Biometrics, Sigmoid

NeuroRehabilitation

- Neuromuscular Electrical Stimulators
- NeuroRobotics



EMG & NMES



Muscle Stimulation for Hand



FES Cycling




Robotic assisted interventions


Picture Sources: Restorative Therapies, Robomedia, Zynex Medical, Biometrics, Columbia Scientific

NeuroSensing & Diagnostics


- EEG & EMG
- Brain Computer Interface
- Peripheral Nerve Sensing
- Transcranial Magnetic Stimulation



Brain Computer Interface



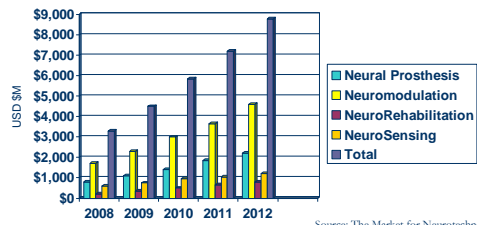
EEG system



Peripheral Nerve Sensing

Picture Source: Cyberkinetics, Neuroometrics, NeuroMetric

Worldwide Neurotechnology Market



Source: The Market for Neurotechnology:
2008-2012, Neurotech Reports.
www.neurotechreports.com

Neurotech Network



Helping people regain life
through neurotechnology

Mission

This non-profit organization focuses on education of and advocacy for access to neurotechnology devices and therapies targeting persons with impairments and the medical professionals.

User Demonstrations & Practitioner Testimonials

- Respiratory Therapy
 - Wendy Smith McBrayer & Lazslo Nagy
- Neural Prosthesis
 - Keith McBride & Lorrie Hemerly
- NeuroRehabilitation
 - Patrick Jacobs & Stephanie Copeland