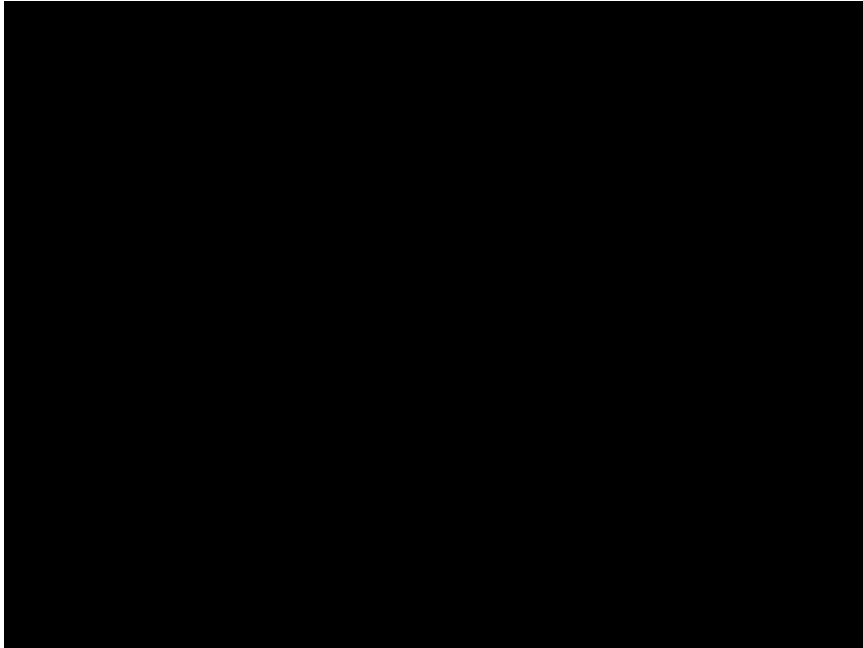


Electrochemicals Industry Landscape

Rajesh Ramanujam, Saurabh Chopra, Rainer Unterguggenberger, Xumin Wu

This work was created in an open classroom environment as part of a program within the Sutardja Center for Entrepreneurship & Technology and led by Prof. Ikhlaq Sidhu at UC Berkeley. There should be no proprietary information contained in this paper. No information contained in this paper is intended to affect or influence public relations with any firm affiliated with any of the authors. The views represented are those of the authors alone and do not reflect those of the University of California Berkeley.

Electroceuticals



- Medical Devices
- Read and modify electrical signals passing along nerves
- Offer treatment for a wide variety of health conditions

Pharma Market is Huge!!


- Breaking News -

Chronic pain treatment market is expected to reach \$105.9 billion by 2024

PRNewswire, Feb2019

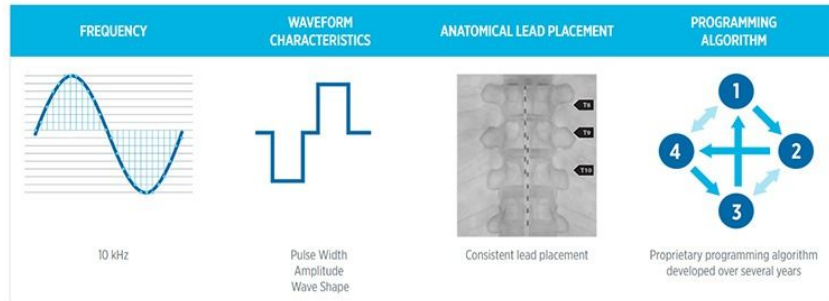
Global Rheumatoid Arthritis Drugs Market \$50.5 Billion by 2025

iHealthCareAnalyst, Nov2019

Global Allergy Drugs Market \$4.8 Billion by 2023

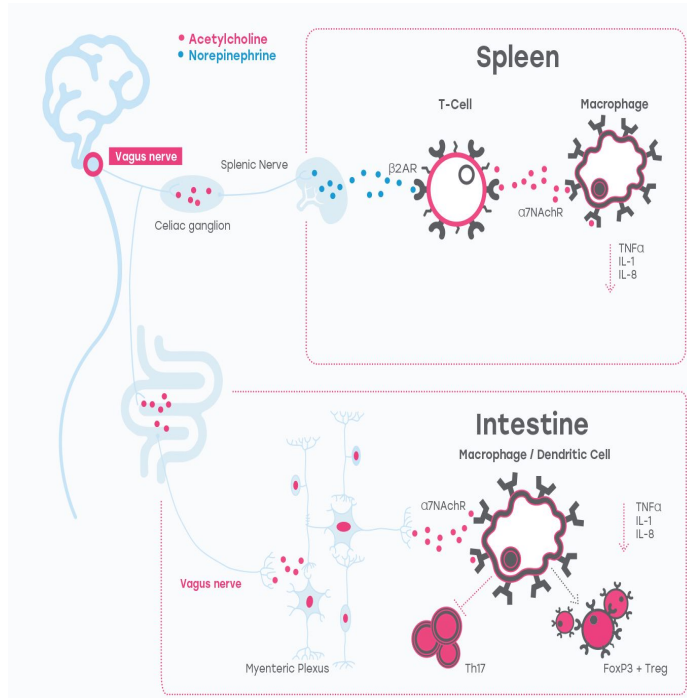
MarketResearchFuture, Mar2020

Nevro: Managing Chronic Back Pain



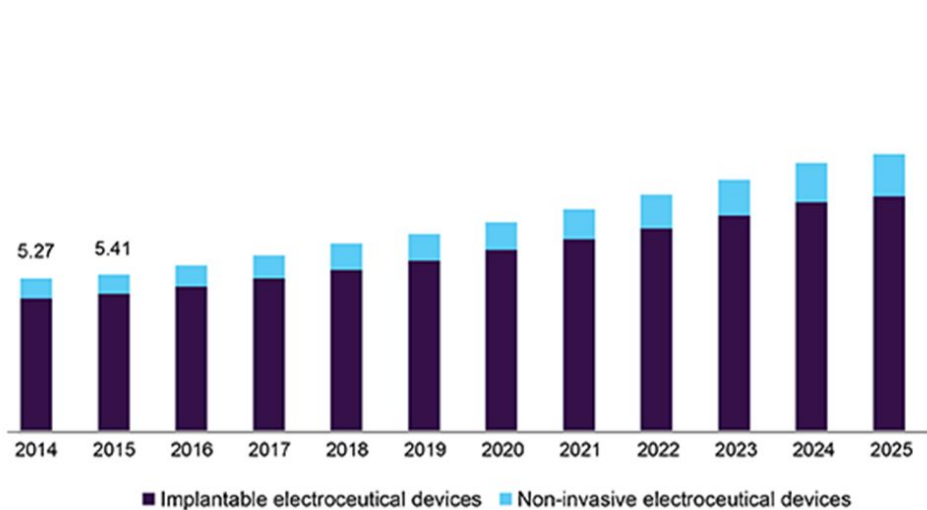
- Back pain is No.1 cause of disability around the world.
- Costs U.S. economy > \$100 billion
- Electrical pulses to spinal cord achieve a significant reduction in severe back and leg pain
- Alternative to Painkillers (Opioids)

Setpoint Medical: Chronic Inflammation



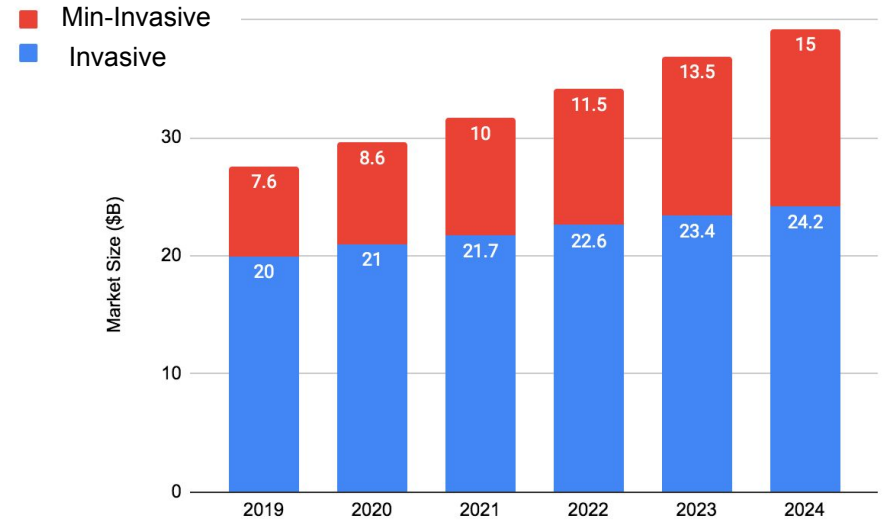
- Pacemaker for Brain
- Chronic Inflammation Management
- Unlock Restorative Power of Inflammatory reflex
- Intersecting & manipulating signaling from the Brain through Vagus nerve

Explosive Growth of Electroceuticals



Source: www.grandviewresearch.com

Source: Grandviewresearch, 2019



Source: BBC Publishing, 2019

30-40B\$ Expected Market in FY24-25
Double digits CAGR

Invasive & Min-Invasive Electroceuticals

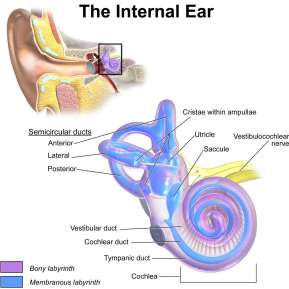
LivaNova



Medtronic



Cochlear



Sonova



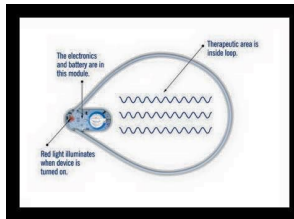
ElectroCore



Setpoint



Bioelectronics



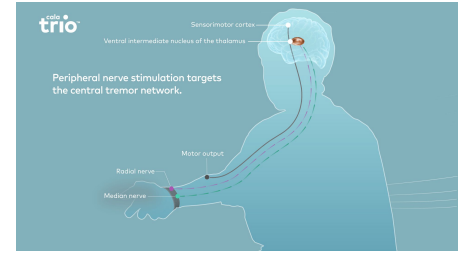
Nevro



LivaNov



Cala Health



StimWave



GALVANI
BIOELECTRONICS

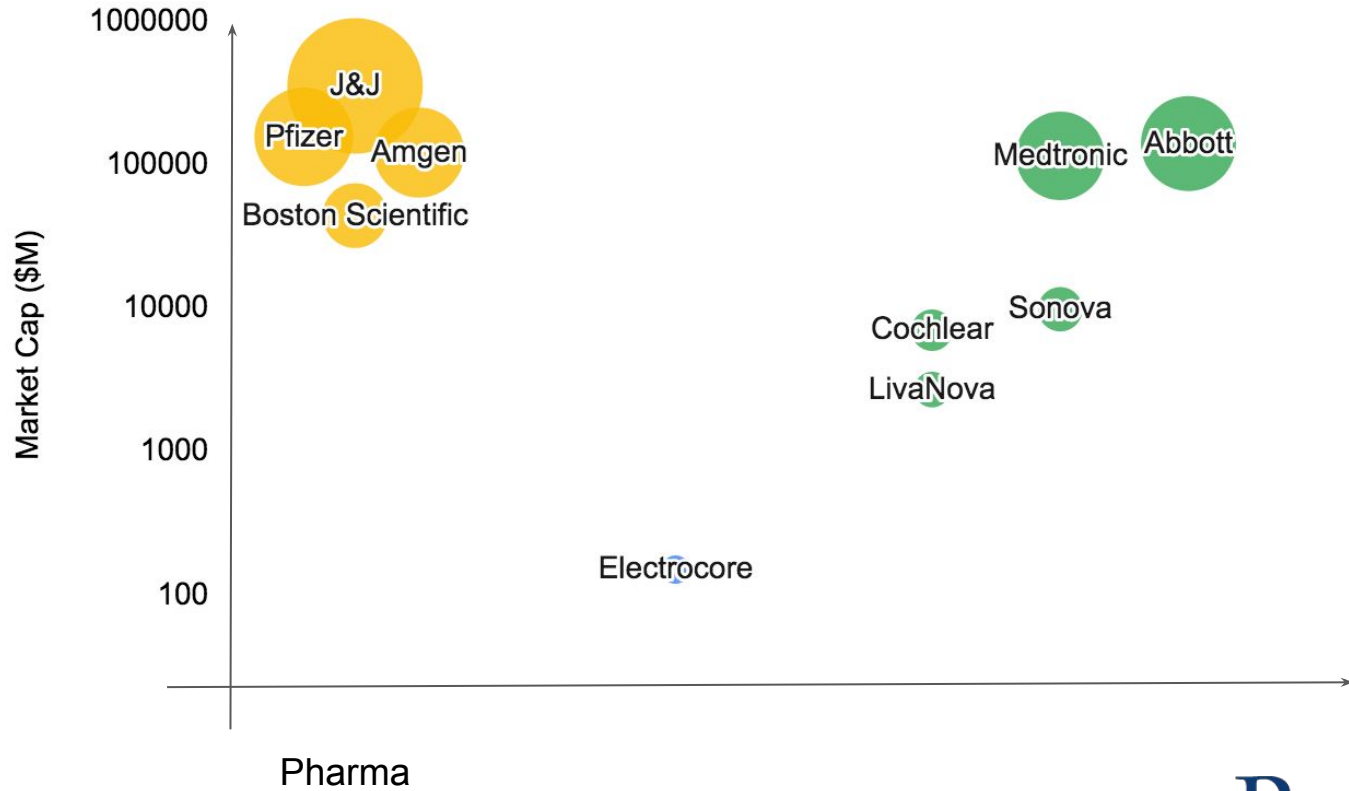
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Berkeley Engineering

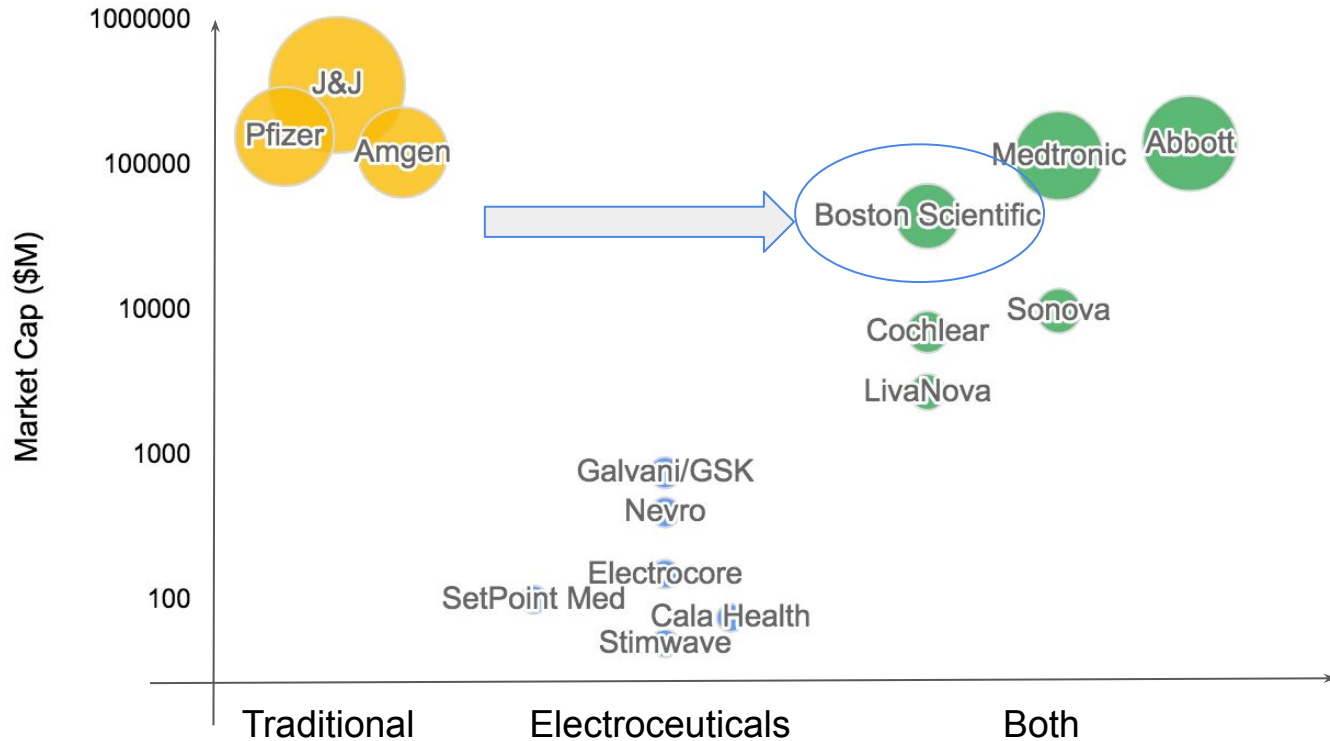
Several minimally invasive products popping up

Berkeley
UNIVERSITY OF CALIFORNIA

Market Capitalization Comparison (2010)

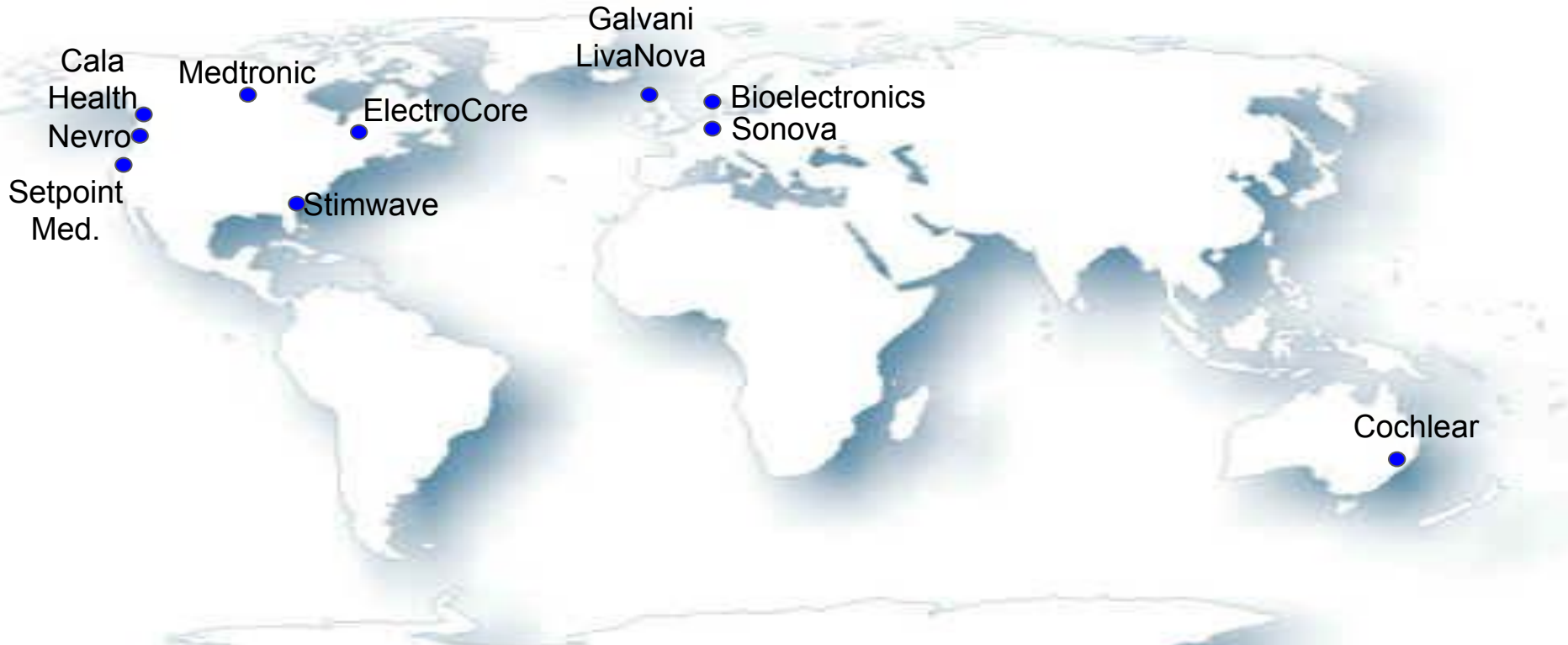


Market Breakdown: Segments (2020)



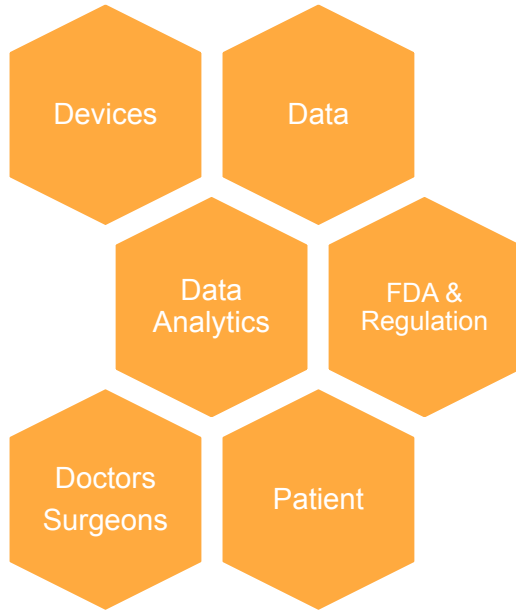
More Big-Pharma companies investing in Electroceuticals

Market Breakdown: Geography



Companies specializing in Electroceuticals springing up across the world

Electroceuticals Ecosystem



- All six parts of ecosystem interdependent
- More complex systems require advances in all areas

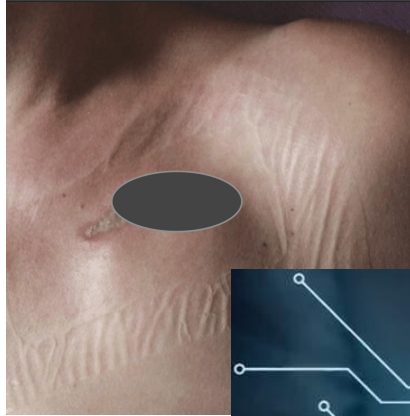
Challenges

- Complexity
 - 86 Billion neurons
 - 150 Trillion Synapses



Challenges

- Complexity
- Safety
 - Infection(1.5~2%)
 - Interference
 - Reliability



Challenges

- Complexity
- Safety
- Regulations
 - A central registry
 - Ethics



Electroceuticals Industry SWOT Analysis

Strengths

- Medical breakthroughs & Semiconductor advancements:- Mapping Neural response, Miniaturization, Low power connectivity
- Strong VC, Funding interests in Health care

Opportunities

- Ready to take on >100B pharmaceutical industry
- Patient compliance, improved quality of care
- Big Data/ML:- Improved response, patient care

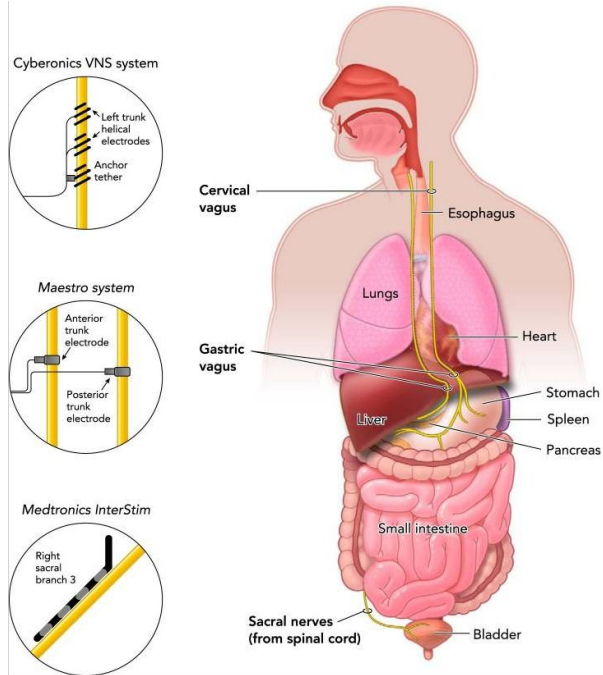
Weakness

- Long term efficacy, Patient acceptance
- Surgical intervention creating barriers
- Diverse ecosystem players with conflicting business models

Threats

- Regulatory Compliance
- Security, Privacy concerns
- Business model scalability

Pre 2010: Challenge is Selectivity of Stimulus



“The best way to predict the future is to study the past”

- Electroceuticals approved for seizures, depression, Obesity, pain management
- Problem is selectivity:
 - Side effects from non-selective stimulation, limits treatment option to only 1/3 of patients
- Future: Miniaturization enables Closed-Loop Control
 - Controlled stimulation by recording whole organ function
- Big data/ML to continuously improve selectivity
 - Huge advantage over pharmaceutical options with little side effects.

Future Landscape Predictions

- Electroceuticals will be mainstay treatment for Chronic disease management taking on pharma industry due to recent technology breakthroughs.
- Next big wave of advances/products will come post changes in regulation and public policy
- Players with strengths on multiple ecosystem components & established business scale through partnerships will win.
 - GSK/Galvani, Verily/Google is primed to lead this industry
 - Pharmaceutical industry majors (eg: Pfizer, J&J) will acquire/partner with electroceuticals startups

Thank you



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