NEUROSCIENCE

It’s All in Your Head

The Institute for Neurological Discoveries

Peter G. Smith, PhD, Director
Why Neuroscience?

• One in 3 Americans will suffer from a major neurological disorder.
• The older you get, the more likely you are to be afflicted.
• Can rob you of mind and identity.
• Very expensive: treatment and care
• No cures, no survivors.
What happens if something goes wrong?

Movement Disorders (Parkinson’s, Stroke) (chronic pain) (deafness, dyslexia)

Sensory Disorders

Communication Disorders

Affective Disorders (Schizophrenia)

Dementias (Alzheimer’s)

Blindness

Visual Processing

Virtual Memory

Smell

Writing

Speech Area

Planning Organization

Reasoning

Personality

Movement

Speech Understanding

Hearing

Vision

KU MEDICAL CENTER
The University of Kansas
Neuroscience: a long-standing strength at KUMC

Kansas Intellectual and Developmental Disabilities Research Center (KIDDRC)

- Founded in 1966 as one of 12 original NIH-funded Mental Retardation Research Centers.
- With 50 years of continuous funding totaling $40 million, the KIDDRC remains at the top of an elite group of 15 medical centers nationwide.
- KIDDRC strongly promoted Neuroscience programs at KUMC and KU.
The IND consolidates major Neuroscience strengths

- $143 million in external funding for neuroscience–related research
  - $91 million from the NIH
  - $29 million total in 2011

- Neuroscience is key to translational medicine at KU
  - Frontiers: $20 million Clinical and Translational Science Award
  - One of an elite group of 60 medical centers

- The Region’s most advanced brain imaging facilities (Hoglund Brain Imaging Center)

- 1 of 25 inaugural NeuroNEXXT clinical trial centers
  - 200 clinical trials ongoing at KUMC

- 1 of 29 Alzheimer’s Disease Research Centers nationwide
The IND unites major Neuroscience programs

Executive Committee

• Peter Smith, Director: Director, Kansas Intellectual and Developmental Disabilities Research Center
• Rick Barohn, MD, Associate Director: Chair, Department of Neurology; Director, Pioneers CTSA
• William Brooks, PhD: Director, Hoglund Brain Imaging Center
• Paul Camarata, MD: Chair, Department of Neurosurgery
• Paul Cheney, PhD: Chair, Department of Molecular and Integrative Physiology
• Randy Nudo, PhD: Director, Landon Center on Aging
• Cary Savage, PhD: Director, Center on Behavioral Neurosciences *
• Russel Swerdlow, MD: Director, Alzheimer’s Disease Research Center *

Advisory Representation from:

Anatomy & Cell Biology, Psychiatry, Rehabilitation Medicine, Pharmacology & Toxicology, Hearing & Speech, Allied Health, & LU-Lawrence.

* New member
Institute for Neurological Discoveries

*Transforming discoveries into cures for neurological disorders*

Established in 2008

More than 120 clinical and basic scientists at 6 area institutions working on:

1. Brain Injury and Repair
2. Neuromuscular and Movement Disorders
3. Neurodegenerative Disorders
4. Hearing and Equilibrium Disorders
5. Women’s Pain
6. Cognitive and Behavioral Health
22 Disease Focus Areas

- Addiction & Impulse Control
- Alzheimer’s & other dementias
- Amyotrophic lateral sclerosis
- Autism and intellectual disabilities
- Behavioral and psychiatric disorders
- Epilepsy
- Fibromyalgia
- Hearing loss
- Huntington’s Disease

- Parkinson’s Disease
- Pelvic pain
- Peripheral neuropathy
- Migraine & TMJ
- Multiple Sclerosis
- Myasthenia Gravis
- Myopathies
- Spinal Cord Injury
- Stroke
- Tinnitus
- Traumatic Brain Injury
- Tremors
- Vertigo & balance disorders
The IND ... … provides a framework for formation of clinical/translational/basic science collaborative teams that can respond rapidly to neuroscience funding opportunities. 

Does it work?
22 Disease Focus Areas

- Addiction & Impulse Control
- Alzheimer’s & other dementias
- Amyotrophic lateral sclerosis
- Autism and intellectual disabilities
- Behavioral and psychiatric disorders
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IND in action

• August, 2010: Grateful patient in Rehab Medicine. Wealthy KC business man with an interest in recovery from chronic spinal cord injury and desire to promote local research.

• Submitted proposals for 5 projects to the Foundation Board of Trustees embodying relevant IND strengths

• 2 selected: neural prosthetics and modified stem cells

• SCIRP Launched April 15, 2011: $7M ($4M in first 3 years)
Neural Prosthetics: Brain-computer interfaces

KUMC
Randy Nudo, PhD
Paul Camarata, PhD
Paul Cheney, PhD
Shawn Frost, PhD

Case Western Reserve University
Pedram Mohseni, PhD

Univ. of Washington
Eberhardt Fetz, PhD
Chet Moritz, PhD
Restoring spinal cord pathways

- Neurons and their connections are lost for good
- How can we grow new neurons?
  - Stem cells
    - Embryonic stem cells have problems
- New technology can turn a patient’s own skin into nerve cells
  - Fewer ethical concerns
  - No immunological rejection
  - Can control the types of cells they become
Creating a rodent model of spinal cord injury
Making new nerve cells

Adult Skin Cells

Induced Pluripotent Stem Cells

Neurons in a dish

Cells injected after SCI
Spinal cord repair teams

**Spinal cord injury**
Judith Larson, DVM
Paul Arnold, MD
Dora Agbas, PhD

**Imaging**
Nancy Berman, PhD
Bill Brooks, PhD

**Stem Cell generation**
Soumen Paul, PhD
Jay Vivian, PhD
Mark Weiss, PhD (KSU)
David Albertini, PhD

**Drug Discovery /High Throughput Screening**
Ross Stein, PhD (KU-Lawrence)
Pete McDonald, PhD (KU-Lawrence)

**Behavior**
Ken McCarson, PhD
Michelle Winter
The IND comprises many other examples of world-class clinical and translational neuroscience programs.

SCIRP is an example of how the IND can rapidly move emergent programs into active, established translational research programs.

The IND also incorporates mature clinical and basic programs: 2 examples.
Clinical Neuroscience Neurosurgery

Paul J. Camarata, MD, FACS
Chair, Department of Neurosurgery
Neuroscience in the news
Stroke

- 3rd Leading cause of death
- Leading cause of death and disability
- Someone has stroke every 40 s
- Hemorrhagic – blood clot
- Ischemic – vessel blockage
Ischemic Stroke

• Telemedicine links to advise physicians in rural areas on stroke treatment
• Catheter delivery of clot-busting drugs
• Placement of new devices to remove clots
Treatment of Brain Aneurysms

- Standard therapy
  - Clips, coils
- Novel therapy
  - Filling with glue
  - Treatment with flow diverting stents
Blister Aneurysm
Exciting time in Translational Research in Neural Repair

- Novel treatments for Stroke, aneurysm repair
- Novel treatment spinal cord injury
- Brain tumor research
- Deep brain stimulation for OCD, depression
- minimally invasive surgery for brain hemorrhage
Brain, Health, and Prevention

Cary R. Savage, Ph.D.
Director, Center for Health Behavior Neuroscience
John H. Wineinger Professor of Psychiatry
University of Kansas Medical Center
Prevention of Disease: Obesity, Diet, Exercise

• Obesity is not a neurological disease
• However, it is the outcome of behaviors regulated by the brain
• Neuroscience is illuminating causes of the obesity epidemic and also potential new solutions
The Obesity “Epidemic”

1990

2010
U.S. Life expectancy is slipping

- From 11th 20 years ago to 37th
- Now tied with Cuba
- Attributable to preventable risk factors
- Despite best medical system in the world
Top Causes of Death in the U.S.

1. Heart Disease
2. Cancer
3. Stroke
4. Chronic Lung Disease
5. Accidents
6. Alzheimer’s Disease
7. Diabetes

• All are affected by *Preventable Risk Factors*
• These risk factors are linked to brain function
Causes of the Obesity Epidemic

*Focus on Brain*
Causes of the Obesity Epidemic

Hardees Monster Thickburger®

Burger King Meat Monster®

KFC Double Down®

Taco Bell Locos Tacos®
Causes of the Obesity Epidemic
Dopamine Reward Pathways

Functions:
- reward/salience
- pleasure, euphoria
- motor function (fine tuning)
- compulsion
- perseveration

Locations:
- Frontal cortex
- Striatum
- Substantia nigra
- Nucleus accumbens
- VTA
- Hippocampus
Brain Function Differences Between Obese and Healthy Weight Adults

- Obese groups show increased brain activations to appetizing food pictures
- Cause or effect?
- What are the connections to intervention?
Brain Function Changes after Bariatric Surgery (LAP-BAND®)

- 12 weeks post-surgery, average weight loss 13.4 kg (29.5 lbs)
- *Brain Function Changes After Surgery*
Brain Function Predictors of Successful Dieting

- Activation in this brain region predicted future weight loss

**Right Prefrontal Cortex**

- The most complex processes
- Planning, forming intentions
- Decision making based on anticipated consequences
Physical Fitness Protects Against Brain Atrophy in Alzheimer’s Disease

*Research from the KUMC ADC*

Fitness associated with less atrophy in brain areas most affected by AD
Paradigm Shift in Healthcare

- Focus on preventable risk factors for disease
- Why will patients come to hospitals?
  - State-of-the-art treatment of disease
  - Prevention of disease
  - Hospitals as centers of health
- Insurance companies are recognizing the value of prevention in attempts to control cost
Interactions Between Neuroscience, KUMC, and KU Hospital

- Institute for Neurological Discoveries
- Hoglund Brain Imaging Center
- Alzheimer’s Disease Center
- Center for Health Behavior Neuroscience
- KU Weight Management Program
- KU Cancer Center
- Cardiovascular Research Institute
- Center for Advanced Heart Care
- Bariatric Surgery Programs
- Diabetes Institute
Neuroscience: The Next Frontier

• The IND represents strong and vibrant programs
• Poised to make major contributions and advancements in brain therapy, repair and prevention
• Huge opportunities for growth through development of new and existing programs
• Kansas City can (will?) become an internationally recognized hub for translational neuroscience