



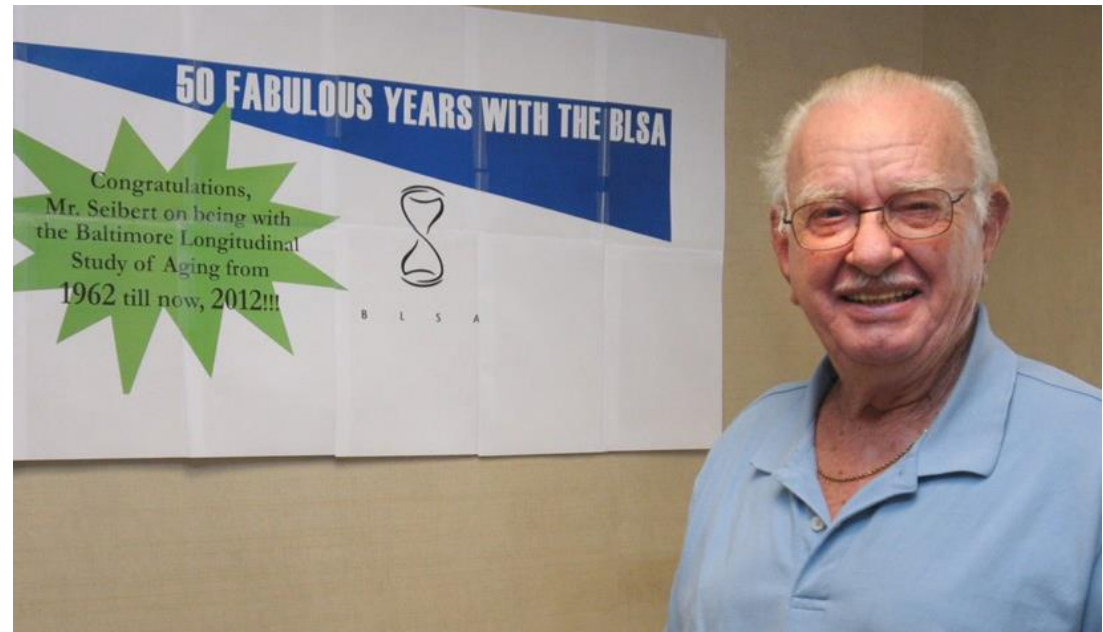
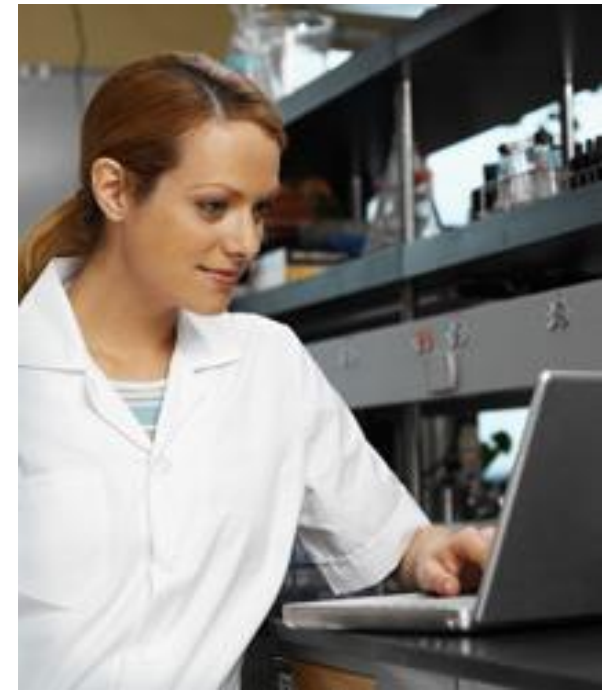
# The Baltimore Longitudinal Study of Aging (BLSA)



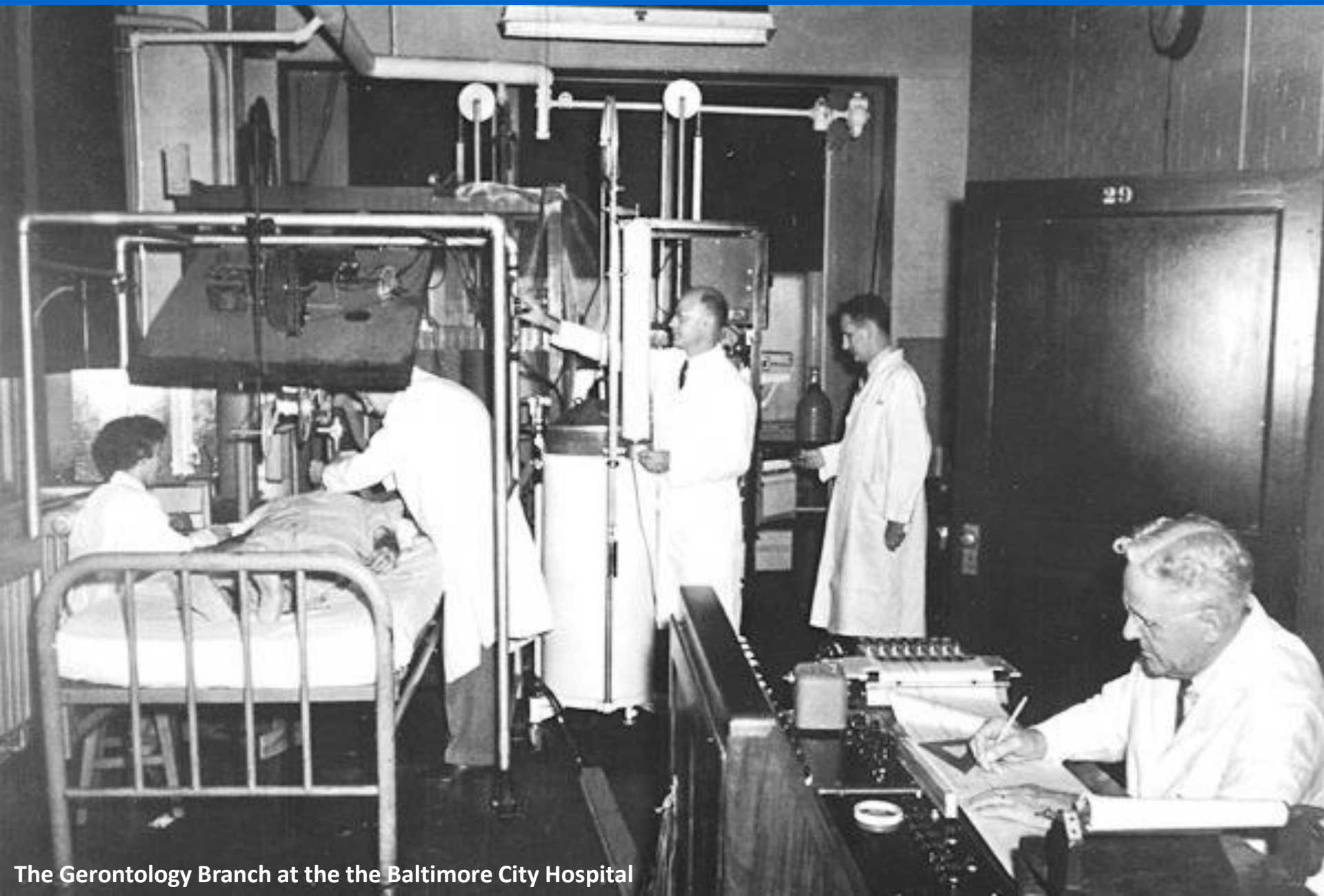
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# Agenda

- What is the BLSA?
- How can I work with BLSA?



# The Baltimore Longitudinal Study of Aging (1953)



The Gerontology Branch at the the Baltimore City Hospital

# What is the Baltimore Longitudinal Study of Aging?

**Established** in 1958 as a continuous enrollment “**life-long**” cohort to study normative aging (NIA was established in 1962)

**Overhauled** in 2003/04 by Luigi Ferrucci with a **new paradigm** to identify multifactorial sources of aging processes, including frailty, loss of mobility and cognitive impairment

**Expanded** in 2008 and 2011 “**IDEAL**”; targeted enrollment of healthy elders to promote research on healthy aging

# BLSA Study Population: total 3218

## MEN

Age at entry	White	Black	Other
<30	245	11	5
30-39	251	35	13
40-49	251	57	11
50-59	215	50	9
60-69	238	45	13
70-79	313	15	5
80-89	118	1	2
90+	9	0	0
<b>TOTAL</b>	<b>1640</b>	<b>214</b>	<b>58</b>

## WOMEN

Age at entry	White	Black	Other
<30	143	9	7
30-39	114	44	13
40-49	155	71	16
50-59	133	71	16
60-69	120	59	13
70-79	162	30	2
80-89	105	5	1
90+	6	0	0
<b>TOTAL</b>	<b>938</b>	<b>289</b>	<b>68</b>

No. of visits	men	women
0-4	741	655
5-9	508	423
10-19	541	212
20+	127	11
<b>TOTAL</b>	<b>1917</b>	<b>1301</b>

# The Goals of BLSA

**Characterize** multiple aspects of the aging process and their interaction:

- **Describe** longitudinal physical and cognitive changes that define aging
- **Identify** genetic, physical, behavioral and environmental factors that affect the rate of physical and cognitive aging
- **Understand** interrelationships between aging and chronic disease and other conditions and their independent and joint impact on age-related decline
- **Identify** strategies for successful adaptation to aging
- **Develop** hypotheses concerning possible targets for intervention that may positively affect several aspects of the aging process and prevent age-related diseases

**Endpoints** include life expectancy, healthy longevity, mobility limitation, cognitive impairment and frailty

# Measures in the Baltimore Longitudinal Study of Aging

## BLSA Paradigm

A Hierarchical Network of Measures

### Homeostatic Network/Behavioral Factors

#### Hormones

Insulin, Ghrelin, Leptin, Adiponectin, Glucose, Testosterone, Estradiol, DHEAs, Cortisol, TSH

#### Inflammation

PCR, IL-6, sIL-6R, gp130, TNF- $\alpha$ , TNFr-1, TNFr-2, IL-18, IL-15, Homocysteine

#### Immune Function

WBC and Differentials, Cytopheresis

#### Sleep and Rest

Sleep Duration and Quality, Autonomic Function and Heart Rate Variability

#### Nutrition

Dietary Intake, VitD, VitB12, Folate, VitE, Albumin

#### Activity and Engagement

Exercise, Accelerometry Recreation, Social Interaction

### Physiological Domains Relevant to Function

#### Central Nervous System

Cognition, Motivation  
Motor Control, Coordination, Executive Function

#### Peripheral Nervous System

Nerve Conduction of Sensory and Motor Nerves

#### Muscle Quality and Body Composition

Isokinetic and Isometric Strength  
Muscle Spectroscopy and Biopsy

#### Bone and Joints

Pain, ROM, Bone Density-Quality-3D Distribution (DXA and pQCT),

#### Energetic Cost and Availability

RMR, Cardiac Structure and Function, Arterial Compliance and IMT, Exercise Tolerance, Respiratory Function, Energetic Cost of Walking, Fatigue

#### Sensory Feedback

Visual Acuity, Contrast, Visual Field, Proprioception, Tactile Sensation, Hearing and Sound Discrimination, Taste Buds

### Outcomes

#### Mobility

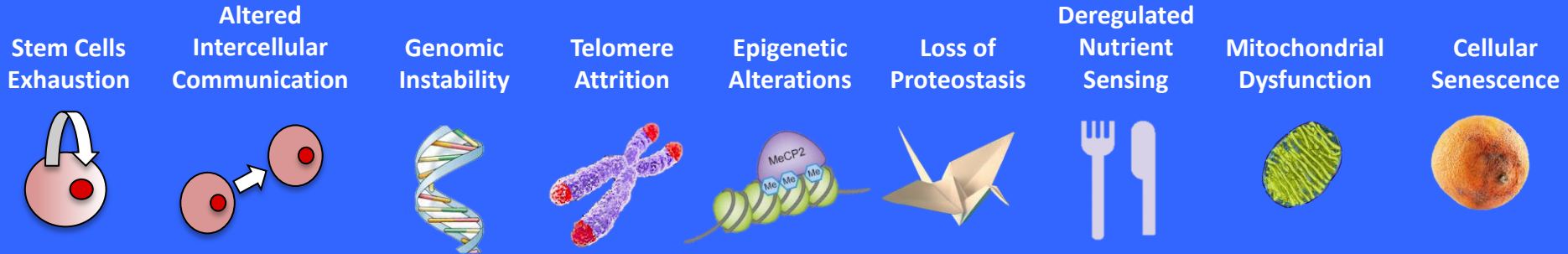
Self-Report  
Performance  
Gait Laboratory

#### Cognition

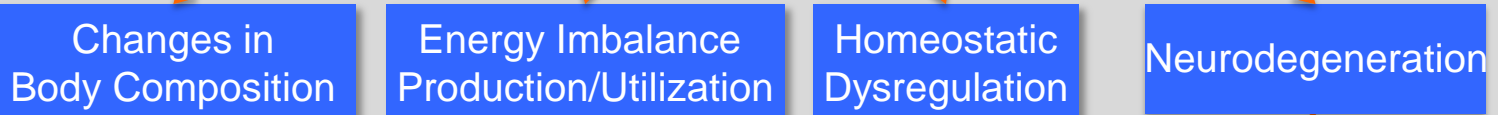
Performance  
Neuroimaging

# What are the mechanisms by which aging and disease affect aging phenotypes and longevity?

## AGING and DISEASES



### Aging Phenotypes



- Disease Susceptibility
- Reduced Functional Reserve
- Reduced Healing Capacity and Stress Resistance
- Unstable Health
- Failure to Thrive

Ferrucci L, Studenski S. Clinical Problems of Aging. In: Harrison's Principles of Internal Medicine, 18<sup>th</sup> Ed. – 2011

The Hallmarks of Aging  
 Carlos López-Otín, María A. Blasco, Linda Partridge, Manuel Serrano, and Guido Kroemer. Cell 2013; 153: 1194



# BLSA Philosophy and Evolution

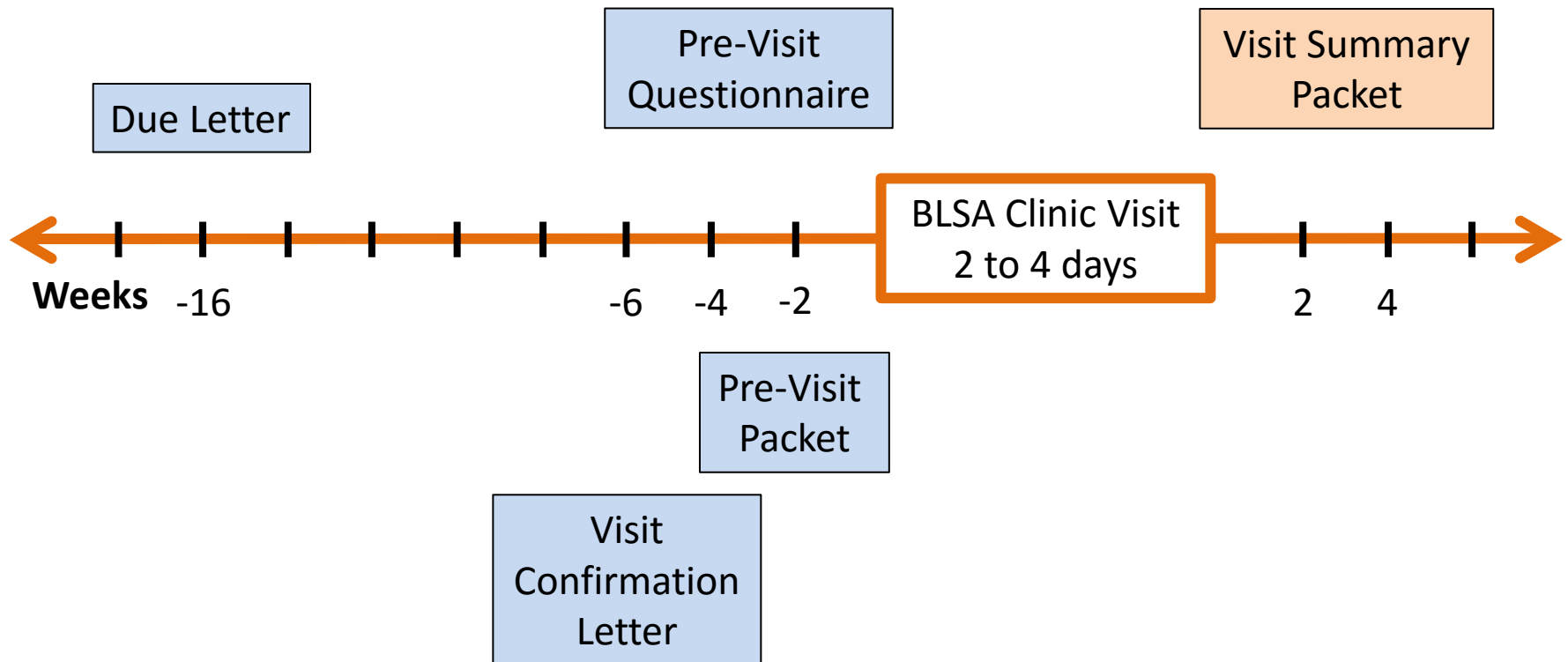
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## The BLSA aims to be responsive to:

- Emerging research questions in aging
- New discoveries and technologies
- Opportunities for translational studies
- Emphasis on extra- and intramural collaboration
  - **Well-characterized human population**
  - **Continuous systematic follow-up**
  - **Extensive bio-specimen bank**
  - **Targeted recruitment of exceptionally healthy (IDEAL)**

# Participant Visit Timeline

Visit frequency: age <60 every 4 years, age 60-79 biannually; age ≥80 annually



# Core and Core+ Measures\*

## CORE

Physical Examination + EKG  
Medical Interview  
Medications  
Vitals and Anthropometry  
General Interview  
Clinical Labs  
Core Cognitive Battery  
Physical Performance Testing  
Strength

**\*All eligible participants  
every visit**

## CORE+

Gait Lab  
Exercise Tolerance/Spirometry  
Resting Metabolic Rate  
Holter Monitor  
Echocardiography/Cardiovascular  
DXA and CT  
Early Markers Battery  
MRI , fMRI and MRS  
Nerve Conduction/Sensitivity  
Vision and Strip Meniscometry  
Auditory and Vestibular Function  
Ankle Proprioception  
Research Labs and 24Hr Urine  
Oral Glucose Tolerance Test  
Saliva/Other Biospecimens  
Taste Bud Photography  
FFQ, Fatigability, Accelerometry  
Personality

# Special and Special+ Measures\*

## **SPECIAL**

Core Body Temperature  
Deuterated Creatine  
Muscle Biopsy  
Cytapheresis

## **SPECIAL+**

Energy Expenditure (DLW)  
Lumbar Puncture  
Skin Biopsy

**\*Phased implementation or administered to selected participants and/or at selected or limited visits**

## **OPTIONAL STUDIES**

Regional Adiposity  
VALIDATE  
Autopsy  
Neuroimaging (PET)

Special and special+ measures are implemented to test new state of the art technology, verify new hypotheses that emerged in the BLSA and/or open the study to new hypotheses proposed by an intramural or extramural collaborator.

# How to work with BLSA: research partnerships

- [www.blsa.nih.gov](http://www.blsa.nih.gov)
- Application process: new website mechanism for letter of intent, approval, full proposal
- Variable lists
- Interaction with BLSA investigators

***"Researchers at NIH and at other academic and research institutions in the United States and internationally are welcome—and encouraged—to use BLSA data and specimens for scientific projects and grant applications."***

# Thank You



# Questions?