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Garrison Institute on Aging: A New Hope for Elderly Individuals and Patients with Alzheimer's Disease

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Abstract

The Garrison Institute on Aging (GIA) is an established institute within Texas Tech University Health Sciences Center, whose mission is to promote healthy aging through cutting-edge research on Alzheimer's disease (AD) and other diseases of aging through innovative educational opportunities for students, clinicians, researchers, health care professionals, and the public. The GIA has multiple programs, including both research and education on healthy aging and AD, community outreach, caregiving, the Retired Senior Volunteer Program, Healthy Lubbock, the GIA Brain Bank, healthy aging seminars, research seminars, and collaborations and scholarships. The GIA programs connect basic and clinical researchers and health care professionals, and provide a unique environment to help our growing elderly population and patients with AD and their families.

THE GARRISON INSTITUTE ON AGING

The Garrison Institute on Aging (GIA), formerly the Institute for Healthy Aging, was established in 1999 by the Texas Board of Regents to meet Texas Tech University Health Sciences Center's (TTUHSC) strategic priority on aging and as a collaborative initiative with the TTUHSC schools of Allied Health, Medicine, Nursing, and Pharmacy. The GIA is a unique organization, whose mission is to promote healthy aging through cutting-edge research on Alzheimer's disease (AD) and other diseases of aging through innovative educational opportunities for students, clinicians, researchers, health care professionals, and the public. The vision of the GIA is to become nationally and internationally recognized as a center of excellence for the creation and application of new knowledge about healthy aging

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through research, innovative interdisciplinary education, and collaborative community outreach efforts.

Initially, the Institute formulated its mission and worked with an interdisciplinary team to foster research on aging with the assistance of a multi-million dollar grant from the U.S. Administration on Aging from 2000–2003. In 2004, through an endowment funded by Mr. and Mrs. Shirley Garrison and by private donations, the Garrison Institute on Aging was created to support aging research and education programs. Paula Grammas, PhD, was then recruited to serve as the GIA Executive Director and conduct research on neurodegenerative diseases, specifically AD, and establish an educational component. With the leadership of Dr. Grammas and the GIA staff, an education and community outreach division was established that focused on aging and preventive health. Thus, the Geriatric Education and Training Academy was created with the assistance of a grant from the U.S. Department of Education and private donations. From 2004–2012, the GIA educated more than 1,700 health care professionals and paraprofessionals through the Certified Nurse Aide (CNA) program. The CNA program focused on training health care professionals that assisted the elderly populations. In 2007, researchers designed a collaborative, multidisciplinary study known as the Cochran County Aging Study, which researches cognitive decline and dementia syndromes of the elderly in rural Texas, who are mainly under-served Mexican-American persons. The GIA also developed the first multidisciplinary, multi-school program —the Student Scholars program—that trains university-level seniors from Texas Tech University (TTU) and TTUHSC in health care issues of the elderly. The community outreach division has grown from providing health fairs through Healthy Lubbock to providing new programs that focus on chronic disease self management, healthy eating and active living.

In the GIA research laboratories, academic professionals lead cutting-edge research projects aimed at understanding AD and other diseases of aging, as well as developing novel therapeutic approaches to cure or prevent age-related disorders. Former GIA Executive Director Paula Grammas, Ph.D., is a leader in researching inflammation and cardiovascular aspects of aging and AD. Dr. Grammas has published over 130 peer-reviewed papers, and her research has been continuously funded since 1990. Dr. Grammas has received several honors, including the Presbyterian Health Foundation Chair in Neuroscience Award for Outstanding Achievement in Alzheimer Research, the Alzheimer Research Award from the Fraternal Order of American Eagles, and the Zenith Award from the Alzheimer’s Association.

In 2014, P. Hemachandra Reddy, Ph.D. joined the TTUHSC as the new GIA Executive Director and Chief Scientific Officer, and a Professor of Cell Biology & Biochemistry, Neuroscience & Pharmacology, and Neurology Departments. He also holds the Mildred and Shirley L. Garrison Chair in Aging. Dr. Reddy’s research on aging and neurodegenerative diseases, including AD, Huntington’s disease (HD), and multiple sclerosis (MS), has been peer-reviewed and recognized as groundbreaking. Dr. Reddy has received continual funding since 2000 and has been the principal investigator on multiple research projects funded by the National Institutes of Health, Alzheimer’s Association, and other national and local foundations and Pharmaceutical Companies. Since 2007, Dr. Reddy has served as a charter

member of the VA Merit Review Study Section, and has served on many other NIH study sections and foundation panels, such as the Alzheimer's Association and the Medical Research Council. Dr. Reddy is also a charter reviewer for the NIH Study Section, Neural Oxidative Metabolism and Death. Dr. Reddy serves as an editor and as an associate editor for many scientific journals, and he is also a member of more than 20 editorial boards. In 2014, Dr. Reddy was elected Fellow of the American Neurological Association.

looseness-1Dr. Reddy's research laboratory at the GIA focuses on understanding molecular and cellular bases of aging and age-related neurodegenerative diseases. The Reddy Laboratory is interested in the following areas of research: aging, neurodegenerative diseases including AD, HD, Parkinson's disease, and MS, mitochondria, oxidative stress, diabetes/obesity, and gender-based neuronal changes. Currently, the Reddy Laboratory is involved in multiple projects, including investigating: 1) the roles of amyloid-β (Aβ), synaptic pathology, impaired mitochondrial dynamics, mitochondrial damage, and neuronal dysfunction in the development and progression of AD; 2) mitochondria-targeted molecules and AD therapeutics; 3) the role of Aβ with phosphorylated tau interactions in causing synaptic dysfunction and neuronal damage in AD neurons; 4) the role of the mutant Huntington protein in inducing impaired mitochondrial dynamics and mitochondrial damage, synaptic damage, and neuronal dysfunction in HD; and 5) the roles of oxidative stress and mitochondrial dysfunction in MS.

PROGRAMS AT THE GARRISON INSTITUTE ON AGING

As shown in Fig. 1, the GIA has multiple aging programs: 1) community outreach and education on healthy aging and Alzheimer's dementia, 2) caregiving, 3) Lubbock Retired Senior Volunteer Program (RSVP), 4) Healthy Lubbock, 5) the GIA Brain Bank, 6) scientific research on aging and AD and other dementias, 7) the GIA healthy aging lecture series, 8) the GIA research seminars, and 9) collaborations and scholarships.

Community outreach and education

The top priority for the GIA community outreach and education staff is to increase information available to lay and scientific audiences about factors relating to healthy aging, risks of developing chronic diseases, AD and other dementias, and age-related diseases particularly in individuals 50 years of age and older. The staff focuses on developing physical and mental exercises for older individuals and explaining the benefits. The goal is to raise awareness about health care, nutrition, and exercise. The GIA outreach programs are non-profit and are designed to fill in gaps often left by the services provided by the state and federal government. The programs target the elderly population, individuals with chronic diseases, and low-income neighborhoods. Most of the GIA staff is actively involved in outreach programs that educate the community through informational booths at health fairs and farmers' markets. In addition, health screenings and on-site nutritional information is provided in area neighborhoods. The GIA community outreach activities are well received and appreciated within the areas they serve.

Caregiving

The GIA collaborates with the Alzheimer's Association, family medicine, and aging agencies to provide resources associated with activities of daily living, health care, financial matters, companionship, and social interaction for caregivers in the Lubbock and rural communities near Lubbock.

The GIA also conducted a pilot respite program. Respite for family caregivers provides the caregiver relief from their daily care responsibilities and also supports the physical, social, and psychological health of care recipients. Few family caregivers are able to access the amount of respite that they need, particularly family caregivers in rural areas. The Cochran County Community-Based Respite Program was a pilot program of the Cochran County Aging Study generously funded by the Carl B. & Florence E. King Foundation. Volunteers from the community provided respite services for family caregivers once a week for four hours at the Griffith Senior Citizens Center in Morton, TX. The program was provided to families at no cost and was sustained by the support of community volunteers.

Retired Senior Volunteer Program

The Lubbock Retired Senior Volunteer Program (RSVP) began in 1979 and in 2008 was moved to the GIA from the Texas Tech University College of Human Sciences. Since 2008, the Lubbock RSVP program has obtained funding. RSVP matches adults 55 and older with volunteer services in the community. Currently, the RSVP program has 600 active volunteers that serve over 50 agencies. Under GIA sponsorship, Lubbock RSVP also connects senior citizens with health care professionals, through a variety of programs, as shown in Fig. 2. Throughout the year, the Lubbock RSVP Director makes presentations on healthy aging to community groups and explains how the program matches senior citizens with volunteer opportunities.

Healthy Lubbock

In September 2007, the GIA community outreach division, along with business organizations and health care professionals, created a coalition and established the Healthy Lubbock program. Healthy Lubbock established several new programs including Healthy Lubbock Day and GET FiT Lubbock. Healthy Lubbock Day is a collaborative effort between the City of Lubbock Parks and Recreation Department and other Lubbock health organizations that organize a one-day event to promote Lubbock's health resources. Over 30 vendors and 500 participants attend the event yearly.

GET FiT Lubbock is a community-wide fitness challenge in which individuals from the community, ranging in age from 18 to 80, earn points for weight loss, minutes of daily exercise, and attendance at community health events. The GIA staff created a web-based tracking system that allows participants to create an account, establish a profile, and log their exercise time and nutritional information. The fitness challenge includes an opportunity to exercise independently, listen to educational lectures from experts in both exercise and nutrition, and to attend community events. The GIA staff encourages independent exercise, but also hosts exercise sessions in local gyms. Since its launch in 2007, community participants have lost more than 12,000 pounds and have logged over 90,000 hours of

exercise. GET FiT Lubbock was recognized by the Texas Council on Cardiovascular Disease and Stroke as the *Outstanding Program for the 2008 Texas Cardiovascular Health Promotion Award*. Details of Healthy Lubbock are shown in Fig. 3.

The programs established through the efforts of Healthy Lubbock have resulted in grant funding and collaboration with the Texas Department of State Health Services (DSHS). In 2011, the GIA received a grant from the Texas DSHS Nutrition, Physical Activity, and Obesity Prevention (NPAOP) program, and was renewed in 2012. The grant was tasked with the following directives: 1) the effects of additional nutritional information on concession stand menus at local swimming pools and sports complexes—whether persons select healthier eating choices given such nutritional information before they order; 2) the impact of providing demonstrations on how to prepare healthy meals, at health fairs and farmers' markets—whether persons who saw the demonstrations applied the information to meals prepared at home; 3) the effect of a symposium on worksite wellness for local healthcare professionals, human resources professionals, business owners, and employees; and 4) whether walking trails marked as such at a local sports complex increased their use by patrons attending the sports events.

In 2012, the GIA received a grant from the DSHS Transforming Texas Program to implement the following projects in Lubbock County, Texas and in the nearby rural community of Hale County, Texas: a) prevent and reduce the exposure to second-hand smoke by establishing coalitions and educating the community about the effects of second-hand smoke; b) promote active living and healthy eating through a marketing campaign that promotes shared-use paths; c) improve community access to fresh fruits and vegetables through a farm-to-work program in which farmers' markets are set up at worksites for TTUHSC employees and students; and d) create a public educational campaign that encourages adults who have been diagnosed with diabetes in the previous 12 months to have their blood pressure and cholesterol checked at local medical facilities.

In 2014, DSHS Texas Healthy Communities awarded the GIA Community Outreach Department a grant to conduct a health assessment of Lubbock County, produce an active living plan, and activate a dashboard for the community. The DSHS Texas Healthy Communities Program assists communities to assess their existing environments, implement changes in local environmental and policy infrastructure, and adopt priority public health practices to reduce risk factors for chronic diseases. Through this collaboration, the GIA has established the Physical Activity Committee. They are leading the charge in developing the active living plan that will be shared with community leadership.

GIA Brain Bank

The GIA Brain Bank was established in 2007, with funding support from Mr. Shirley L. Garrison and the Garrison Family Foundation (Fig. 4). This program was created for two reasons: 1) to provide a free brain autopsy to families who wish to confirm the clinical diagnosis of dementia on their loved one; and 2) to provide brain tissue for research to scientists at the GIA and other qualified scientists. By providing specimens for research to scientists will better understand neurodegenerative diseases, such as AD. The GIA hopes not

only to elucidate the origins of neurodegenerative diseases but also to improve the treatment and care of patients with dementia.

While it is important to enroll specimens from patients with dementia, it is equally important to do so from individuals with no dementia. Studying tissue from both demented and non-demented persons will enable researchers to identify and compare changes in the brain, changes that are associated with aging and with neurodegenerative diseases. The GIA Brain Bank receives specimens not only from the state of Texas, but also from New Mexico, Oklahoma, Louisiana, and other states.

The GIA Brain Bank staff educates and promotes the program at health fairs, community events, via the Internet and by word of mouth. It is important that arrangements be made well in advance, as information about the patient, procedural arrangements, and proper documentation should be made and completed in order to conduct a brain autopsy. To assist, the GIA Brain Bank has prepared *Documentation of Intent for Autopsy* packets. Within the packet are forms that are intended for different scenarios and, depending on where the patient is being cared for (at home, hospital, or nursing home), will dictate which forms the family need to complete. The GIA staff will review these forms with family members and answer any questions or concerns regarding the documents and actual autopsy procedures. Once the appropriate forms are identified for the family's situation, they are then distributed to physicians, hospital personnel, nursing homes personnel, home care personnel, and funeral directors. An example follows of how a donation to the GIA Brain Bank is handled, when the brain bank is contacted directly by a family member: 1) A family member will contact the GIA Brain Bank coordinator with questions about the program and procedures. 2) The coordinator will answer all questions and concerns family members have and should the family request or decide to enroll in the program, the coordinator will mail the family the *Documentation of Intent for Autopsy* packet. 3) Once the packet is received, additional questions may follow from the family and they are encouraged to contact the GIA Brain Bank coordinator. 4) Should the family decide not to enroll, and then no other follow up will be done. 5) If the family decides to enroll, then the Patient History document, Funeral Home document, and Housing document will be completed by the family and returned to the GIA Brain Bank coordinator. 6) The coordinator will then follow up with the contacts listed on all the above forms to confirm the family's intention of a brain autopsy and to answer any questions they may have. 7) The coordinator then will locate/contact a qualified professional to do the actual brain autopsy. The GIA Brain Bank has established contacts in certain cities and states to assist in this procedure. 8) When all parties have agreed to provide their individual services, then the coordinator will share all the pertinent information with all parties involved. The patient's housing facility will be informed to contact the GIA Brain Bank coordinator at the time of death and the coordinator will be responsible to initiate the other procedures for the brain autopsy. The funeral home will be informed where the body will be located at the time of death and also be provided the information of the facility of where the body will be transported for the brain removal. 9) The autopsy is conducted within 10 hours of the time of death and the actual procedure usually takes 15 to 20 minutes. 10) Once the brain is removed, it is weighed and processed according to GIA Brain Bank protocols, which includes freezing the left half of the brain, fixing the right half of the brain in formalin, collecting demographics on the patient, such as the patient's age, and age at

disease onset. 11) The body is released to funeral home for the prearranged funeral arrangements once the brain tissue is removed. 12) The frozen and fixed brains are sent to our laboratory for storing. After two weeks, the fixed tissue is sent to a neuropathologist for diagnosing. 13) Once received by the neuropathologist, an autopsy report is generated usually within 6 to 9 months after the patient's death with the final diagnosis. 14) A copy of the autopsy report is sent to the family and any other family or medical personnel the family requested/listed during the time of completing the enrollment process. Details of GIA Brain Bank can be found at http://www.ttuhsc.edu/centers/aging/brainbank.aspx

Current Research Projects at GIA

The GIA is home to a large number of scientists and their research staff, all of whom are dedicated to researching aging, AD, HD, and MS. A few projects that are currently underway at the Reddy Laboratory of GIA are summarized below.

Project 1: Amyloid-β, synaptic pathology, and mitochondrial dysfunction in AD

According to the Alzheimer's Association, an estimated 5.4 million Americans were identified as suffering from AD [1]. The disease usually begins to manifest after age 60, and the risk of AD onset increases with age. It is estimated that by the year 2050, 50% of people worldwide who are 85 years of age or older will be afflicted with AD. Two-thirds of women and one-third of men are at lifetime risk for AD. Despite tremendous progress in AD research, there is still no clear understanding of why more women than men are at risk for AD, and there are still no early detectable markers and no drugs or agents that can delay or prevent AD in men or women. Aging is considered the number one risk factor for late-onset AD. Several cellular mechanisms are reported to be involved in AD pathogenesis. However, mitochondrial dysfunction and synaptic damage stand out as early events in AD progression.

The Reddy Laboratory has undertaken a global gene-expression study that uses a transgenic mouse model of AD (a model with the amyloid-β protein precursor; AβPP). Dr. Reddy and his research team found that genes related to mitochondrial energy metabolism and apoptosis were upregulated in 2-, 5-, and 18-month-old AβPP mice, compared to age-matched wild-type mice [2]. These results suggest that mitochondrial energy metabolism might be impaired by mutant AβPP and Aβ, and that the upregulation of mitochondrial genes may be a compensatory response to this impairment. Further, Aβ was found to be associated with mitochondria in AD neurons and for generating reactive oxygen species, mitochondrial dysfunction, and synaptic damage, all of which have been implicated in AD pathogenesis [3]. For the first time, the Reddy Laboratory demonstrated that Aβ interacts with a mitochondrial fission protein, dynamin-related protein 1 (Drp1), which is known to induce excessive GTPase enzymatic activity and to cause excessive mitochondrial fragmentation and abnormal mitochondrial distribution in AD neurons [4, 5]. Further, Dr. Reddy recently found that the voltage-dependent anion channel 1 (VDAC1; a mitochondrial permeability transition pore protein) interacts with Aβ and phosphorylated tau, and causes mitochondrial damage in neurons affected by AD [6]. Reddy's group is currently investigating the physiological relevance of these abnormal interactions in neurological disease processes, such as AD, in order to develop molecular inhibitors to reduce Aβ-and phosphorylated tau-induced neuronal toxicities in disease progression.

Project 2: Mitochondria-targeted molecules and AD therapeutics

In the mitochondrial therapeutics project, the Reddy research team is investigating whether mitochondria-targeted molecules can reduce oxidative damage and Aβ pathology, increase neurite outgrowth, and ameliorate cognitive deficits in AβPP transgenic mice [7]. To study mitochondrial function and dysfunction, Aβ pathology, and cognitive behavior, Reddy and his research team are: 1) treating Aβ PP mice with mitochondria-targeted molecules and 2) crossing them with mitochondria-targeted catalase transgenic mice (MCAT) mice, which are known to survive 5 months longer than normal, wild-type mice [8]. Further, they are also studying gender-based protective effects of MCAT in double mutant AβPPxMCAT mice relative to AβPP mice.

Project 3: Abnormal interaction of Aβ with phosphorylated tau in AD neurons: Implications to synaptic dysfunction and neuronal damage

Using postmortem brains from AD patients at different stages of disease progression and control subjects, and brain tissues from multiple lines of AD mice, including AβPP, AβPPxPS1, and 3xTg-AD mice, the Reddy team studied the physical interaction between Aβ and phosphorylated tau. We found monomeric and oligomeric Aβ interacted with phosphorylated tau in neurons affected by AD [9]. Further, these interactions progressively increased with the disease process. These findings led to conclude that Aβ interacts with phosphorylated tau and may damage neuronal structure and function, particularly at synapses, leading to cognitive decline in AD patients. These findings suggest that binding sites between Aβ and phosphorylated tau need to be identified and molecules developed to inhibit this interaction. Currently, the Reddy Laboratory is identifying the molecular inhibitors that may reduce abnormal interactions between Aβ phosphorylated tau to reduce Aβ- and phosphorylated tau-induced neuronal toxicities in disease progression.

Project 4: Mutant huntingtin, mitochondrial dynamics, and HD

Using postmortem brains from patients with HD and brains from transgenic mice with HD, the Reddy Laboratory is exploring the role of abnormal mitochondrial dynamics in the progression of HD [10–13]. Using primary neurons from the transgenic mouse models of HD; state-of-the-art, live-cell imaging tools; and transmission electron microscopy, the Reddy Laboratory is investigating axonal transport of mitochondria, mitochondrial biogenesis, mitochondrial dynamics (e.g., fission and fusion balance), and synaptic activity in AD neurons [13]. Recently, the Reddy Laboratory is studying the efficacies of mitochondria-targeted molecules, Mdivi 1, MitoQ, and SS31, *in vitro* (using stably expressed expanded polyglutamine repeats in mouse striatal neurons) and *in vivo* HD transgenic mice [14, 15]. Further, they are studying primary neurons and mammalian cells with high throughput screening tools, and are screening small molecule libraries in order to identify molecules that protect neurons in patients with HD and other neurodegenerative diseases.

Project 5: Experimental therapeutics of multiple sclerosis

Oxidative stress and mitochondrial dysfunction are involved in the progression and pathogenesis of MS [16]. Using an experimental autoimmune encephalomyelitis (EAE)

mouse model (mice that mimic MS symptoms) and the mitochondria-targeted molecule MitoQ, the Reddy research team is studying the beneficial effects of MitoQ on EAE mice. Initial results are revealing that pretreatment and treatment of EAE mice with MitoQ reduce neurological disabilities associated with EAE and lead to significantly suppressed inflammatory markers of EAE, including the inhibition of inflammatory cytokines and chemokines [17]. Currently, they are studying the neuroprotective mechanisms of MitoQ in EAE mice and also preparing to study the effects of multiple neuroprotective molecules on MS patients in a series of clinical trials.

The GIA Healthy Aging Seminars

The GIA sponsors the Healthy Aging Seminars, a series of 1-hour seminars designed to educate senior citizens, patients with AD and their family members, nurses, caregivers, and other health care professionals about new advances in healthy aging and Alzheimer's dementia. The GIA routinely invites experts on aging, AD, and other age-related diseases to give seminars in the Lubbock community, such as at a local community center, and also on the TTUHSC campus. Each fall, the yearlong seminar series is announced, and each seminar series is very well attended, with audiences ranging from 30 to 200 persons. Details about this seminar series can be found at http://www.ttuhsc.edu/centers/aging/healthyaging.aspx.

The GIA Research Seminars

The GIA Research Seminars, a new program started in 2014 by Dr. Hemachandra Reddy, focus on research experts presenting new research findings on aging, AD, and dementia-related and age-related diseases. This program is open to the public and to persons in the scientific community. The details can be found at http://www.ttuhsc.edu/centers/aging/researchseminar.aspx.

Collaborations and scholarships

The Reddy Laboratory of GIA is actively collaborating with investigators at TTU and the TTUHSC-School of Medicine, and investigators from outside TTUHSC, including Johns Hopkins University and Baylor College of Medicine and others. In addition, the GIA also participates in multiple student training programs: 1) The Student Scholars in Geriatrics, 2) The SOM Student Summer Research Program, and 3) The High School Student Scholars Research Program.

The Student Scholars in Geriatrics (SSG)

The SSG is an inter-professional program that offers students from TTUHSC and TTU who are interested in the geriatric field. Students attend lectures, clinical practicum, community service, and an inter-professional geriatric service event. Students participate in the program for one academic year with the option to re-apply for additional terms in the program. Select students will have the opportunity to attend regional and national meetings of the American Geriatrics Society and the Gerontological Society of America.

The purpose of the SSG Program is to develop a cadre of students from multiple disciplines who have a long-term commitment to advancing geriatric healthcare and are actively engaged in inter-professional projects designed to extend the years of active, healthy life for

older adults. Creating leaders in geriatrics is key to the long-term success of this program; therefore, the students are charged with developing learning activities for themselves and others.

The goals of the project include 1) providing hands-on opportunities to work with the geriatric population in academic, community service, and clinical care settings; 2) provide exposure to the field of Geriatrics in classroom- and practice-based environments; 3) provide an opportunity to participate in a longitudinal clinical project; and 4) provide students with the experiences that will help them to become leaders who promote geriatrics to their fellow students and the community at large.

The SOM Student Summer Research Program

The GIA also participates in the SOM Student Summer Research Program, an 8-week program designed to help students gain experience in an area of research interest. First-year medical students in Lubbock are encouraged to coordinate with interested faculty members on project proposals that are to be submitted for approval to the Office of the Dean. A stipend in the amount of $2,240 will be paid to each participating student in accordance with this guideline, and students are required to present information regarding summer research activities during the Student Research Week in Spring 2016. Two SOM students are working in the Reddy Laboratory of GIA and conducting research. One project is focused on molecular basis of amyloid beta and phosphorylated tau in the progression and pathogenesis of AD. The purpose of the second project is to investigate the role of synaptic damage, oxidative stress/mitochondrial dysfunction in relation to Aβ and phosphorylated tau in the progression and pathogenesis of AD.

The High School Student Scholars Research Program

The High School Student Scholars Summer Research Program is a new initiative by Dr. Reddy, to help high school students gain experience in the research areas of aging and neurodegenerative diseases. It is an 8-week program, supported by GIA. Currently, one student is working in the Reddy Laboratory of GIA to understand the molecular basis of synaptic damage using neuronal cultures of AD.

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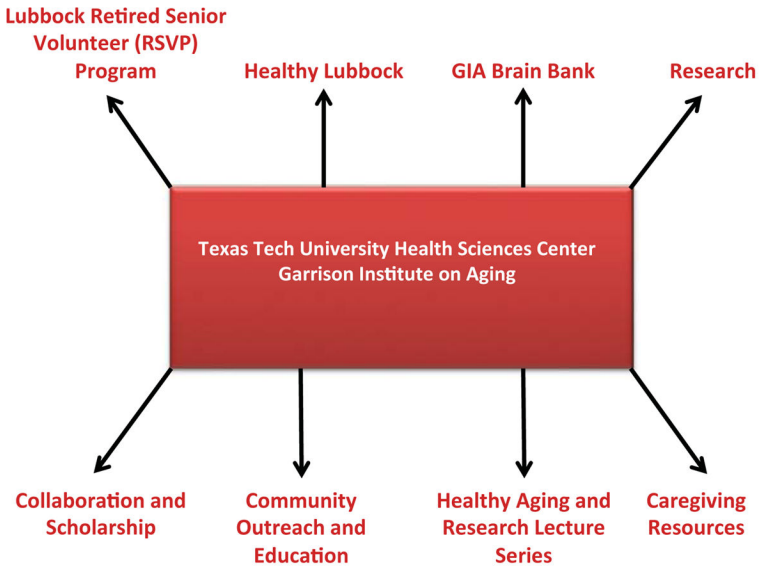

Fig. 1.

Current outreach and research programs of the Garrison Institute on Aging of Texas Tech University Health Sciences Center.

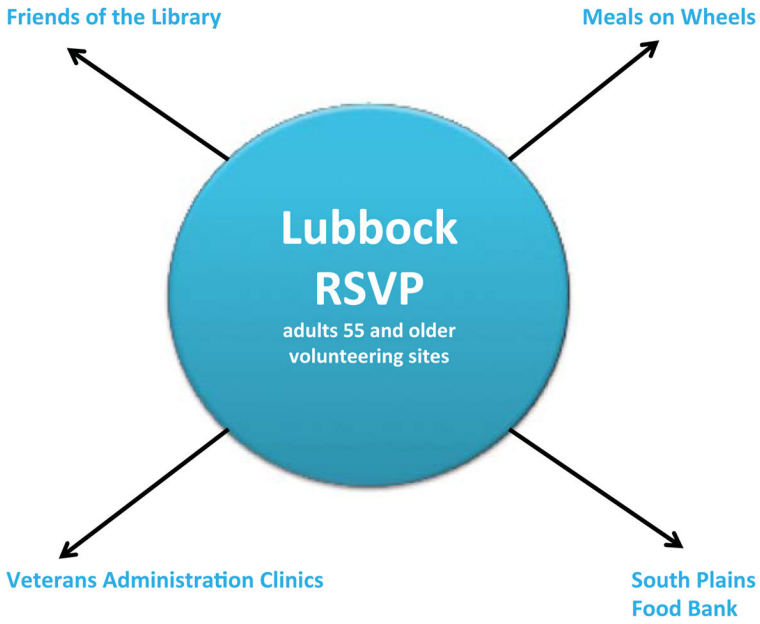

Fig. 2.

Current programs of retired senior volunteer programs at the Garrison Institute on Aging of Texas Tech University Health Sciences Center.

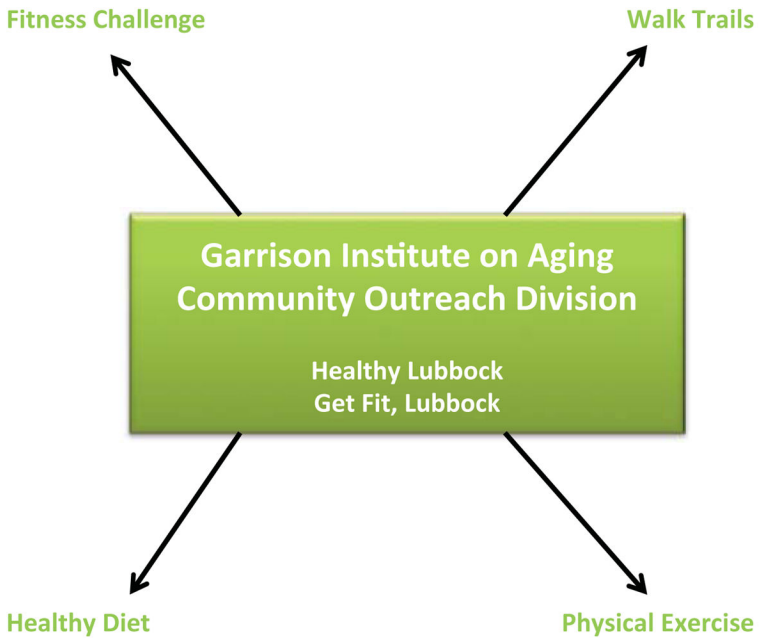

Fig. 3.
Healthy Lubbock programs of the Garrison Institute on Aging of Texas Tech University Health Sciences Center.

Fig. 4.
Flow chart of the Garrison Institute on Aging Brain Bank of Texas Tech University Health Sciences Center.