

HEALTHY LONGEVITY GLOBAL COMPETITION

2020 Catalyst Awardees

Sponsor: Chinese Academy of Medical Sciences

Personalized test for intestinal microflora and health management of the elderly

Principal Investigator	Zhang Xinlei, PhD
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Co-Investigator(s)	Jiang Taijiao; PhD and Wang Yongqiang; PhD

PROJECT DESCRIPTION

In recent years, population aging has become a severe social problem in global. With the growth of age, the elderly people are prone to various chronic diseases for the decline of physiological function. Studies indicated that intestinal microflora are associated with the development of some chronic diseases such as fatty liver, hypertension, diabetes, cardiovascular system, nervous system, and tumors, which could possibly shed light on health of the elderly. Our team provides intestinal microflora detection and health management services to individual users through the Internet. User can easily and systematically understand the personalized intestinal microbiota and promote the healthy development of intestinal flora in our system. Users can obtain samples through a specially designed stool sampling device, perform next-generation sequencing, conduct a comprehensive interpretation based on the genome big data analysis and the cloud platform, then generate personal flora health test reports and achieve personalized health management plans. The product of intestinal flora detection in this project can accurately obtain the compositional information of bacteria, and quickly provide the type and distribution of the flora. By integrating knowledge from flora distribution, gene function and diseases, this product can interpret the intestinal age, nutritional and metabolic status for the elderly. Furthermore, it can be used to evaluate the disease status, predict the incidence risk and give prevention and intervention suggestions for common chronic diseases and degenerative diseases such as diabetes, constipation or diarrhea, Alzheimer's disease. The risk assessment report of these diseases can help to formulate a comprehensive health management plan and benefit for the disease prevention.

Oral microbiome, health management throughout the life cycle

Principal Investigator	Yuan Wang, PhD
PI Primary Affiliation	The Affiliated Hospital of Stomatology, School of Stomatology, Zhejiang University School of Medicine
Co-Investigator(s)	None

PROJECT DESCRIPTION

The earth was formed roughly 4.5 billion years ago, and microbes are thought to be the origins of life. It was calculated by scholars that the ratio between resident microbes and human cells is likely to be one-to-one and the human being is defined as a "superorganism". In fact, the fetus is exposed to a wide variety of microbes while he is still in the womb. A baby's arrival represents not only the beginning of a life, but also the beginning of a symbiosis with a billion bacteria. More than 700 bacterial species reside in the oral cavity and an oral microbiome is essential for health management throughout the life cycle. Intestinal colonization by bacteria of oral origin has been correlated with several negative health outcomes, including inflammatory bowel disease,

nervous system disease, respiratory system disease, cardiovascular disease, digestive system disease, renal disease, rheumatoid arthritis and diabetes, etc. Some findings suggest that the oral cavity may serve as a reservoir for potential intestinal pathobionts that can exacerbate systemic disease. The object of this research is to provide oral health management and dietary interventions throughout the life cycle. First, from the perspective of the whole life cycle and systemic health, we carry out dynamic monitoring and comprehensive evaluation, put forward oral health advice, guidance, action and management. Second, we expect to establish an oral bacteria routine and develop individualized prevention, diagnosis and treatment strategies for oral and systemic diseases based on oral flora. Finally, we hope to be able to introduce a variety of measures for precision intervention of the oral key species.

Sleep Guardian: An RF-Based System Guarding Your Sleeping

Principal Investigator	Yu Gu, PhD
PI Primary Affiliation	Hefei University of Technology
Co-Investigator(s)	Miao Sun; Anyi Guo; and Ken Chen

PROJECT DESCRIPTION

“Sleep, like air, food, and water, is a basic necessity for the human being.” -WHO

Sleep is crucial for the wellness of older adults' physical and mental health. However, current sleep monitoring approaches mainly rely on medical sensors and require professionals to operate, hindering their practicability for older adults. To this end, we propose SleepGuardian, an RF-based system monitoring various types of fine-grained information, including respiratory rate and heart rate, to provide accurate and automatic sleep monitoring services for older adults. It has two key merits. Firstly, it is cost-effective since the low-cost WiFi infrastructure is widely accessible nowadays. Secondly, sleep monitoring via wireless signals is nonintrusive and unnoticeable for targets, suitable for older adults. More specifically, the SleepGuardian automatically collects the Channel State Information (CSI) from commodity WiFi devices. It then exploits the inherent characteristics of channel data on the intervene from a sleeping person to monitor this person's sleeping postures and vital signs, including respiratory rate and heart rate. The SleepGuardian thus offers an offline sleep logging service and an online abnormality warning service. The offline service provides a fine-grained sleep log like respiratory rate and heart rate, timing, bedtime regularity, sleep onset, and nighttime awakenings. The online service keeps guarding the subject for any abnormal behaviors during sleep like intensive body twitches and a sudden seizure attack. Once an abnormality happens, it will automatically warn the designated contacts like a nearby emergency room or a close-by relative. We prototype SleepGuardian with low-cost WiFi devices and evaluate them in real scenarios. Experiments show that SleepGuardian delivers desirable results.

New target, new mechanism, rapid antidepressant candidate YH-200

Principal Investigator	Yong-He Zhang
PI Primary Affiliation	Department of pharmacology, School of Basic Medical Science, Peking University, Beijing, China
Co-Investigator(s)	None

PROJECT DESCRIPTION

Inspired by the mechanism of ES ketamine, we are developing a novel antidepressant, YH-200, which is designed to address the slow onset of commonly used antidepressants in clinical practice. YH-200 showed a rapid antidepressant effect by maintaining glutamate system balance and enhancing the synaptic plasticity. As an alternative treatment for ketamine, it has a slower onset of action than ketamine, but faster than common antidepressants, without the side effects of resistance, addiction and drug dependence which are common for

ketamine. YH-200 is a new type of antidepressant that is safer and more rapidly acting. The rapid antidepressant effects and safety of YH-200 have been demonstrated in preclinical animal studies to relieve many of the core symptoms of depression, including despair, anhedonia, anxiety, and sleep disturbances. YH-200 is selected from natural products and obtained by structural modification, which could be synthesized simply and environmental-friendly. YH-200 has been authorized by United States patent and China patent license. We are currently raising funds to verify the previous safety tests, establish the quality standards of the synthesis process and preparation production standards for YH-200, and complete the pre-clinical trial study according to the requirements of FDA.

Research on Key Techniques of Individualized Precision Magnetic Stimulation to Improve Working Memory in Alzheimer's Disease

Principal Investigator	Wang He, PhD
PI Primary Affiliation	Institute of Biomedical Engineering, Chinese Academy of Medical Science & Peking Union Medical College
Co-Investigator(s)	None

PROJECT DESCRIPTION

The main clinical manifestation of Alzheimer's disease (AD) is working memory impairment. Studies have shown that repetitive transcranial magnetic stimulation (rTMS) on the prefrontal and parietal cortex can improve the working memory performance of patients. However, the existing technology is unable to individualized and accurately locating the magnetic stimulation target, resulting in poor treatment effect, and seriously affecting the in-depth development of rTMS technology in the clinical precision treatment of AD.

Present project intends to locate the magnetic stimulation target based on the individualized cortico-hippocampal connectivity, and provide key technical and theoretical support for the individualized and precise treatment of AD with rTMS.

1) Realize the software module construction of individualized cortico-hippocampal connectivity based on Granger causality model to locate magnetic stimulation targets. 2) Module integration and testing based on the precision positioning and navigation system of transcranial magnetic stimulation. 3) Analyze the individual differences in stimulation target location based on magnetic resonance imaging experiments. 4) Combining rTMS memory behavior experiments to provide theoretical support for this project.

Individualized and precise positioning of magnetic stimulation targets can significantly improve the stability and reliability of the clinical treatment of AD with rTMS. Therefore, in response to the above problems, this project proposes a magnetic stimulation target location method based on individualized cortico-hippocampal connectivity, accurately locates the position with the strongest functional connectivity to the hippocampus on each subject's prefrontal and parietal cortex as magnetic stimulation target to guide rTMS, and the research results of the project are expected to provide an accurate and easy-to-operate method for positioning and marking magnetic stimulation targets for the clinical application of individualized treatment of AD with rTMS.

Preparation, Preclinical Safety and Effectiveness Research of Body Insulated Acupuncture Needle

Principal Investigator	Tianxin Li, PhD
PI Primary Affiliation	University of Science and Technology, Beijing
Co-Investigator(s)	Xiaohua Chen; PhD; Associate Professor; Shuiyang Xu; PhD; Lu Zhang; PhD; Deputy chief physician; Guangdi Hu; PhD; Chief physician; Jianwu Shen; PhD; Deputy chief physician; Jianhua Fu; PhD

PROJECT DESCRIPTION

The therapeutic effect of a body insulated acupuncture needle for electrotherapy was explored based on interdisciplinary research. Now, we have successfully prepared the acupuncture needle and applied for the patents. The needle has also passed the test of biocompatibility, skin sensitization, intradermal test, cytotoxicity, and so on. Our research makes full use of modern nanotechnology, applies nanomaterials to the needle preparation, uses plasma vapor deposition technology, scanning electron microscope (SEM), transmission electron microscope (TEM), and other technical methods to characterize the needle body. We have prepared the acupuncture needle that can meet the relevant standard of Chinese medical devices (Standard number: GB 2024-2016) to fulfill clinical application requirements. The study aims to acquire a product that can completely fulfill clinical application requirements and have industrialization conditions to realize the independent research and development on the acupuncture needle product. The new acupuncture needle can realize the targeted electroacupuncture to acupoint at different needling points, such as superficial fascia, deep fascia, nerve trunk, and ganglion, and quantitative control of the therapy process. While solving the poor safety issues caused by the strong electrical sensation of electrotherapy and practicing the idea of precision medicine, “Sancai” Acupuncture therapy of Academician Cheng Shennong could be better achieved. Meanwhile, the difficulty of a fundamental experiment like collecting physiological electrical signals of specific structures in animals can also be solved. The body insulated acupuncture needle can be used to explore the impact of different stimulation and stimulation signals on the treatment and physiotherapy of illness. This application is a real inheritance and development of traditional Chinese medicine by modern medical methods.

Construction of a risk prediction model for falls in the elderly and study on intervention strategies

Principal Investigator	Tao Fu
PI Primary Affiliation	Tianjin University of Sports
Co-Investigator(s)	Yafei Duan; MD; Zhuqing Dong; MD and Diruo Zhang; BS

PROJECT DESCRIPTION

Falls in the elderly not only cause physical trauma and disability, but also bring psychological problems such as depression, anxiety and fear of falling, leading to an increase in disability and death. Falls have become a serious public health problem in the elderly society. At present, it is still challenging to predict the fall of the elderly. So it is very important to construct a full-index quantitative prediction model of the fall risk of the elderly from the inherent factors of the potential fall risk of the elderly. All the kinds of indexes of physical function will be tested, by analyzing the factors that cause falls, the characteristics of falls in the elderly are clarified. Then, a discriminant model for the elderly risk prediction will be established. Effective intervention methods are explored, and prevention strategies for falls in the elderly are formulated. The database and platform of exercise prescription for the elderly will be established. So as to reduce the injuries caused by falls and improve the quality of life of the elderly.

LinkingMed Intelligent Radiotherapy Cloud

Principal Investigator	Ryan Zhang, PhD
PI Primary Affiliation	Netherlands Cancer Institute and master of Southeast University,
Co-Investigator(s)	Cooper Lee; MBA

PROJECT DESCRIPTION

LinkingMed, located in the Science and Technology Park of Tsinghua University, Haidian District, Beijing, is an artificial intelligence enterprise focused in the field of radiotherapy. Based on artificial intelligence and cloud

computing technology, the company provides AI-based OAR auto-contouring, target auto-contouring, treatment auto-planning, quality auto-controlling and other technical tools and cloud services for hospital radiotherapy departments and third-party imaging and radiotherapy centers. Based on cloud service platform, LinkingMed also provides professional remote collaboration and radiotherapy operation network services for the radiotherapy doctors and physicists.

3D Image Fusion Technology-Mediated Robot Application Research in Elderly Bone Joint Soft Tissue Diseases

Principal Investigator	Ruoxiu Xiao, PhD
PI Primary Affiliation	University of Science and Technology Beijing
Co-Investigator(s)	Junlai li; MM and Yuanyuan Lu; MD

PROJECT DESCRIPTION

At present, there are 250 million elderly patients with bone joint soft tissue diseases in China. For the therapy of patients, drug therapy and joint replacement or arthrodesis are often adopted, while but the satisfaction rate is low. Currently, the interventional treatment of bone joint soft tissue diseases mostly uses empirical positioning or 2D ultrasound positioning, which faces challenges and risks. The proposed 3D Image Fusion Technology-mediated Robot intends to expand the application range of interventional therapy in bone joint diseases though solving the problem of precise positioning of interventional therapy, and main contributions: Achieved 3D reconstruction of the lesion by 3D ultrasound, CT and MRI images, and fused them with real-time 2D ultrasound images, to solve the problem of real-time registration of 2D images and 3D reconstruction; 2) Implemented the mixed-reality technology based on the 3D reconstructed models of ultrasound, CT and the MRI to solve the problem of non-invasive, operable, and visualized 3D real-time accurate positioning; 3) Achieved automated surgical robot path-guided injection technology to solve the problem of relying on doctors for subjective treatment. The proposed real-time multi-modal fusion 3D Image Fusion mediated robot can significantly improve the level of clinical medical care for bone joint soft tissue diseases.

New Strategies and Prognosis for Diagnosis and Treatment of Pituitary Adenomas: Research Based on Medical Big Data and AI

Principal Investigator	Ming Feng, MD
PI Primary Affiliation	Peking Union Medical College Hospital, Chinese Academy of Medical Science
Co-Investigator(s)	None

PROJECT DESCRIPTION

Pituitary adenoma is one of the most common tumors in the nervous system. Because of the atypical early symptoms and the lack of understanding of clinicians, pituitary adenoma is easily misdiagnosed as hypertension, diabetes and other common diseases, because of which treatment is delayed. And how to accurately carry out early diagnosis, surgical efficacy prediction, treatment strategy formulation is still lack of guidelines to regulate clinical diagnosis and treatment. However, it is difficult to make accurate judgment only based on the personal clinical experience of doctors. Based on the massive clinical multimodal data, this study uses weak supervision learning to extract and structure the medical record information. And machine learning is used to extract the MRI image features. Then a multidimensional diagnosis and prediction model of pituitary adenoma is established. Finally, the prospective cases will be used to verify and optimize the model. This study can assist clinicians to make accurate diagnosis and individualized treatment strategies for pituitary adenoma, to predict postoperative tumor recurrence and guide follow-up. This study breaks through the limitations of the existing diagnosis and

treatment technology and mode, and provides new methods and ideas for the accurate diagnosis, individualized treatment and evaluation of pituitary adenoma by using the methods of big data and artificial intelligence.

An innovation in vertebroplasty for osteoporotic vertebral compression fracture: New curved percutaneous vertebroplasty system

Principal Investigator	Lin Hong, PhD
PI Primary Affiliation	Zhongshan Hospital of Fudan University
Co-Investigator(s)	Dong Jian; PhD; Tian Bo; PhD; Wang Zixiang; MM; Zhuang Chenyang; MM; Jiang Libo; PhD; Li Juan; MD

PROJECT DESCRIPTION

In the current aging process, osteoporosis has become a crucial public health problem globally. Vertebral compression fracture is one of the most common and serious complications of osteoporosis, which can cause pain, restricted movement, and even death due to complications. Percutaneous vertebroplasty (PVP) is an effective minimally invasive treatment for osteoporotic vertebral compression fractures (OVCFs), and it is in a rapidly developing stage at present. Most of the traditional PVP surgical instruments have disadvantages such as bone cement leakage, recurrence of compression fractures in adjacent segments, greater trauma to patients, and long operation time due to technical limitations. This project chooses nickel-titanium alloy as the raw material to study the shaping, rolling, welding, and sterilization methods. Relying on the Zhongshan Hospital of Fudan University, we innovatively design and develop a new type of curved PVP system, which can reach contralateral centrum by unilateral puncture, reduce trauma, realize directing, positioning, multi-point and precise injection, effectively reduce blood vessel damage, local hematoma and bone cement leakage rate, arc-shaped disperse to fill bone cement, provide ideal biomechanical support, reduce the incidence of secondary fractures, and orderly utilize bone cement from mixing to injection steps. A survey showed a potential of approximate 100,000 consumers just in Shanghai, let alone nationwide and worldwide. While saving economic cost, it also helps numerous patients reduce postoperative complications and speed up the recovery process.

Study on innovative anti-Parkinson disease drug candidates targeting dynamic modification of ULK1 phosphorylation

Principal Investigator	Liang Ouyang, PhD
PI Primary Affiliation	State Key Laboratory of Biotherapy and Cancer Center, West China Hospital, and Collaborative Innovation Center of Biotherapy, Sichuan University, Chengdu, China
Co-Investigator(s)	None

PROJECT DESCRIPTION

Parkinson's disease (PD) is a common neurodegenerative disease. With the development of aging population in China, the incidence rate is increasing year by year, which seriously affects the quality of life of the elderly. At present, it is urgent to develop highly effective and low toxic new anti-PD drugs. Based on the structure of the original autophagy target ULK1, BL-918, an agonist with anti PD potential, was designed and synthesized by computer-aided method and chemical space directed synthesis method. BL-918 can specifically activate ULK1 phosphorylation to induce autophagy in vivo and in vitro, and has a good anti-PD effect in animal models. On the basis of previous studies, we plan to optimize targeted small molecules, intervene in the phosphorylation of ULK1, study the structural biology of small molecule-ULK1 complex, and carry out rational drug design and structural optimization of BL-918, and finally obtain 1-2 small molecule anti-PD drugs targeting ULK1 regulation autophagy network with independent intellectual property rights, complete the anti-PD effect study in vivo and illuminate the detailed dynamic modification mechanism. The new structure and mechanism of these compounds

are expected to overcome the shortcomings of existing PD clinical drugs, and provide new methods and clues for the research of anti-PD small molecule drugs. Using the optimized compounds to target the phosphorylation modification of ULK1, the treatment and molecular mechanism intervention of PD can be studied, which can be used to study the function of autophagy in neurodegenerative diseases. The study of PD treatment and molecular mechanism intervention by the optimized compounds, targeting phosphorylation modification of ULK1, would pave a way for the functional research of autophagy in neurodegenerative diseases and the further development of anti-PD drugs with new therapeutic strategies.

Artificial Intelligence Assisted Improving Management of Community Chronic Kidney Disease (ALARM-CKD)

Principal Investigator	Li Yang, MD
PI Primary Affiliation	Renal Division, Peking University First Hospital, China
Co-Investigator(s)	None

PROJECT DESCRIPTION

Chronic kidney disease (CKD) has become a significant yet neglected public health challenge world widely with increased mortality and morbidity. It affects over 10% of population in modern societies and more than half are elderly. There is a huge CKD population in China, 120million, which would lead to over 2 million cases of newly developed end stage kidney disease (ESKD) if without an effective CKD managing system. As most of the CKD patients, especially the elderly, routinely visit primary medical institutions, we then established a new digital intelligent medical model that would help improve the prevention, diagnosis and treatment of CKD in the primary medical service. This Artificial intelligence Assisted improving Management of Community chronic Kidney Disease (ALARM-CKD) medical model includes an AI-based CDSS-Doctor terminal for automatic CKD recognition and staging, recognition of high-risk patients and guideline-based individualized treatment recommendations, an AI-based CDSS-Patient terminal for patient's education and life style guidance, and a portable biochemical testing equipment for home renal function monitoring. The effectiveness of this AI based system will be verified by a cluster randomized controlled trial. It is expected to greatly reduce the incidence of ESKD and cardiovascular complications in CKD population.

Research and development of renal denervation with cryoablation for the treatment of cardiovascular diseases

Principal Investigator	Junbo GE, MD, PhD
PI Primary Affiliation	Zhongshan Hospital, Fudan University; Shanghai Institute of Cardiovascular Diseases
Co-Investigator(s)	Li Shen; MD; PhD; Yizhe WU; MD; PhD; Zhiqiang PEI; MD; Meng JI; MD; PhD and Han Chen

PROJECT DESCRIPTION

Cardiovascular disease (CVD) has a serious impact on human health around the world, the elderly especially. It brings great burden and challenge to global public health work. In disease control, exploring ways to inhibit the overactivation of sympathetic nerve system (SNS) and the renin-angiotensin-aldosterone (RAS) system has long been a priority and hot field.

Recently, studies related to renal denervation (RDN) have made some progress in the treatment of CVD such as hypertension, heart failure, arrhythmia, metabolic syndrome, etc. Radiofrequency and ultrasonic ablation are the most studies energy sources but controversial in terms of stability, reliability, and efficacy.

Cryoablation, as an energy resource, has been experimentally used in areas such as oncology and atrial fibrillation. It has the characteristics of short action time, more thorough ablation and higher safety. Therefore, we designed the world's first cryoablation system for renal denervation (cryo-RDN) and verified the short-term safety and effectiveness of the cryo-RDN by large animals.

We plan to carry out a series of pre-market clinical studies to further explore the long-term safety and effectiveness of cryo-RDN in hypertension patients, and screening of high-responsive patients. While expanding indications to other CVDs, we hope to provide a viable solution for global health, especially for elder people.

Research and Development of Dipeptide Self-Assembled Hydrogel-Targeted Drug Delivery System in Tissue Repair after ESD

Principal Investigator	Li Jingtao, MD
PI Primary Affiliation	China-Japan Friendship Hospital;
Co-Investigator(s)	Zhang Yi; MD; PhD; Bai Shuo; PhD

PROJECT DESCRIPTION

Endoscopic submucosal dissection (ESD) is the first-line therapeutic option for early GI cancer. However, large-scale artificial ulcers are prone to several complications, including bleeding, perforation, scar formation and stricture, which affect clinical efficacy and quality of life seriously. Elderly patients are at higher risk of these complications. Biogenic extracellular matrix has been proved to reduce inflammatory reaction and promote healing, but it is difficult to extract, purify and maintain biological activity. Meanwhile it also causes more immune rejection, which has been replaced by artificial materials with similar structure and function. Our previous studies showed that a new type short peptide self-assembled hydrogel, which was used in submucosal injection during ESD, could facilitate procedure and promote healing by regulating inflammatory microenvironment via macrophage differentiation. On this basis, we plan to use the novel biomaterial, short peptide self-assembled hydrogel, as the structural basis to add the low-toxicity gene vector, assemble the components, such as microRNA and stromal protease, to construct the drug delivery system. The achievement transformation of this new targeted drug delivery system will have important application value in promoting minimally invasive treatment of early GI cancer, especially. It will also provide an opportunity to reduce complications in elderly patients. The project also holds great promise in crosstalk of engineer and medicine.

TCM program for cancer pain prevention and treatment

Principal Investigator	Li Feng, MD, PhD
PI Primary Affiliation	National Cancer Center/National Clinical Research Center for Cancer/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College.
Co-Investigator(s)	Lixing Liu; MD; PhD; Jiayang Chen; MD; PhD; Yukun Yin; MD; PhD; Yurong Zhang; MD; Zishu Qin; MD; Zhenglong Jiang; MD; Wei Jin; MD; PhD; Jie Li; MD; PhD; Qinglin Zhang; MD; PhD; Jinyuan Chang; MD; Peijin Li; MD; Hao Li; MD

PROJECT DESCRIPTION

Malignant tumors and cancer pain are serious health problems that occur with the aging of the population, which have a bad impact on people's lives as well as health and social and economic development. In recent years, with the increasing recognition of malignant tumors and other chronic diseases, traditional Chinese medicine has gradually become a new opportunity for research and treatment of malignant tumors and cancer pain. This research uses the platform of the National Cancer Center/National Cancer Research Center to take cancer pain patients as an example. It has a patented Chinese medicine preparation Yishen Qutong Granule with perfect medicinal properties, pharmacodynamics, clinical efficacy and safety evaluation. The method of strengthening

vitality, removing blood stasis and detoxification with granules as the core drug is the principle of treatment, using multi-center, triple-blind, randomized controlled clinical trial research methods, combined with the team's concept of "cancer pain TCM treatment superior population" for data processing, and finally formed A standardized treatment plan for traditional Chinese medicine to treat cancer pain promoted to primary medical institutions to achieve the goal of taking the lead in action and promoting people's health.

Intelligent Glasses-Free 3D Virtual Environment Rehabilitation System

Principal Investigator	Le Li, PhD
PI Primary Affiliation	The First Affiliated Hospital, Sun Yat-sen University
Co-Investigator(s)	Haowen Liang; PhD

PROJECT DESCRIPTION

We are developing an Intelligent Glasses-free 3D Virtual Environment Rehabilitation System (IGVERS) and our first target group is patients after stroke. Stroke is among the leading cause of long-term disability with up to 85% of patients with stroke experience upper limb motor deficits. Motor function of upper limb, in particular the hand function, occupies more than 60% of the physical function for an individual. However, the recovery of upper limb motor function post stroke is clinical challenging, and the outcomes of upper limb rehabilitation remains unsatisfactory. Our technique integrates neural rehabilitation, virtual reality technology, somatosensory interaction technology, naked eye 3D display technology and other multidisciplinary knowledge to create a virtual reality rehabilitation training system that can be used for rehabilitation evaluation and training. The equipment used in this project includes glasses-free 3D display, leap motion controller and self-designed rehabilitation training program. The program is designed to provide patients with more vivid, interesting, convenient and effective rehabilitation treatment training techniques and methods.

Diagnosis and treatment in hydrocephalus related reversible senile dementia

Principal Investigator	Junji Wei, PhD
PI Primary Affiliation	Peking Union Medical College Hospital
Co-Investigator(s)	ing Gao; PhD; Feng Feng; PhD; Caiyan Liu; PhD; Yi Wang; PhD; Huan Chen; PhD

PROJECT DESCRIPTION

Dementia is a common cognitive disorder in the elderly population. One of its important causes is normal pressure hydrocephalus (NPH), which features a clinical triad of gait disturbance, cognitive impairment and urinary incontinence, but with a normal intracranial pressure. For patients who have not been diagnosed or properly treated, the condition can gradually progress, leading to worsening of the dementia, paralysis or even death, which will place a heavy burden to not only the family but also the society. For many years, neurologists lacked the knowledge and research on the cognitive impairment caused by NPH and its surgical feasibility. we establish a multidisciplinary NPH research team. The research team conducted clinical and imaging screening of normal pressure hydrocephalus patients and carried out the corresponding epidemiological investigations. Suspected patients were evaluated and analyzed using cerebrospinal fluid tap test. Once NPH was diagnosed, ventricular-peritoneal shunt or lumbar-peritoneal shunt will be performed with follow-up after the surgery. We obtained the epidemiological data, found potential biomarkers in peripheral blood and cerebrospinal fluid and established a standardized evaluation system for NPH patients with standardized surgical treatment procedures.

Diversified “Caring Bank” for Disabled Older Adults Based on the Long-Term Care Insurance System

Principal Investigator	Hui-Ling Li, PhD
PI Primary Affiliation	School of Nursing, Medical College of Soochow University
Co-Investigator(s)	Lu Lin, PhD, Ya-Ling Wang, PhD, Chun-Hui Li, MSN, Yin Wu, MSN, Li Tian, PhD, Hong-Yan Meng, MSN, Yan-Ming Wu, MSN, Heng-Mei Cui, MSN, Fei Ma, MSN, Xi-Yu Yang, MSN; Jie Fan, BSN, ; Hong-Ying Pan, MSN, Bei He, Rui Sun, MSN

PROJECT DESCRIPTION

At present, the serious shortage of professional caregivers for the disabled old adults is becoming an increasingly prominent issue in China. Based on our previous research on the long-term care evaluation criteria and home care service procedures for the disabled older adults, we aim at establishing a diversified “caring bank”, which innovates the existing policies through constructing effective training mechanisms for full-time health care workers and continuous incentive measures for part-time volunteers. In this way, medical staff, social workers, young elderly and college students can be recruited into the “caring bank” team. We aim to not only develop online training courses, incentive virtual currencies and an e-management platform, but also smooth the circulation mechanisms among different elements of the “caring bank”. Thus, we can provide scientific evidence for our government to establish caring policies for the disabled older adults.

Study on the mechanism of bone protection of polysaccharide compound IMM-H021 for the treatment of osteoarthritis

Principal Investigator	Haijing Zhang, PhD
PI Primary Affiliation	Institute of Materia Medica, Peking Union Medical College & Chinese Academy of Medical Sciences
Co-Investigator(s)	Lianqiu Wu; PhD

PROJECT DESCRIPTION

Osteoarthritis (OA) is a chronic joint disease characterized with degenerative articular cartilage damage. The prevalence rate of OA among people over 65 is as high as 68%. Most of the available drugs for OA are symptomatic treatment, and more specific and effective drugs for OA are urgently needed. Current drugs at Phase III and NDA mainly target at COX-2 and there is lack of novel drugs that target at cartilage protection. The effects of polysaccharide compound IMM-H021 on OA has been evaluated by seven animal models. The results of acute toxicity test and subacute toxicity test prove the safety of IMM-H021. Preliminary studies show that IMM-H021 can promote the repair of cartilage, but the mechanism of the cartilage protection is not clear. This project will focus on cartilage protective mechanism of IMM-H021 from cartilage, subchondral bone and synovium by using treadmill, immunohistochemistry, MRI, CT and RNAi. The results of this study will not only elucidate detailed mechanism for the clinical application of IMM-H021, but also provide new ideas and targets for the treatment of OA and other diseases with polysaccharide compounds.

A Novel Ultrasound-Derived Virtual Fractional Flow Reserve for Identifying Coronary Heart Disease

Principal Investigator	Chenguang Li, MD, PhD
PI Primary Affiliation	Department of Cardiology, Shanghai Institute of Cardiovascular Diseases,

	Zhongshan Hospital, Fudan University;
Co-Investigator(s)	Yizhe Wu; MD; PhD; Zhiqiang Pei; MD; PhD; Yihui Cao; and Rui Zhu

PROJECT DESCRIPTION

Fractional flow reserve (FFR) is widely used for the assessment of myocardial ischemia. Intravascular ultrasound (IVUS) is an intracoronary imaging method that provides information about lumen and vessel morphology. We developed a method to calculate IVUS-derived FFR (IVUS-FFR), which is based on an original fluid dynamics-based and a machine learning algorithm, for the assessment of myocardial ischemia. It is a relatively simple technique that can accurately evaluate the anatomical severity of coronary lesions, and therefore it is expected to help clarify the detailed association and true frequency of mismatch between anatomy and physiology.

Internet Plus's whole person, whole process and whole cycle chronic disease management

Principal Investigator	Wen Ergang, MM
PI Primary Affiliation	Sichuan Academy of Medical Sciences, Sichuan Provincial People's Hospital
Co-Investigator(s)	Wang Li; MD; Gu Xiaohui; PhD; Zhen Ling; PhD

PROJECT DESCRIPTION

Internet plus medical health has become a major initiative of the country. Under the policy guidance and trend of "Internet plus medical health", the construction of Internet hospital based on the entity hospital has become an effective way to break through and innovate itself. Internet medical care will gradually become a useful supplement to traditional diagnosis and treatment mode. Build Internet plus chronic disease management platform, based on the potential of hospitals, and strive to improve medical service action, enhance and broaden the hospital's medical service capabilities and business income sources, and get through the online and offline health services for people and follow-up health services. The Internet Hospital of Sichuan Provincial People's hospital aims at "providing patients with classified and graded continuous health management covering pre hospital, in hospital and post hospital", and explores the construction of the whole course management system and operation mode of Internet hospital in line with the characteristics of Sichuan Provincial People's hospital. Cross regional, Cross team construction of patient-centered, doctor-patient interaction, social support of the whole course of management model, to help patients with chronic disease scientific and effective disease management, health promotion and health management as a means to control the risk factors of chronic diseases, improve the quality of life of patients with chronic diseases, reduce the risk of high-risk groups, reduce the incidence, death and disability of preventable chronic diseases, and promote the whole life Cycle health.

The STICK Model to Stimulate Active and Sustained Healthy Physical Activity

Principal Investigator	Qian Geng, MD, EMBA
PI Primary Affiliation	Innovation Center for Social Technology and Aging @JITRI and Nanjing City Vocational College
Co-Investigator(s)	None

PROJECT DESCRIPTION

While physical activity is shown to dramatically decrease hospitalization expense and reduce mortality among older adults, behavior change from physical inactivity towards forming a new habit of regular physical exercise remains to be a difficult challenge globally. Different from the traditional, often ineffective, approach to shaping new behavior through standard health education lectures, we have developed a new system named the STICK

model, based on the Social Technology Theory. The STICK model includes five action strategies: i.e., Social network through forming a peer group and supportive community to stimulate initial participation; application of digital Technology to enable health visualization of health status, fear, and progress, to maximize psychological feelings, trigger and strengthen activity change; Integrated service and support from the government, community, organizations in order to promote sustainable change; health Coach, who are the core for ensuring behavior change through goal setting, encouragement, and provision of feedback; and Key reward including culturally appropriate and timely material and symbolic incentives to maintain motivation for desirable changes. The STICK model is employed in two consecutive stages: In the initial, short-term intervention stage, we apply STICK to ensure behavior change from unfreezing inactivity stage to forming and consolidating a new behavior. In the subsequent, mid to long-term stage, we continue to use STICK strategies to turn the newly formed behavior into a habit that is actively managed by older adults themselves towards a sustainable lifestyle. The goal of this study is to implement and test the STICK model and identify predictors of exercise inertia and motivation development, so that we will be able to replicate and assess this approach on a larger scale.

An Integrated and Precise Medical System for CABG

Principal Investigator	Yu Yang MD
PI Primary Affiliation	Beijing Anzhen Hospital, Capital Medical University
Co-Investigator(s)	Bi Yong PhD; Yang Jian; PhD; Cheng Dewen; PhD; Yu Wenyuan; MD; Liu Hongli; MD; Fan Kangjun; MD; Chen Liang; MD; Ding Xiaohang; MD

PROJECT DESCRIPTION

Coronary artery bypass grafting (CABG) is the treatment generally recommended for patients with severe CAD. However, in pace with the continual boost in the number of patients and the severity and complexity of patients' condition, the imbalance between supply and demand of surgical volume in China is gradually revealed. In addition, long-term endeavor is required for the quality of diagnosis and treatment to break through the current plateau. In order to tackle these barriers, it is necessary for us to increase the integration, precision and standardization of the process of diagnosis and treatment through the development of relative medical devices. To this end, our team has been devoting ourselves to the development of an integrated and precise medical system for CABG, which includes "Software for surgical risk assessment and strategy selection" based on artificial intelligence, "Instruments for surgical navigation and quality control" based on lidar and laser speckle technology, and MR navigation glasses as system terminal presentation equipment. In addition, block chaining technology is applied simultaneously in an attempt to achieve data desensitization as a measure concerning patients' privacy protection. The system can realize ① automatic calculation of Syntax score based on coronary angiography; ② revascularization strategy recommendation based on Syntax score results and international guidelines; ③ CABG risk prediction; ④ target vessel positioning; ⑤ "noninvasive, real-time, green, quantitative" monitoring of perfusion blood flow; ⑥ quality control of operation based on the changes of myocardial perfusion before and after bypass. The success of this system will be able to provide an effective solution for surgeons to overcome the adversity in the current diagnosis and treatment.

Discovery and Development of a Novel PI3K/HDAC Dual Inhibitor PH-20 for the Treatment of Lymphoma

Principal Investigator	Heng Xu, PhD
PI Primary Affiliation	Institute of Materia Medica, Chinese Academy of Medical Sciences and Peking Union Medical College
Co-Investigator(s)	None

PROJECT DESCRIPTION

Lymphoma is a cancer of the lymphatic system and often occurs in elderly patients. To address the limited therapeutic efficacies and potential drug-drug interactions derived from single-target anti-lymphoma drugs, a structurally distinct PI3K/HDAC dual inhibitor PH-20 was identified to bear nanomolar potencies against PI3K and HDAC at the same time. PH-20 displays high anti-proliferative activities on a variety of lymphoma cell lines, yielding a synergistic effect of combined inhibition of both PI3K and HDAC. It has been confirmed that PH-20 shows superior anti-cancer activities in lymphoma xenograft animal models as well as a favorable safety profile. Overall, PH-20 shows promise in discovery of new therapeutics for the treatment of lymphoma by simultaneously targeting PI3K and HDAC pathways with a single molecule.

Genetically enhanced mesenchymal stem cell therapy for aging and aging-related diseases

Principal Investigator	Yusheng Cai, PhD
PI Primary Affiliation	Institute of Zoology, Chinese Academy of Sciences;
Co-Investigator(s)	Zeming Wu; PhD; inghui Lei; PhD; Wei Li; PhD; Lingling Geng; PhD; Si Wang; PhD

PROJECT DESCRIPTION

Aging is the predominant risk for organ degeneration and then the onset of many chronic diseases, including liver cirrhosis, chronic obstructive pulmonary disease, and cardiovascular diseases. Harnessing single-cell sequencing techniques, we captured the aging landscapes of aorta and coronary arteries in non-human primate, and further characterized FOXO3A, a longevity-associated transcription factor, as a master regulator gene that was downregulated in six subtypes of monkey vascular cells during aging. Based on the important clue, we developed genetically enhanced human mesenchymal stem cells (MSCs), a well-known stem cell source for regenerative therapy, by recoding two nucleotides in FOXO3 gene to activate its activity constitutively. MSCs contribute directly to the homeostatic maintenance of the organs they reside, and their dysfunction is considered one of the driving forces for deleterious changes in organs during aging. MSC therapy has been established as a promising approach to treat multiple inflammatory disorders or ischemic conditions due to their immune-modulatory and angiogenic properties. However, the efficacy and safety of MSC therapy for aging and its related diseases haven't been well studied yet. Our genetically enhance strategy reinforced the MSC more robust regenerative capacities and a reduced risk for tumorigenesis. Additionally, these cells exhibited increased resistance to multiple stresses and cellular senescence, elevated regenerative capacity and reduced transformation potential. Moreover, FOXO3- genetically-enhanced human MSCs could effectively promote cardiac repair after mouse myocardial infarction. Collectively, our study demonstrated the superiority and safety of this MSC enhancement strategy and opened a new avenue for the stem cell treatment of aging-related diseases.

Intelligent laryngeal mask based on flexible pH sensing technology

Principal Investigator	Xia Min, PhD
PI Primary Affiliation	Department of anesthesiology, the First Affiliated Hospital of University of Science and Technology of China
Co-Investigator(s)	Chen Xu; Wu Hao; Zhang Wei; PhD; Assistant professor; Li Nengbing

PROJECT DESCRIPTION

We are developing an intelligent laryngeal mask in the process of surgery because aged individuals exhibit an impaired pharyngeal function, incoordination of swallowing and breathing, considered as an increased number of swallows occurring during inspiration, resulting in increased risk of aspiration. The accurate anesthesia is one of the most important factors of the successful surgery in elderly critically patients. Clinically, reducing stress is one

of the important links. The laryngeal mask with low stimulation and high safety is often chosen by the anesthetist. But it is limited by the potential risk of reflux. We innovates the application of pH, temperature and flexible sensing technology in the field of airway, and combines the Internet of Things (IOT) with cloud communication technology to develop an intelligent laryngeal. The intelligent laryngeal mask is invented by using the detection signal digital real-time output/display/alarm system, the sensor, analog front-end (AFE), multi-channel signal amplifier chip (including digital-analog converter ADC). The automatic monitoring, early warning and intelligent suction of reflux fluid can be realized. The related product patents have been submitted for application. We have more confidence in the perioperative anesthesia management of elderly patients with our intelligent laryngeal mask.

Public Service Informatization in the Context of the Aging Health

Principal Investigator	Wenjie WU
PI Primary Affiliation	inan University, Guangzhou, China
Co-Investigator(s)	Qunxia MAO, Guobing CHEN; Zhuoming CHEN,

PROJECT DESCRIPTION

Cloud-based service configurations are spawning new toolkits into the aging health care systems. High-resolution treatment data of elderly social groups are crucial for shaping the health policy design for decades to come, but remain understudied in the developing world. Building on a set of patents and scientific funding support, our cloud platform and informatization services (e.g. <https://www.i-rehab.cn/oldPeopleService.html>) have offered useful aging health monitoring and disease treatment solutions for elderly families in the communities. Our work aims to provide compelling evidence of formulating policy engagement strategies with public and private sectors to shape the development of public health service informatization in China and other emerging markets. Our cloud platform-based evidence can help bridge gaps in recovering the presence of aging health problems in a low-cost and timely manner, allowing developing countries with high aging health market potentials to enjoy big data dividends.

Sexual Health Among Older Adults in China: A Multi-Disciplinary Study

Principal Investigator	Huachun Zou, MD, PhD
PI Primary Affiliation	School of Public Health (Shenzhen), Sun Yat-sen University
Co-Investigator(s)	Bowen Liang; MD; Bingyi Wang; MS; and Team

PROJECT DESCRIPTION

Remarkable advances in medicine bring about larger numbers of older adults, defined in this application as 50 years and older. Sexual health is an increasingly important topic in this aging population, but our conventional approaches shy away from the topic. Our team has a rich experience in behavioural science, sociology, medicine, and public health. We propose the following specific aims: 1) Understand the status of sexual health and wellbeing among older adults. 2) Determine preferences for sexual health services among older adults. 3) Identify high-quality messages to promote the uptake of inclusive sexual health services among older adults. 4) Create policy recommendations about how to make sexual health services more adaptive to the needs and preferences of older adults.

Study on Life Extension Effect of Benzo-pentagonal Heterocyclic Compound XST-125

Principal Investigator	Xue Situ, PhD
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PI Primary Affiliation	Institute of Medicinal Biotechnology, Chinese Academy of Medical Sciences
Co-Investigator(s)	None

PROJECT DESCRIPTION

Osteoporosis seriously affects the health and lifespan of the elderly. After years of research, our research group has found that a class of five-membered benzo heterocyclic compounds, represented by XST-125, have a definite effect in promoting bone formation in senile osteoporosis. On this basis, the mechanism was clarified and the structure was precisely optimized in this project through chemical and biological methods, so as to improve the efficacy and reduce the off-target effect. Additionally, the effects of derivatives on bone mass, fracture incidence and fracture recovery were systematically evaluated, and their clinical value in the treatment of senile osteoporosis was elucidated. Further, the correlations between intervention with osteoporosis and other aging-related factors and life prolonging were clarified, and preclinical drug research was carried out. The project is intended to contribute to the improvement in the efficacy and even health and longevity of elderly patients with osteoporosis.