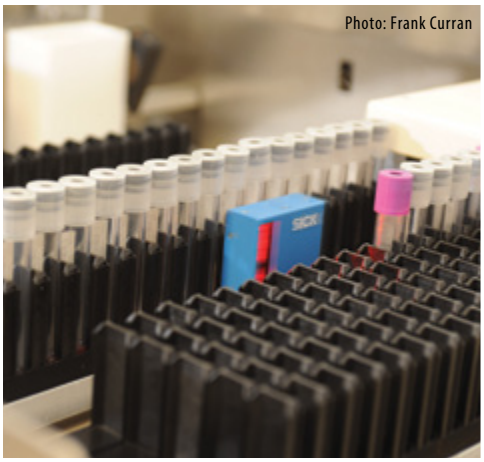
Photo: Frank Curran

VA research on

GENOMICS

New knowledge about the role of genes in health and disease holds the promise of developing safer, more effective, personalized treatments for many conditions.

ABOUT GENOMICS

• A gene is the basic unit of heredity. Genes act as instructions to make proteins, which carry out countless functions in the body.

• The Human Genome Project (HGP) was an international research effort to sequence and map all of the genes of humans, which are together known as the genome. When the HGP was completed in 2003, this gave scientists the ability, for the first time, to read nature's complete genetic blueprint for the human organism.

• HGP has estimated that every human has between 20,000 and 25,000 genes.

• The completion of the genome map has created the emerging field of "precision medicine," (also known as "personalized medicine") which will allow health care providers to better optimize therapies for each individual patient in the future.

VA RESEARCH ON GENOMICS: OVERVIEW

• VA researchers are working to develop personalized treatments, based on patients' genes and other individual factors.

• VA is well-equipped to study genomics. The department has a large and diverse patient population; an integrated network of basic research and clinical programs; and an electronic medical record system that offers a rich source of health and clinical data.

• A Genomic Medicine Program Advisory Committee, which advises the Secretary of Veterans Affairs, lays the groundwork for the VA Research Genomic Medicine Program. Members include leaders in the public and private sectors and academia in the fields of genetic research and medical genetics; genomic technology; health information technology; and health care delivery, policy, and program administration. The committee also includes a Veterans Service Organization representative.

• Among the areas in which VA already uses genomics-based approaches to provide care are tests to confirm hemochromatosis, a hereditary condition in which iron builds up in the body. VA also uses genomic medicine to predict Veterans' responses to cholesterol-lowering statin drugs and to help diagnose and treat breast, colon, and other cancers.

• VA's Million Veteran Program (MVP) was conceived and implemented to foster discoveries and bring precision medicine to the forefront of VA care. MVP is now more than halfway past its enrollment goal of 1 million Veterans, whose coded DNA samples and health information will provide an unprecedented resource for researchers.

SELECTED MILESTONES AND MAJOR EVENTS

2006 – Launched a genomic medicine initiative to advance knowledge of how genes affect health and to promote personalized medicine for Veterans

2007 – Established a laboratory in Little Rock, Arkansas, to conduct diagnostic or treatment-related genetic tests for Veterans and to serve as a genetic research lab

2011 – Launched the Million Veteran Program (MVP) to establish one of the world's largest databases of health and genetic information

2014 – Found that an alteration in a common gene could help predict how well patients with lung cancer respond to chemotherapy

2015 – The working group on the President's Precision Medicine Initiative recommends that the governance of its new PMI cohort program include VA representation

2016 – Developed a test to determine whether a respiratory illness is caused by an infection from a virus or bacteria

2016 – Announced a collaboration with the Department of Energy (DoE) to apply the powerful computing assets available at DoE National Labs to the MVP program

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2016 – Began the APOLLO Network, a new tri-agency coalition with the Department of Defense (DoD) and the National Cancer Institute (NCI) that will enable oncologists to more rapidly and accurately identify effective drugs to treat cancer based on their patients' unique genomic profiles

RECENT STUDIES: SELECTED HIGHLIGHTS

• **A variation in a common gene called caveolin-1 could help predict how well patients with lung cancer respond to chemotherapy.** Patients with that variation tended to respond better to chemotherapy, and also tended to have higher survival rates, in a study at the Atlanta VA Medical Center and Emory University. Because cancer patients and their doctors are often battling against both the disease and time, the ability to quickly identify which treatments will and will not be effective allows patients and doctors the ability to change treatment options sooner rather than later. (*PLoS One,* Sep. 15, 2014)

• **Variants in a gene responsible for regulating blood pressure may also cause shrinking of the hippocampus,** a small region of the brain that plays an important role in memory and spatial navigation. A research team from VA's Geriatric Research, Education, and Clinical Center in Nashville and Vanderbilt and Duke Universities found that three variants of the AGTR1 gene, part of a hormone system responsible for regulating blood pressure and fluid balance, were associated with greater change in hippocampal volume and memory problems. (*American Journal of Psychiatry,* Nov. 1, 2014)

• **Four specific RNA molecules were found at significantly lower than normal levels** in Veterans who had had traumatic brain injuries (TBIs) and also suffered from PTSD. Researchers at the James J. Peters VA Medical Center in the Bronx and VA's War-Related Illness and Injury Study Center tested blood samples from 58 Iraq and Afghanistan Veterans. Veterans who had PTSD had significantly lower levels of the U55 RNA molecule, and Veterans who had both a TBI and PTSD had lower levels of that molecule and also the ACA48, U35, and U83A molecules. (*American Journal of Neurodegenerative Diseases,* Dec. 5, 2014)

• **Injecting nerve growth factor directly into the brains of patients with Alzheimer's disease can reactivate dying brain cells,** according to researchers at the VA San Diego Healthcare System and the University of California. Nerve growth factor is a protein that promotes the growth, organization, and maintenance of nerve cells. The findings indicate that providing people with additional nerve growth factor is safe over extended periods, and merits continued testing as a potential treatment for Alzheimer's disease. (*JAMA Neurology,* October 2015)

• **Two RNA molecules are missing in 10 to 40 percent of tumors in patients with 12 common cancers—**and patients whose tumors do not have these molecules have poorer survival rates than their peers. The two molecules, SNORD50A and SNORD50B, directly inhibit a well-known cancer-associated protein called K-Ras. According to researchers from the VA Palo Alto Healthcare System and Stanford University, this is the first time an RNA molecule of this kind has been shown to act as a powerful tumor suppressor. (*Nature Genetics,* January 2016)

For more information on VA studies on genomics and other key topics relating to Veterans' health, please visit www.research.va.gov/topics

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