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Undersea medicine is one of the most exciting research areas in medical science and the US sea services, combining fascinating studies of how the human body responds to extreme environments, atmospheres, and pressures with wide applicability across both the military and civilian spheres.

Undersea medicine is defined by the Emergency Medicine Residents Association as the specialty involving “treatment with hyperbaric oxygen, but also the study of extreme environments, immersion effects, and marine life injuries.” The Undersea Medicine & Performance program of the Office of Naval Research specializes in such studies, while also incorporating military specific research, such as development of the augmented reality Diver Augmented Vision Display to improve the underwater situational awareness of military divers, tear resistant and cold water capable diving wetsuits to enhance the dexterity and agility of divers in hazardous cold water conditions, and helium efficient Mark 29 rebreathers. These developments increase the capability of the warfighter, and also expand access to the oceans for all of humanity, benefiting aquatic safety, marine research, and rescue operations. It is inherently human to explore, to “go where no one has gone before.” By staying on the cutting edge of human performance, undersea medicine directly supports this human imperative.

The Navy and Marine Corps have a vested interest in supporting research into undersea medicine. As the the two primary maritime armed forces of the United States, maintaining an advantage in diving technology, medicine, and research is vital to remain competitive with near-peer adversaries, now and in the future. The value of submarines have been proven in every major conflict since the Second World War, and Navy divers, whether in Explosive Ordnance Disposal, Special Warfare, or Underwater Construction, have become essential in the day to day operations of the US military. Investing in undersea medicine, especially dive medicine and technology, is essential to protect personnel in the submarine, dive, and naval special warfare communities. These servicemembers, through the nature of their occupations, are exposed to the extreme environments and pressure conditions studied in undersea medicine far more often than their surface warfare counterparts. Additionally, the US sea services are the world experts in maritime rescue and salvage, capabilities that save lives, equipment, and technology every year. Maintaining proficiency and improving efficiency in these tasks requires investment in undersea medicine research.

The aforementioned Undersea Medicine and Performance program of the Office of Naval Research is led by Dr. Sandra Chapman. As the program officer, Dr. Chapman is responsible for leading the program in its day to day operations and research improving the capabilities of the undersea warfighter, and improving treatment for pressure related conditions. Dr. Chapman’s career began with a bachelor’s degree in economics from the University of California, Santa Barbara. She was then accepted to the Pennsylvania State University College of Medicine as a Ph.D student, studying Human Papillomavirus and its interactions with keratinocytes, the main type of human skin cell, comprising 90% of human epidermis. She also conducted research at the National Institute of Allergy and Infectious Disease of the National Institutes of Health as a component of her Ph.D education.

After earning her Ph.D in Molecular Medicine, Dr. Chapman served as a Policy Fellow at the American Association for the Advancement of Science where she published cutting edge papers in nanotechnology's use in cancer treatment, and led a pilot program to migrate the Small Business Innovation Research program's data to the National Science Foundation Data Warehouse. She then joined the Office of Naval Research's Force Health Protection Program, and was promoted to her current position as the program officer of the Undersea Medicine and Performance program. The program is currently focused on warfighter augmentation programs.

As someone with an interest in the biological sciences, public policy, and military service, Dr. Chapman is a role model and inspiration for me. Her multidisciplinary and impactful work spans infectious disease, to data science, to economic policy, to undersea medicine. In the future, I hope to make as much of an impact as Dr. Chapman has. Reading and examining her work, and especially her work at the Office of Naval Research, has led me to a greater interest in undersea medicine, and to dreams of someday completing an undersea medicine fellowship. As an undersea medicine physician, I would be qualified to conduct high level research, serve as an undersea medical officer in the Navy, and work to help victims of maritime disasters.

In the future, undersea medicine is poised to deliver some of the most exciting advances in medicine and human performance. Development of so-called "human gills" is one example of such an advance. Current diving technology requires breathing gas to be carried into the depths from the surface, whether in the form of a normal scuba apparatus, a diving rebreather and tank, or an umbilical cord. While current technology has sought to make this as painless and efficient of a process as possible, the possibility of exhausting an air supply, or having to resort to a possibly dangerous combination of gases, is an ever present problem. Divers must carefully measure, track, and calculate their gas intake as they descend and new pressure zones. They must begin ascent once they reach a calculated gas volume and time, in order to avoid decompression sickness. Human gills would dramatically lessen or even eliminate such a time pressure, allowing for longer dives and underwater operations, as well as greater dexterity and agility from not having to carry a heavy tank. The current line of investigation into this subject at the Undersea Medicine and Performance program involves the separation of water molecules into component hydrogen and oxygen atoms for divers to breathe.

Another line of research at the Undersea Medicine and Performance program involves treatment and prophylaxis for various gas and pressure related illnesses, including oxygen toxicity, nitrogen narcosis, and decompression sickness. This line of research examines the possibility of a pill, or set of pills that divers can take before operations, eliminating the need for specialized gas mixtures below 100 feet. To treat decompression sickness, researchers are investigating an IV drip medication that can bind to the gases involved in causing decompression sickness in the blood, allowing treatment without the customary hyperbaric chamber.

In 2040, technology under development right now could allow safe and easy recreational exploration of the ocean deep, without fear of decompression sickness or drowning. Further advances in the Diver Augmented Vision Display could be put to work in underwater museums, allowing people to swim through exhibits and see information on their diving masks. Undersea medical research could also provide the launching ground for endeavors in a myriad of different fields. As the predictions of climate scientists increasingly become reality, an increased familiarity and capability to build, live, and work underwater could see the creation of underwater or partially submerged complexes to study human interactions with the environment, and how to leverage the oceans to lessen the impacts of climate change.

The Navy and Marine Corps stand to benefit immensely from the advances in undersea medicine possible in 2040. More information provided to divers who need to worry about fewer mission critical indications means more capable personnel, more advanced missions, and a further reach for American seapower. Advances in human adaptation to undersea environments would allow for new operating bases and locations, better reinforcement for ports against devastating storms, and an expansion of the undersea domain of warfare.

In 2040, the world will be a much different place. Advances in undersea medicine would allow the Navy, Marine Corps, and indeed the nation at large to prepare for future threats, to save lives, and to protect the health of people everywhere.