Medical Research Breakthroughs Without a Medical School

Goleta campus puts its bioengineering research to work to create real life outcomes in the community.

BY SONIA FERNANDEZ

Imagine an instrument that can visualize your potential for developing multiple sclerosis or other neuropathies of the nervous system long before the outward symptoms occur. Or, a device that can take the guesswork and human error out of delivering insulin dosages to individuals with diabetes. How about nanoparticles designed to stop internal bleeding or deliver chemotherapy selectively to tumor sites? Those feats of next-generation medicine are becoming realities at UC Santa Barbara, thanks to the growing momentum of bioengineering research and a unique research partnership between the university and clinical partners in the community and from around the world.

A SYSTEMS APPROACH TO PERSONALIZED MEDICINE

It's a novel approach that takes away the obstacles found in traditional, teaching hospital-bound modes of medical research and treatment. Called the Translational Medicine Research Laboratories, this unique initiative brings together the university's research prowess with the experience and expertise of clinicians at the local Cottage Hospital system and beyond. Their unique collaboration, which allows researchers and clinicians to work together as though they are a unified entity, is the only one of its kind in the country.

"For us, the definition of translational medicine is understanding the entire disease process and all of the information and subjective and objective data, and using that to benefit healthcare," said Dr. Scott Hammond, executive director of TMRL.

"Traditional medicine is reductionist," he said, "which means that you look for the most obvious relationship between things you can understand, and then reduce down until you understand the disease or person from the deconstructed parts." It's an approach that doesn't allow much room to account for indirect factors and effects, he explained. "Reductionism depends on simple answers and does not account for the relationship between factors. Complex disease states don't have simple solutions."

"The partnership between UCSB and Cottage creates a unique opportunity for physicians, scientists and engineers to interact and collaborate in order to continue this tradition in an era where the community physician may not have access to the vast resources, physical and human, afforded by TMRL," said Dr. Lisa Ferrigno, associate director of the trauma center at Santa Barbara Cottage Hospital. "My role as director of clinical research at TMRL and active involvement with academic faculty validates one of the tenets of the TMRL: to actively involve community based medicine into cutting-edge medical research."

The systems approach of translational medicine could shift the way medicine is practiced in the near future, with a new emphasis on prediction and understanding of all causal factors. The use and development of technology is essential to the discipline for detection, prediction, monitoring, research and treatment of disease states. One of the great benefits of TMRL, said Hammond, is the bridge that it creates between engineering, the sciences,

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technology developers and clinical practice. It's a conduit that accelerates research findings into concrete outcomes, and opens the door for emerging technologies to be put to use where they are needed, unfettered by the administrative obligations and the necessary bureaucracy of a teaching hospital.

One such example is a UCSB project in materials professor Jacob Israelachvili's lab to create a user-friendly bench-top device that can demonstrate, at the molecular level, structural pathologies that could be precursors to debilitating membrane-related diseases such as multiple sclerosis. Had it not been for the research partnership's ability to gather more data locally, the project would likely have had to go to institutions north or south of the community to continue development, said Hammond, a problem that occurs for many technology companies that grow out of "bench phase" on the Central Coast.

"In essence, and in the past, local funding did not necessarily and directly benefit the local community," said Hammond. TMRL's ability to speak the vernacular of both engineering and medicine opens the door not only to UCSB spinoffs, but also to potential industry partners – both new and well-established – by providing an efficient path for developing, testing, validating and ultimately getting technology into clinical trials and in the marketplace.

And it's only the tip of the iceberg as TMRL looks to forge more clinical partnerships in the future. One ongoing project involves a team effort between the university, UK-based company Acuitas Medical, local radiology group Pueblo Radiology and international medical technology giant Siemens. This effort intends to look at details in bone that have previously been unavailable and could enable doctors to predict changes to bone tissue that may be early signs of nefarious bone diseases.

On the UCSB campus, TMRL's other major endeavor is to examine existing research on campus for ways to capitalize on discoveries, breakthroughs and inventions to advance their clinical applications and maximize their impact on medicine. Because of its ability to translate ideas and research between bench and bedside, students and researchers from related disciplines will have opportunities to enhance their exposure to the world of medicine, according to Hammond.

TODAY'S RESEARCH, TOMORROW'S TREATMENT

Bioengineering as a whole has grown by leaps and bounds at UCSB, as researchers continue to take engineering approaches to biological problems and vice versa. In Frank Doyle's lab, the professor of chemical engineering and his team are developing an artificial pancreas, a fully automated closed-loop system that analyzes blood sugar and delivers the appropriate amount of insulin at the right time. The project, a joint collaboration between UCSB and local Sansum Diabetes Research Institute, would revolutionize diabetes treatment by allowing therapy to adapt to changing lifestyles and habits while minimizing the effect of fluctuating blood sugar levels in people with type I diabetes.

The university is poised to take advantage of the critical mass of bioengineering research on campus with the upcoming construction of a building dedicated to bioengineering, as well as advanced academic offerings in the field.

"Hubs, such as the laboratories in this building, truly enable the multi-disciplinary interactions that are the hallmark of UCSB's research," said Doyle, who is also UCSB's associate dean of research and director of the Institute for Collaborative Biotechnologies, an organization that will find its home in the state-of-the-art facility. Planned to begin construction this summer, the bioengineering building has been a project in progress for years.

The new facility will also give the university a vantage point from which to expand its bioengineering offerings from an undergraduate concentration and a Ph.D. emphasis to an undergrad major and an independent Ph.D. program. This path will enable the university to attract highly qualified faculty and students while continuing to perform cutting-edge research in the growing field.

Clockwise from opposite left: A rendering of the new Bio-Engineering building. An artificial Pancreas being created to analyze blood sugar and deliver adequate insulin. Students engage in research and analysis through bio-medical programs. UCSB's associate dean of research, Frank Doyle and Dr. Esal Dassau hold an artificial pancreas.