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A New Paradigm in Patient Care

Emergency intubation in the field is a challenge for everyone involved, most especially the patient. Paramedics and EMTs have to contend with less than ideal circumstances while they attempt to insert a stiff laryngoscope down the throat and into the lungs of a nonresponsive patient.

“And the success rate is only about 50%, which is far below what I would have expected,” said UC Santa Barbara mechanical engineering assistant professor [Elliot Hawkes](#). A variety of factors contribute to failed emergency intubations: the lack of practice of EMTs and medics compared to doctors in hospitals, the uncontrolled setting and, importantly, the patient’s own anatomy, which naturally tries to prevent foreign objects from entering the trachea.

Hawkes knows there’s a better way, one that could more reliably open a patient’s airway while minimizing trauma. And he’s being recognized for his out-of-the-box thinking with a 2020 Packard Fellowship in Science and Engineering, awarded to innovative early-career scientists and engineers whose research over time is expected to lead to new discoveries that improve people’s lives and enhance our understanding of the universe.

“I’m delighted that Prof. Elliot Hawkes' innovative work in soft robotics has been recognized with a prestigious Packard Fellowship,” said UC Santa Barbara Chancellor Henry T. Yang. “His research in growing robots and their practical applications has potential impacts in areas ranging from medical diagnosis and delivery, to search-and-rescue and much more. Our campus is most grateful to the David and Lucile

Packard Foundation for their investment in our faculty researchers and their quest to advance scientific discovery and innovation.”

“I am so honored to have been selected as a 2020 Packard Fellow and am so grateful for all the support I received from mentors and colleagues at UCSB and beyond,” Hawkes said.

At the heart of Hawkes’ innovation is his expertise in soft robotics — a fairly recent genre of robots that are made with flexible, compliant materials to interact with their environment in gentler ways. Instead of a metal laryngoscope to open an airway and guide the air-supplying endotracheal tube, Hawkes’ invention relies on a self-deploying flexible conduit that “grows” from its tip — a “vine robot” that everts due to the steady pressure of air from within.

“The EMT would simply place a mouthpiece on the person and press go, and the device would grow down into the lungs and allow intubation,” Hawkes said. He and his research team continue to improve on the robot by making it able to navigate around the epiglottis, the flap at the top of the larynx that prevents objects from entering the windpipe.

“We have some prototypes that show promise in models that are used by doctors in training,” he said. The device could become even more useful by minimizing transmission of highly infectious microbes, such as the SARS-CoV-2 virus, from patients in severe respiratory distress while allowing even non-experts to intubate.

But the soft intubation robot is just one of many beneficial technologies that could be realized from his bigger vision of a nature-inspired paradigm for accessing deep inside the body.

“How does nature access points that are in confined, constrained environments? There are a number of examples, like roots growing through soil, or the nerve cells in your body growing during development through tightly packed cells,” Hawkes said. “They are very soft, compliant tubes or conduits that grow from their tips while steering along tortuous paths.”

This concept could change numerous medical procedures such as endoscopy, bronchoscopy or endovascular surgery, to guide specialized tools or cameras in a minimally invasive, frictionless way through the body.

Awarded \$875,000 over five years from the David and Lucile Packard Foundation, Hawkes and his team plan to formalize the physical principles governing pressure-driven artificial tip growth across path tortuosity, material properties and scale; and then use this knowledge to create a comprehensive set of design principles “to create minimally invasive devices with heretofore unrealizable capabilities.”

“For the last few thousands of years, surgery has involved pushing relatively hard tools into peoples’ bodies,” Hawkes said. “We think this paradigm shift from something rigid being pushed through a body to something soft that grows and steers could revolutionize this area of medicine.”

Hawkes joins an illustrious group of scientists and engineers at the cutting edge of their fields. Packard Fellows have gone on to receive the highest accolades, including the Nobel Prizes in Chemistry and Physics, the Fields Medal, the Alan T. Waterman Award, the Breakthrough Prize, the Kavli Prize, and elections to the National Academies of Science, Engineering and Medicine. Notably, all three U.S. women who won the Nobel Prize in the past three years are Packard Fellows: Frances Arnold, Jennifer Doudna and Andrea Ghez.

“Now, more than ever, we need science,” said Frances Arnold, chair of the Packard Fellowships Advisory Panel, 2018 Nobel Laureate in Chemistry and 1989 Packard Fellow. “In a year when we are confronted by the devastating impacts of a global pandemic, racial injustice and climate change, (the Packard Fellows) offer us a ray of hope for the future. Through their research, creativity and mentorship to their students and labs, these young leaders will help equip us all to better understand and address the problems we face.”

About UC Santa Barbara

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